**IN THE UNITED STATES DISTRICT COURT**
**FOR THE DISTRICT OF DELAWARE**

| | |
|---|---|
| REALTIME ADAPTIVE STREAMING LLC,<br><br>Plaintiff,<br><br>v.<br><br>HAIVISION NETWORK VIDEO INC., HAIVISION NETWORK VIDEO CORP., and HAIVISION KB INC.,<br><br>Defendants. | Case No. 17-1520-JFB-SRF<br><br>JURY TRIAL DEMANDED |

**SECOND AMENDED COMPLAINT FOR PATENT INFRINGEMENT**

This is an action for patent infringement arising under the Patent Laws of the United States of America, 35 U.S.C. § 1 *et seq.* in which Plaintiff Adaptive Streaming LLC ("Plaintiff" or "Realtime") makes the following allegations against Defendants Haivision Network Video Inc., Haivision Network Video Corp., and Haivision KB Inc. (collectively "Defendants" or "Haivision").

**PARTIES**

1. Realtime is a Texas limited liability company. Realtime has a place of business at 1828 E.S.E. Loop 323, Tyler, Texas 75701. Realtime has researched and developed specific solutions for data compression, including, for example, those that increase the speeds at which data can be stored and accessed. As recognition of its innovations rooted in this technological field, Realtime holds multiple United States patents and pending patent applications.

2. On information and belief, Defendants are Delaware corporations with their principal place of business at 13975 W Polo Trail Drive, Lake Forest, Illinois 60045-5119. Defendants reside in this District because they are incorporated in

Delaware. Defendants offer their products and/or services, including those accused herein of infringement, to customers and potential customers located in Delaware and in this District. Defendant Haivision KB Inc. may be served with process through its registered agent for service at: The Corporation Trust Company, Corporation Trust Center 1209 Orange St., Wilmington, DE 19801. Defendants Haivision Network Video Corp. and Haivision Network Video Inc. may be served with process through its registered agent for service at: Corporation Service Company, 251 Little Falls Dr., Wilmington, DE 19808.

## JURISDICTION AND VENUE

3. This action arises under the patent laws of the United States, Title 35 of the United States Code. This Court has original subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

4. This Court has personal jurisdiction over Defendants in this action because Defendants have committed acts within the District of Delaware giving rise to this action and has established minimum contacts with this forum such that the exercise of jurisdiction over Defendants would not offend traditional notions of fair play and substantial justice. Defendants have also committed and continue to commit acts of infringement in this District by, among other things, offering to sell and selling products and/or services that infringe the asserted patents.

5. Venue is proper in this district, *e.g.*, under 28 U.S.C. § 1400(b). Defendants reside in this District because they are incorporated in Delaware. Furthermore, upon information and belief, Defendants have transacted business in the

District of Delaware and have committed acts of direct and indirect infringement in the District of Delaware.

**COUNT I**

**INFRINGEMENT OF U.S. PATENT NO. 8,934,535**

6. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

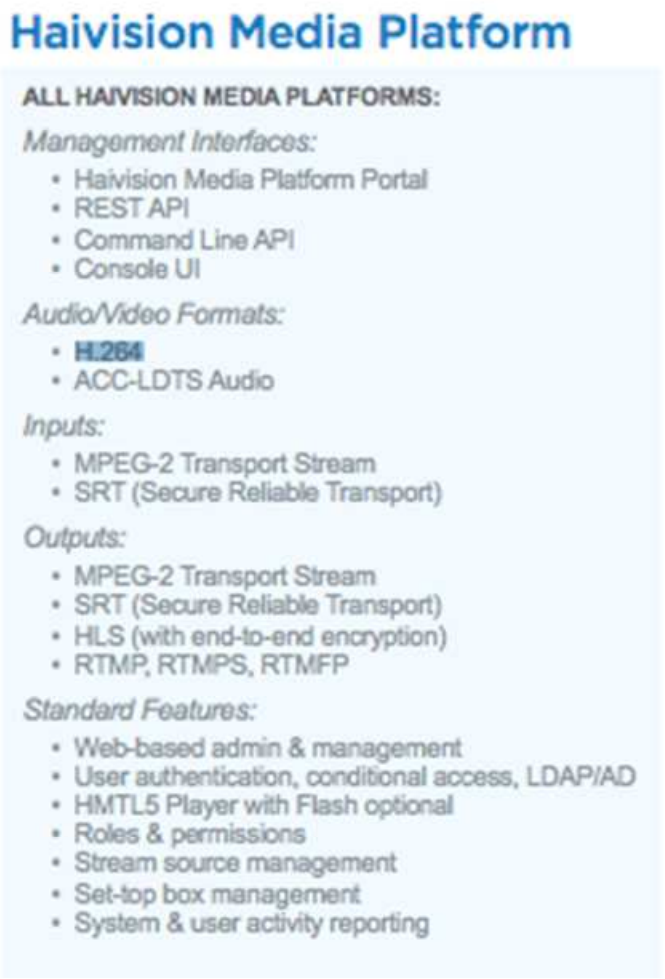
7. Plaintiff Realtime is the owner by assignment of United States Patent No. 8,934,535 ("the '535 patent") entitled "Systems and methods for video and audio data storage and distribution." The '535 patent was duly and legally issued by the United States Patent and Trademark Office on January 13, 2015. A true and correct copy of the '535 patent is included as Exhibit A.

8. On information and belief, Defendants have made, used, offered for sale, sold and/or imported into the United States products that infringe the '535 patent, and continue to do so. By way of illustrative example, these infringing products include, without limitation, Defendants' video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the '535 patent ("Accused Instrumentalities").

9. On information and belief, Defendants have directly infringed and continue to infringe the ’535 patent, for example, through its own use and testing of the Accused Instrumentalities, which when used, practices the method claimed by Claim 15 of the ’535 patent, namely, a method, comprising: determining a parameter of at least a portion of a data block; selecting one or more asymmetric compressors from among a plurality of compressors based upon the determined parameter or attribute; compressing the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks; and storing at least a portion of the one or more compressed data blocks. Upon information and belief, Defendants use the Accused Instrumentalities to practice infringing methods for their own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

10. For example, the Accused Instrumentalities utilize the H.264 video compression standard, as well as Secure Reliable Transport (SRT) technology. “SRT detects the real-time network performance between the encode / decode / transcode endpoints. The endpoints can be dynamically adjusted for optimal stream performance and quality.” *See, e.g.*, https://www.haivision.com/products/srt-secure-reliable-transport/. At least Haivision’s Makito X and KB series devices use H.264 and SRT. *Id.* On information and belief, all of the Accused Instrumentalities detect real-time network performance between the encode / decode / transcode endpoints and dynamically select a compression technique for optimal stream performance.

11. Furthermore, as can be seen by the highlighted text in the below graphic, "All Haivision Media Platforms" support "H.264" as an "Audio/Video Format". *See*




page 7/8 of the datasheet available at http://www3.haivision.com/hmp-datasheet:

12. In addition, from this below webpage listing a Haivision product, "Haivision's award-winning Makito X H.264 encoder transports secure, low latency HD video over any network at extremely low bitrates, making it ideal for live, interactive and bandwidth constrained applications." *See* https://www.haivision.com/products/makito-series/makito-x-h264/ (with "H.264 encoder" being highlighted):


13. This portion of the datasheet also shows that Haivision's Makito X "supports High Profile H.264 encoding." *See* page 1/2 of the datasheet available at


http://www3.haivision.com/datasheet-makito-x:

14. Further portions of the datasheet show that the Haivision Makito X has

| Features | Benefits |
|---|---|
| Low end-to-end latency | Supports mission-critical distribution and interactive communication challenge |
| 4 HD encoding engines | Flexible encoding & compression, adapting to different network environments & applications |
| Multiple destinations per stream | Target different systems, networks, users, and platforms individually |
| Highly efficient encoding | Up to twice the quality or half of the bandwidth, using High Profile H.264 |
| 12 HD 1080p60 channels in 1RU | Highest density available reducing cost, footprint, and energy consumption |
| AES 256 bit encryption | Secure unicast or multicast end-to-end video distribution |
| Metadata support | Insert synchronized KLV into the MPEG stream from IP, embedded, or serial data sources |
| SRT and FEC | Maintain video quality over unqualified networks and low cost public internet connections |
| Integrated with Furnace, InStream and CoolSign | Complete end-to-end video solution |

among its features the ability to perform "Highly efficient encoding" at "Up to twice the quality or half of the bandwidth, using High Profile H.264." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

15. Additional portions of the datasheet show that the Haivision Makito X has technical specifications that use H.264 for both "VIDEO ENCODING/DECODING" and "IP NETWORK INTERFACES." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

16. It also appears that all variations or different models of the Haivision Makito X product utilize H.264, as can be seen by this below listing of the "Makito X Product Portfolio & Ordering Information." *See* page 2/2 of the datasheet available at

**VIDEO ENCODING/DECODING**
*Compression Standard:*
H.264 (MPEG-4 AVC part 10)
ISO/IEC 14496-10
Baseline, Main, and High Profiles
Up to Level 4.2 and lower intermediate levels
I, IP, IBP, IBBP framing
Configurable Group of Picture (GOP) size
Configurable frame rate
Region of Interest Coding
*Bit Rates:*
SD/HD from 32 kbps to 25 Mbps
*Rate Control:*
CBR/VBR
*Latency (encoder only):*
Less than 55ms

**IP NETWORK INTERFACES**
*Standard:*
Ethernet 10/100/1000 Base-T, auto-detect, Half/Full-duplex
Static IP/DHCP
*Connector:*
RJ45
*Networking Protocols:*
Unicast streaming
Multicast streaming (IGMP v3)
Multiple unicast streaming
MPEG transport stream over UDP / RTP
RTMP
SAP (RFC 2974)
Direct RTP - H.264 over RTP (RFC 3984)
SRT (Secure Reliable Transport)

**Makito X Product Portfolio & Ordering Information ****

| | | |
|---|---|---|
| Makito X Single SDI | S/B-292E-HDSDI1 | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single 3G/HD/SD-SDI and Composite channel |
| Makito X Dual SDI | S/B-292E-HDSDI2 | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting dual 3G/HD/SD-SDI and Composite channels |
| Makito X DVI | S/B-292E-DVI | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single channel DVI-I or Component |
| Makito X Decoder Single Channel | S/B-292D-HD1 | Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting single channel 3G/HD/SD-SDI and HDMI |
| Makito X Decoder Dual Channel | S/B-292D-HD2 | Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting dual channel 3G/HD/SD-SDI and HDMI |

http://www3.haivision.com/datasheet-makito-x:

17. The Haivision Makito encoders are also known to be Haivision's hallmark streaming video encoders using H.264, as can be seen by this press release in 2010 (*See* https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

## Haivision Introduces the Highest Density HD H.264 Encoding/Decoding Solution

*New MB6 chassis accepts any combination of Makito encoders and decoders to provide up to six HD 1080p60 channels in a single rack unit form factor*

**MONTREAL and CHICAGO — May 19, 2010 —** Haivision Network Video today announced the release of the new MB6 high-density six-slot chassis for the company's Makito™ HD H.264 encoders and decoders. The new chassis affords the highest density available for 1080p60 H.264 encoding, housing up to six Makito encoder blades in a single rack unit (1-7/8 inch).

"The Makito is by far the most compact HD H.264 design with full 1080p60 performance and an incredible encoding latency of less than 55 milliseconds," said Peter Maag, senior vice president at Haivision Network Video. "The MB6 chassis option provides our most dense configuration option and gives our clients full mix and match capabilities with all of our encoder and decoder products within the Makito family."

Delivering secure H.264 HD video combined with flexible distribution features such as Multi-Streaming™ and HiLo-Streaming™ for addressing disparate audiences, the Makito is the ideal platform for contribution head-ends, advanced communications systems, and central decode monitoring stations for the enterprise, education, federal, and medical markets. The MB6 chassis allows users to best configure the mix of Makito encoders and Makito decoders to achieve the functionality they need in a very small footprint. In addition to providing a high level of versatility, the chassis simplifies deployment in any environment by offering three power supply options: standard AC, medical-grade AC, and DC (20-36 VDC).

**About Haivision Network Video**
Based in Montreal and Chicago, Haivision Network Video is a private company and a world leader in delivering the most advanced and intelligent IP video networking technology. Haivision's products are deployed worldwide within the foremost Fortune 100 companies; in the most rigorous military and defense applications; in state-of-the-art healthcare facilities for video collaboration and training; in highly renowned educational institutions for IPTV, teaching, and remote learning; in the most efficient interactive broadcast applications; and within the world's leading TelePresence suites. Haivision distributes its products through value-added resellers, system integrators, distributors, and OEMs worldwide.

18. Nonetheless, the Makito X is not the only encoder that Haivision has. By

Encoders / Transcoders

### KB Series

H.264, HEVC and 4K encoder and transcoder, on-premise or in the cloud, for internet streaming.

way of non-limiting example, Haivision also has the KB Series which clearly uses H.264, as can be seen by below (https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

*See* https://www.haivision.com/products/kb-series/:

19. In addition, the datasheet for Haivision's KB series H.264 encoders make multiple mentions to using H.264 for "live event streaming" as can be seen by this portion of the Haivision KB series datasheet. *See* page 1/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

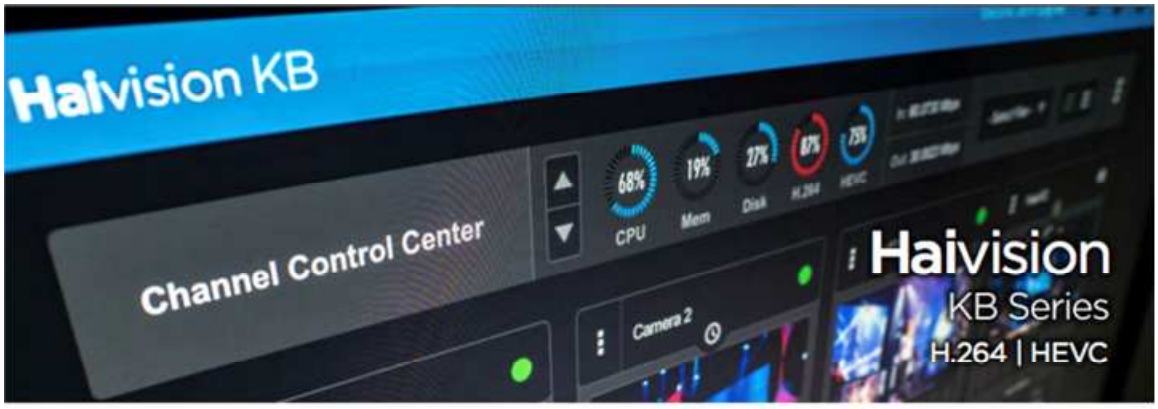
**BEST VIEWING EXPERIENCE**

H.264 & HEVC Internet Media Encoders/Transcoders

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global internet audience. With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p.

These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

| Features | Benefits |
|---|---|
| H.264/HEVC encoding/transcoding | High efficiency video compression over constrained networks for live events contribution |
| H.264/HEVC ABR Cascades | Seamless viewing experience at the player level with dynamic bitrate/resolution tuning |
| SRT protocol | AES encrypted, packet loss resilient live video transport from source encoder to cloud hosted transcoder |
| Extensive CDN Support | Ensure reliable streaming over Akamai, Limelight and other Adobe and Wowza based services |
| 608/708 closed captioning | Support digital television closed captioning standards |
| Small Form Factor (option) | High powered processing in a portable appliance with the KB Mini |
| 360-degree Virtual Reality (option) | Power virtual reality viewing experiences with the KB 4K |




## H.264 & HEVC Internet Media Encoders/Transcoders for Powerful Live Event Streaming

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global Internet audience.

**Hardware Acceleration & ABR Cascades** The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or HEVC encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth savings offered by HEVC.

**Best Viewing Experience on Every Device** With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p. These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

**Get the Most Out of your Uplink Connection to the Cloud** When your internet connection at the source isn't very reliable, and bandwidth is limited, simply send your video streams to a transcoder in the cloud to take care of adaptive bitrate (ABR) distribution. With support for HEVC, the KB Series uses up to 50% less bandwidth than H.264. Additionally Haivision's SRT (Secure Reliable Transport) technology makes low-cost, readily available public internet connections secure and reliable for live video transport from the source to the cloud, getting the most out of your available uplink bandwidth.

20. There are also various other portions of the Haivision KB Series datasheet


**Flexible Deployment Options** The KB Series offers flexible deployment and hardware acceleration options for every live event streaming scenario:

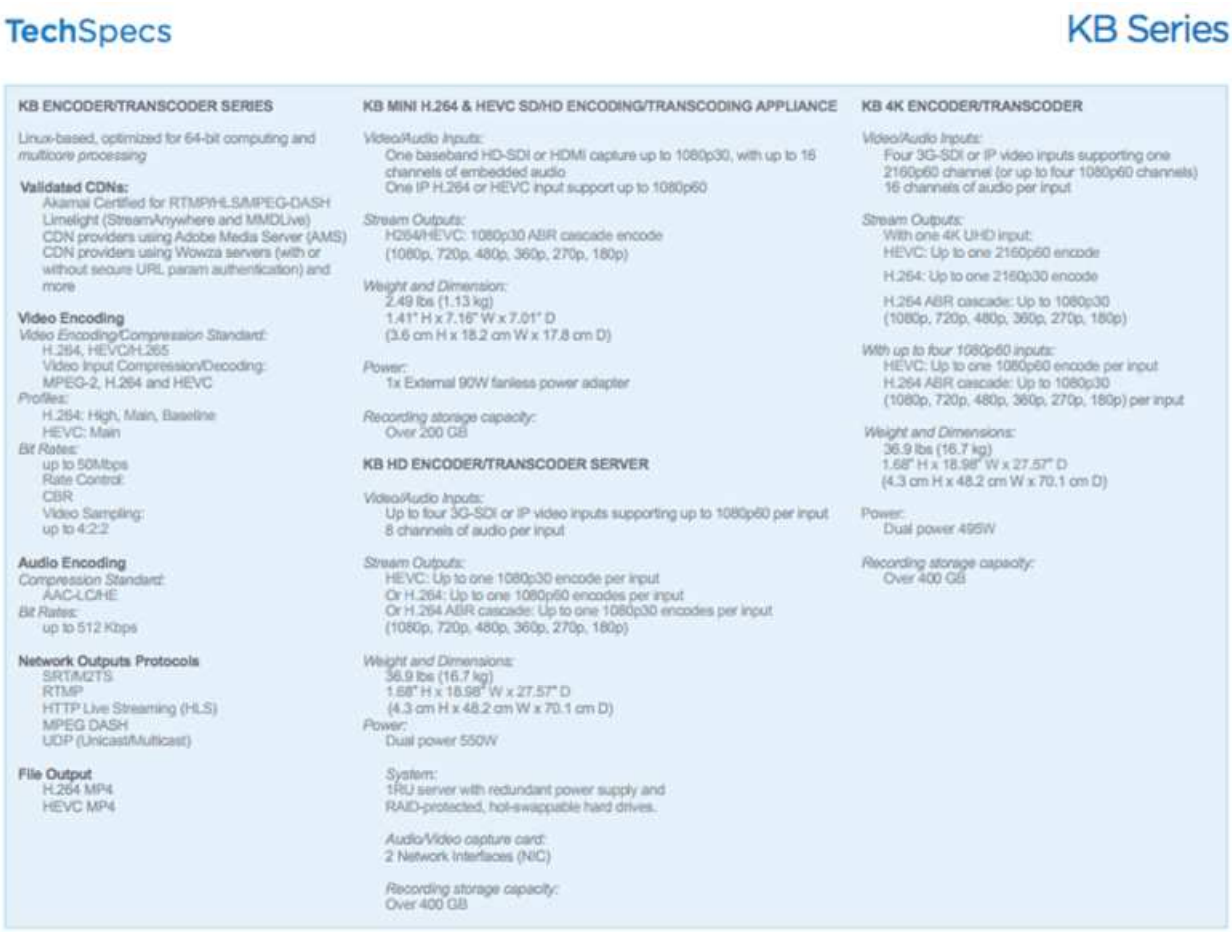
- The award-winning **KB Mini Encoder/Transcoder** is a portable all-in-one H.264/HEVC encoder, ideal for live event streaming from anywhere with an internet connection. Leveraging Intel CPU and GPU hybrid processing to deliver H.264/HEVC cascades up to 1080p, the KB Mini gives you big power in a small form factor appliance.
- A rackmountable server, the **KB Encoder/Transcoder Server** features redundant power supplies, RAID configurations and support for up to four 1080p video input channels. The KB Encoder/Transcoder Server is ideal for enterprise-grade internet streaming and fits within your existing enterprise infrastructure.
- The **KB 4K Encoder/Transcoder** has all the benefits of the KB Encoder/Transcoder Server, with hardware accelerated HEVC encoding to fuel the highest quality streaming events, supporting up to 4K H.264/HEVC viewing experiences with the ability to capture 4K/UHD 2160p over 1x 12G-SDI or 4x 3G-SDI interfaces.

that mention the product's usage of H.264 and being able to provide a "H.264" viewing experience. *See* page 2/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

21. One page of the datasheet for Haivision's KB Series also shows H.264 being used for numerous applications, such as: for a "KB Mini" model device ("KB MINI H.264 & HEVD SD/HD ENCODING/TRANSCODING APPLIANCE"), for an IP "input support up to 1080p60" ("One IP H.264 or HEVC input support up to 1080p60"), for "Stream Outputs" that are "Up to one 2160p30 encode" ("H.264: Up to one 2160p30 encode") and for an "ABR cascade: Up to 1080p30" ("H.264: Up to 1080p30") (also "With up to four 1080p60 inputs"), for "Video Encoding," a "Video Encoding/Compression Standard" ("H.264, HEVC/H.265" and "MPEG-2, H.264 and HEVC"), a "Profile" ("H.264: High, Main, Baseline"), and for the "Stream Outputs" of the "KB HD ENCODER/TRANSCODER SERVER", also "Up to one 1080p60 encodes

per input" ("Or H.264: Up to one 1080p60 encodes per input") and for an an H.264 "ABR cascade," "Up to one 1080p30 encodes per input" ("Or H.264 ABR cascade: Up to one 1080p30 encodes per input") and finally as a "File Output" form ("H.264/MP4"). *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

22. It also appears that all or most variations or different models of the



TechSpecs KB Series

**KB ENCODER/TRANSCODER SERIES**

Linux-based, optimized for 64-bit computing and *multicore processing*

**Validated CDNs:**
- Akamai Certified for RTMP/HLS/MPEG-DASH
- Limelight (StreamAnywhere and MMDLive)
- CDN providers using Adobe Media Server (AMS)
- CDN providers using Wowza servers (with or without secure URL param authentication) and more

**Video Encoding**

*Video Encoding/Compression Standard:*
- H.264, HEVC/H.265
- Video Input Compression/Decoding: MPEG-2, H.264 and HEVC

*Profiles:*
- H.264: High, Main, Baseline
- HEVC: Main

*Bit Rates:*
- up to 50Mbps

*Rate Control:*
- CBR

*Video Sampling:*
- up to 4:2:2

**Audio Encoding**

*Compression Standard:*
- AAC-LC/HE

*Bit Rates:*
- up to 512 Kbps

**Network Outputs Protocols**
- SRT/M2TS
- RTMP
- HTTP Live Streaming (HLS)
- MPEG DASH
- UDP (Unicast/Multicast)

**File Output**
- H.264 MP4
- HEVC MP4

**KB MINI H.264 & HEVC SD/HD ENCODING/TRANSCODING APPLIANCE**

*Video/Audio Inputs:*
- One baseband HD-SDI or HDMI capture up to 1080p30, with up to 16 channels of embedded audio
- One IP H.264 or HEVC input support up to 1080p60

*Stream Outputs:*
- H264/HEVC: 1080p30 ABR cascade encode (1080p, 720p, 480p, 360p, 270p, 180p)

*Weight and Dimension:*
- 2.49 lbs (1.13 kg)
- 1.41" H x 7.16" W x 7.01" D
- (3.6 cm H x 18.2 cm W x 17.8 cm D)

*Power:*
- 1x External 90W fanless power adapter

*Recording storage capacity:*
- Over 200 GB

**KB HD ENCODER/TRANSCODER SERVER**

*Video/Audio Inputs:*
- Up to four 3G-SDI or IP video inputs supporting up to 1080p60 per input
- 8 channels of audio per input

*Stream Outputs:*
- HEVC: Up to one 1080p30 encode per input
- Or H.264: Up to one 1080p60 encodes per input
- Or H.264 ABR cascade: Up to one 1080p30 encodes per input (1080p, 720p, 480p, 360p, 270p, 180p)

*Weight and Dimensions:*
- 36.9 lbs (16.7 kg)
- 1.68" H x 18.98" W x 27.57" D
- (4.3 cm H x 48.2 cm W x 70.1 cm D)

*Power:*
- Dual power 550W

*System:*
- 1RU server with redundant power supply and RAID-protected, hot-swappable hard drives.

*Audio/Video capture card:*
- 2 Network Interfaces (NIC)

*Recording storage capacity:*
- Over 400 GB

**KB 4K ENCODER/TRANSCODER**

*Video/Audio Inputs:*
- Four 3G-SDI or IP video inputs supporting one 2160p60 channel (or up to four 1080p60 channels)
- 16 channels of audio per input

*Stream Outputs:*
- With one 4K UHD input:
- HEVC: Up to one 2160p60 encode
- H.264: Up to one 2160p30 encode
- H.264 ABR cascade: Up to 1080p30 (1080p, 720p, 480p, 360p, 270p, 180p)

*With up to four 1080p60 inputs:*
- HEVC: Up to one 1080p60 encode per input
- H.264 ABR cascade: Up to 1080p30 (1080p, 720p, 480p, 360p, 270p, 180p) per input

*Weight and Dimensions:*
- 36.9 lbs (16.7 kg)
- 1.68" H x 18.98" W x 27.57" D
- (4.3 cm H x 48.2 cm W x 70.1 cm D)

*Power:*
- Dual power 495W

*Recording storage capacity:*
- Over 400 GB

Haivision KB product utilize H.264, as can be seen by this below listing of the "KB Product Portfolio & Ordering Information." *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

23. The Haivision KB Series also appears to be an "award-winning" HEVC.H.264 live video encoder for Haivision, as can be seen by this recent press release available at https://www.haivision.com/about/press-releases/haivisions-kb-series-h-264hevc-encoders-qualified-akamai-media-services-live/:

## Haivision's KB Series of H.264/HEVC Encoders Qualified for Akamai Media Services Live

*New lightweight and compact KB Mini and KB 4K encoders enable low-latency live event contribution and delivery leveraging Akamai's New liveOriginTM for 24/7 live/linear video streaming*

**MONTREAL, CANADA – APRIL 25, 2017 –** Haivision, a pioneer in high performance video streaming, is pleased to announce that their award-winning KB Series HEVC/H.264 live video encoders are qualified for use with the new Akamai Media Services Live capabilities for low-latency live and linear online video delivery.

The KB Series of encoders are used by live event producers to deliver adaptive bitrate HEVC or H.264 cascades to the cloud for distribution to broad audiences watching over the public internet. The latest release of the KB Mini features an even more lightweight and compact form factor and enhanced CPU/GPU adaptive bitrate encoding of H.264 and HEVC, making it ideal for live event streaming. Through the powerful combination of the KB series of encoders and Akamai Media Services Live, event producers have a solution for live event streaming that is suitable for low-latency, broadcast quality streaming experiences to viewers wherever they may be watching.

24. The Accused Instrumentalities determine a parameter of at least a portion of a video data block. As shown below, examples of such parameters include bitrate (or max video bitrate) and resolution parameters. Different parameters correspond with different end applications. H.264 provides for multiple different ranges of such parameters, each included in the "profiles" and "levels" defined by the H.264 standard. *See* http://www.axis.com/files/whitepaper/wp_h264_31669_en_0803_lo.pdf at 5:

### 4. H.264 profiles and levels

The joint group involved in defining H.264 focused on creating a simple and clean solution, limiting options and features to a minimum. An important aspect of the standard, as with other video standards, is providing the capabilities in profiles (sets of algorithmic features) and levels (performance classes) that optimally support popular productions and common formats.

H.264 has seven profiles, each targeting a specific class of applications. Each profile defines what feature set the encoder may use and limits the decoder implementation complexity.

Network cameras and video encoders will most likely use a profile called the baseline profile, which is intended primarily for applications with limited computing resources. The baseline profile is the most suitable given the available performance in a real-time encoder that is embedded in a network video product. The profile also enables low latency, which is an important requirement of surveillance video and also particularly important in enabling real-time, pan/tilt/zoom (PTZ) control in PTZ network cameras.

H.264 has 11 levels or degree of capability to limit performance, bandwidth and memory requirements. Each level defines the bit rate and the encoding rate in macroblock per second for resolutions ranging from QCIF to HDTV and beyond. The higher the resolution, the higher the level required.

*See* https://en.wikipedia.org/wiki/H.264/MPEG-4_AVC:

Levels with maximum property values

| Level | Max decoding speed | | Max frame size | | Max video bit rate for video coding layer (VCL) kbit/s | | | Examples for high resolution @ highest frame rate (max stored frames) |
|---|---|---|---|---|---|---|---|---|
| | Luma samples/s | Macroblocks/s | Luma samples | Macroblocks | Baseline, Extended and Main Profiles | High Profile | High 10 Profile | Toggle additional details |
| 1 | 380,160 | 1,485 | 25,344 | 99 | 64 | 80 | 192 | 176×144@15.0 (4) |
| 1b | 380,160 | 1,485 | 25,344 | 99 | 128 | 160 | 384 | 176×144@15.0 (4) |
| 1.1 | 768,000 | 3,000 | 101,376 | 396 | 192 | 240 | 576 | 352×288@7.5 (2) |
| 1.2 | 1,536,000 | 6,000 | 101,376 | 396 | 384 | 480 | 1,152 | 352×288@15.2 (6) |
| 1.3 | 3,041,280 | 11,880 | 101,376 | 396 | 768 | 960 | 2,304 | 352×288@30.0 (6) |
| 2 | 3,041,280 | 11,880 | 101,376 | 396 | 2,000 | 2,500 | 6,000 | 352×288@30.0 (6) |
| 2.1 | 5,068,800 | 19,800 | 202,752 | 792 | 4,000 | 5,000 | 12,000 | 352×576@25.0 (6) |
| 2.2 | 5,184,000 | 20,250 | 414,720 | 1,620 | 4,000 | 5,000 | 12,000 | 720×576@12.5 (5) |
| 3 | 10,368,000 | 40,500 | 414,720 | 1,620 | 10,000 | 12,500 | 30,000 | 720×576@25.0 (5) |
| 3.1 | 27,648,000 | 108,000 | 921,600 | 3,600 | 14,000 | 17,500 | 42,000 | 1,280×720@30.0 (5) |
| 3.2 | 55,296,000 | 216,000 | 1,310,720 | 5,120 | 20,000 | 25,000 | 60,000 | 1,280×1,024@42.2 (4) |
| 4 | 62,914,560 | 245,760 | 2,097,152 | 8,192 | 20,000 | 25,000 | 60,000 | 2,048×1,024@30.0 (4) |
| 4.1 | 62,914,560 | 245,760 | 2,097,152 | 8,192 | 50,000 | 62,500 | 150,000 | 2,048×1,024@30.0 (4) |
| 4.2 | 133,693,440 | 522,240 | 2,228,224 | 8,704 | 50,000 | 62,500 | 150,000 | 2,048×1,080@60.0 (4) |
| 5 | 150,994,944 | 589,824 | 5,652,480 | 22,080 | 135,000 | 168,750 | 405,000 | 3,672×1,536@26.7 (5) |
| 5.1 | 251,658,240 | 983,040 | 9,437,184 | 36,864 | 240,000 | 300,000 | 720,000 | 4,096×2,304@26.7 (5) |
| 5.2 | 530,841,600 | 2,073,600 | 9,437,184 | 36,864 | 240,000 | 300,000 | 720,000 | 4,096×2,304@56.3 (5) |

25. A video data block is organized by the group of pictures (GOP) structure, which is a "collection of successive pictures within a coded video stream." *See* https://en.wikipedia.org/wiki/Group_of_pictures. A GOP structure can contain intra

coded pictures (I picture or I frame), predictive coded pictures (P picture or P frame), bipredictive coded pictures (B picture or B frame) and direct coded pictures (D picture or D frames, or DC direct coded pictures which are used only in MPEG-1 video). *See* https://en.wikipedia.org/wiki/Video_compression_picture_types (for descriptions of I frames, P frames and B frames); https://en.wikipedia.org/wiki/MPEG-1#D-frames (for descriptions of D frames). Thus, at least a portion of a video data block would also make up a GOP structure and could also contain I frames, P frames, B frames and/or D frames. The GOP structure also reflects the size of a video data block, and the GOP structure can be controlled and used to fine-tune other parameters (*e.g.* bitrate, max video bitrate and resolution parameters) or even be considered as a parameter by itself.

26. Based on the bitrate and/or resolution parameter identified (*e.g.* bitrate, max video bitrate, resolution, GOP structure or frame type within a GOP structure), any H.264-compliant system such as the Accused Instrumentalities would determine which profile (*e.g.*, "baseline," "extended," "main", or "high") corresponds with that parameter, then select between at least two asymmetric compressors. If baseline or extended is the corresponding profile, then the system will select a Context-Adaptive Variable Length Coding ("CAVLC") entropy encoder. If main or high is the corresponding profile, then the system will select a Context-Adaptive Binary Arithmetic Coding ("CABAC") entropy encoder. Both encoders are asymmetric compressors because it takes a longer period of time for them to compress data than to decompress data. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

| | Baseline | Extended | Main | High | High 10 |
|---|---|---|---|---|---|
| I and P Slices | Yes | Yes | Yes | Yes | Yes |
| B Slices | No | Yes | Yes | Yes | Yes |
| SI and SP Slices | No | Yes | No | No | No |
| Multiple Reference Frames | Yes | Yes | Yes | Yes | Yes |
| In-Loop Deblocking Filter | Yes | Yes | Yes | Yes | Yes |
| CAVLC Entropy Coding | Yes | Yes | Yes | Yes | Yes |
| CABAC Entropy Coding | No | No | Yes | Yes | Yes |
| Flexible Macroblock Ordering (FMO) | Yes | Yes | No | No | No |
| Arbitrary Slice Ordering (ASO) | Yes | Yes | No | No | No |
| Redundant Slices (RS) | Yes | Yes | No | No | No |
| Data Partitioning | No | Yes | No | No | No |
| Interlaced Coding (PicAFF, MBAFF) | No | Yes | Yes | Yes | Yes |
| 4:2:0 Chroma Format | Yes | Yes | Yes | Yes | Yes |
| Monochrome Video Format (4:0:0) | No | No | No | Yes | Yes |
| 4:2:2 Chroma Format | No | No | No | No | No |
| 4:4:4 Chroma Format | No | No | No | No | No |
| 8 Bit Sample Depth | Yes | Yes | Yes | Yes | Yes |
| 9 and 10 Bit Sample Depth | No | No | No | No | Yes |
| 11 to 14 Bit Sample Depth | No | No | No | No | No |
| 8×8 vs. 4×4 Transform Adaptivity | No | No | No | Yes | Yes |
| Quantization Scaling Matrices | No | No | No | Yes | Yes |
| Separate Cb and Cr QP control | No | No | No | Yes | Yes |
| Separate Color Plane Coding | No | No | No | No | No |
| Predictive Lossless Coding | No | No | No | No | No |

*See* http://web.cs.ucla.edu/classes/fall03/cs218/paper/H.264_MPEG4_Tutorial.pdf at 7:

The following table summarizes the two major types of entropy coding: Variable Length Coding (VLC) and Context Adaptive Binary Arithmetic Coding (CABAC). CABAC offers superior coding efficiency over VLC by adapting to the changing probability distribution of symbols, by exploiting correlation between symbols, and by adaptively exploiting bit correlations using arithmetic coding. H.264 also supports Context Adaptive Variable Length Coding (CAVLC) which offers superior entropy coding over VLC without the full cost of CABAC.

**H.264 Entropy Coding – Comparison of Approaches**

| Characteristics | Variable Length Coding (VLC) | Context Adaptive Binary Arithmetic Coding(CABAC) |
|---|---|---|
| • Where it is used | MPEG-2, MPEG-4 ASP | H.264/MPEG-4 AVC (high efficiency option) |
| • Probability distribution | **Static** - Probabilities never change | **Adaptive** - Adjusts probabilities based on actual data |
| • Leverages correlation between symbols | **No** - Conditional probabilities ignored | **Yes** - Exploits symbol correlations by using "contexts" |
| • Non-integer code words | **No** - Low coding efficiency forhigh probability symbols | **Yes** - Exploits "arithmetic coding" which generates non-integer code words for higher efficiency |

Moreover, the H.264 Standard requires a bit-flag descriptor, which is set to determine the correct decoder for the corresponding encoder. As shown below, if the flag = 0, then CAVLC must have been selected as the encoder; if the flag = 1, then CABAC must have been selected as the encoder. *See* https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-H.264-201304-S!!PDF-E&type=items (Rec. ITU-T H.264 (04/2013)) at 80:

**entropy_coding_mode_flag** selects the entropy decoding method to be applied for the syntax elements for which two descriptors appear in the syntax tables as follows:

- If entropy_coding_mode_flag is equal to 0, the method specified by the left descriptor in the syntax table is applied (Exp-Golomb coded, see clause 9.1 or CAVLC, see clause 9.2).
- Otherwise (entropy_coding_mode_flag is equal to 1), the method specified by the right descriptor in the syntax table is applied (CABAC, see clause 9.3).

27. The Accused Instrumentalities compress the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks, which can be organized in a GOP structure (see above). After its selection, the asymmetric compressor (CAVLC or CABAC) will compress the video

data to provide various compressed data blocks, which can also be organized in a GOP structure. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

**Entropy Coding**

For entropy coding, H.264 may use an enhanced VLC, a more complex context-adaptive variable-length coding (CAVLC) or an ever more complex Context-adaptive binary-arithmetic coding (CABAC) which are complex techniques to losslessly compress syntax elements in the video stream knowing the probabilities of syntax elements in a given context. The use of CABAC can improve the compression of around 5-7%. CABAC may requires a 30-40% of total processing power to be accomplished.

*See*

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.602.1581&rep=rep1&type=pdf

at 13:

Typical compression ratios to maintain excellent quality are:

- 10:1 for general images using JPEG
- 30:1 for general video using H.263 and MPEG-2
- 60:1 for general video using H.264 and WMV9

*See* http://www.ijera.com/papers/Vol3_issue4/BM34399403.pdf at 2:

Most visual communication systems today use Baseline Profile. Baseline is the simplest H.264 profile and defines, for example, zigzag scanning of the picture and using 4:2:0 (YUV video formats) chrominance sampling. In Baseline Profile, the picture is split in blocks consisting of 4x4 pixels, and each block is processed separately. Another important element of the Baseline Profile is the use of Universal Variable Length Coding (UVLC) and Context Adaptive Variable Length Coding (CAVLC) entropy coding techniques.

The Extended and Main Profiles includes the functionality of the Baseline Profile and add improvements to the predictions algorithms. Since transmitting every single frame (think 30 frames per second for good quality video) is not feasible if you are trying to reduce the bit rate 1000-2000 times, temporal and motion prediction are heavily used in H.264, and allow transmitting only the difference between one frame and the previous frames. The result is spectacular efficiency gain, especially for scenes with little change and motion.

The High Profile is the most powerful profile in H.264, and it allows most efficient coding of video. For example, large coding gain achieved through the use of Context Adaptive Binary Arithmetic Coding (CABAC) encoding which is more efficient than the UVLC/CAVLC used in Baseline Profile.

The High Profile also uses adaptive transform that decides on the fly if 4x4 or 8x8-pixel blocks should be used. For example, 4x4 blocks are used for the parts of the picture that are dense with detail, while parts that have little detail are transformed using 8x8 blocks.

28. On information and belief, the Accused Instrumentalities store at least a portion of the one or more compressed data blocks in buffers, hard disk, or other forms of memory/storage.

29. On information and belief, Defendants also directly infringe and continue to infringe other claims of the ’535 patent, for similar reasons as explained above with respect to Claim 15 of the ’535 patent.

30. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, *e.g.*, in the manner specified in the H.264 standard.

31. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods claimed by the ’535 patent.

32. On information and belief, Defendants have had knowledge of the ’535 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendants knew of the ’535 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendants will have known and intended (since receiving such notice) that its continued actions would actively induce and contribute to the infringement of the claims of the ’535 patent.

33. Upon information and belief, Defendants’ affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, *e.g.*, through training, demonstrations, brochures, installation and user guides, have induced and continue to induce users of the Accused Instrumentalities to use them in their normal and

customary way to infringe the ’535 patent by practicing a method, comprising: determining a parameter of at least a portion of a data block; selecting one or more asymmetric compressors from among a plurality of compressors based upon the determined parameter or attribute; compressing the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks; and storing at least a portion of the one or more compressed data blocks. For example, Defendants adopted H.264 in their encoder devices and streaming services. For similar reasons, Defendants also induce their customers to use the Accused Instrumentalities to infringe other claims of the ’535 patent. Defendants specifically intended and were aware that these normal and customary activities would infringe the ’535 patent. Defendants performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the ’535 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendants engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendants have induced and continue to induce users of the Accused Instrumentalities to use the Accused Instrumentalities in their ordinary and customary way to infringe the ’535 patent, knowing that such use constitutes infringement of the ’535 patent. Accordingly, Defendants have been, and currently are, inducing infringement of the ’535 patent, in violation of 35 U.S.C. § 271(b).

34. Defendants have also infringed, and continue to infringe, claims of the ’535 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process,

or using the systems, of the ’535 patent, and constitute a material part of the invention. Defendants know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the ’535 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendants have been, and currently are, contributorily infringing the ’535 patent, in violation of 35 U.S.C. § 271(c).

35. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the Accused Instrumentalities’ compression features, Defendants have injured Realtime and are liable to Realtime for infringement of the ’535 patent pursuant to 35 U.S.C. § 271.

36. As a result of Defendants’ infringement of the ’535 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendants’ infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendants, together with interest and costs as fixed by the Court.

## COUNT II

## INFRINGEMENT OF U.S. PATENT NO. 9,769,477

37. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

38. Plaintiff Realtime is the owner by assignment of United States Patent No. 9,769,477 (“the ’477 patent”) entitled “Video data compression systems.” The ’477 patent was duly and legally issued by the United States Patent and Trademark Office on September 19, 2017. A true and correct copy of the ’477 patent is included as Exhibit B.

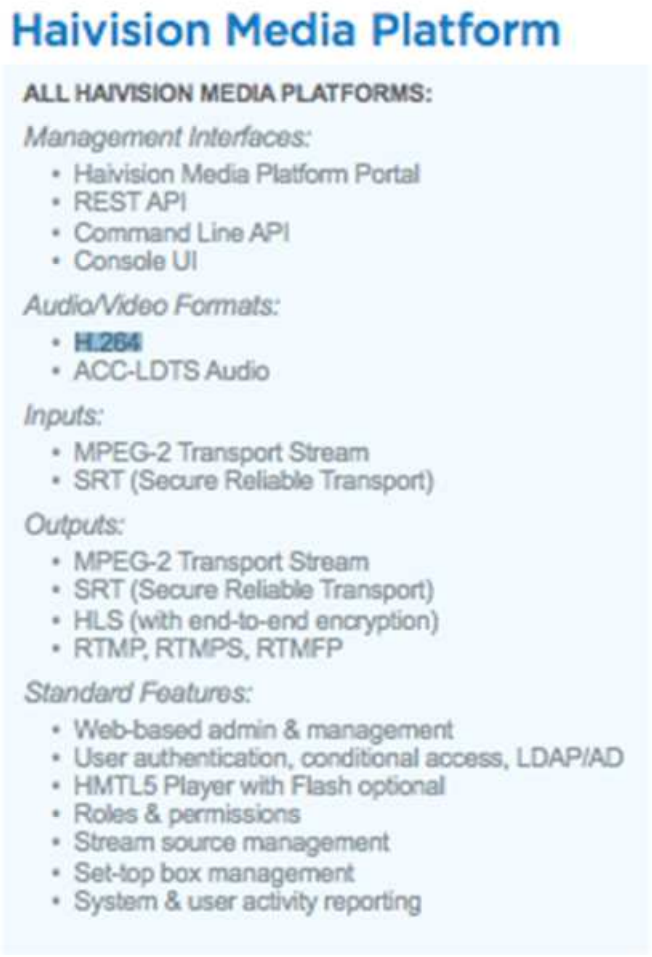
39. On information and belief, Defendants have made, used, offered for sale, sold and/or imported into the United States products that infringe the ’477 patent, and continue to do so. By way of illustrative example, these infringing products include, without limitation, Defendants’ video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the ’477 patent (“Accused Instrumentalities”).

40. On information and belief, Defendants have directly infringed and continue to infringe the ’477 patent, for example, through its own use and testing of the Accused Instrumentalities, which when used, practices the system claimed by Claim 1 of the ’477 patent, namely, a system, comprising: a plurality of different asymmetric data compression encoders, wherein each asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to utilize one or more data compression algorithms, and wherein a first asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to compress data blocks containing video or image data at a higher data compression rate than a second asymmetric data compression encoder of the plurality of different asymmetric data compression encoders; and one or more processors configured to: determine one or more data parameters, at least one of the determined one or more data

parameters relating to a throughput of a communications channel measured in bits per second; and select one or more asymmetric data compression encoders from among the plurality of different asymmetric data compression encoders based upon, at least in part, the determined one or more data parameters. Upon information and belief, Defendants use the Accused Instrumentalities to practice infringing methods for their own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

41. For example, the Accused Instrumentalities utilize the H.264 video compression standard, as well as Secure Reliable Transport (SRT) technology. "SRT detects the real-time network performance between the encode / decode / transcode endpoints. The endpoints can be dynamically adjusted for optimal stream performance and quality." *See, e.g.*, https://www.haivision.com/products/srt-secure-reliable-transport/. At least Haivision's Makito X and KB series devices use H.264 and SRT. *Id.* On information and belief, all of the Accused Instrumentalities detect real-time network performance between the encode / decode / transcode endpoints and dynamically select a compression technique for optimal stream performance.

42. Furthermore, as can be seen by the highlighted text in the below graphic, "All Haivision Media Platforms" support "H.264" as an "Audio/Video Format". *See*




page 7/8 of the datasheet available at http://www3.haivision.com/hmp-datasheet:

43. In addition, from this below webpage listing a Haivision product, "Haivision's award-winning Makito X H.264 encoder transports secure, low latency HD video over any network at extremely low bitrates, making it ideal for live, interactive and bandwidth constrained applications." *See* https://www.haivision.com/products/makito-series/makito-x-h264/ (with "H.264 encoder" being highlighted):


44. This portion of the datasheet also shows that Haivision's Makito X "supports High Profile H.264 encoding." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

45. Further portions of the datasheet show that the Haivision Makito X has among its features the ability to perform "Highly efficient encoding" at "Up to twice the

| Features | Benefits |
|---|---|
| Low end-to-end latency | Supports mission-critical distribution and interactive communication challenge |
| 4 HD encoding engines | Flexible encoding & compression, adapting to different network environments & applications |
| Multiple destinations per stream | Target different systems, networks, users, and platforms individually |
| Highly efficient encoding | Up to twice the quality or half of the bandwidth, using High Profile H.264 |
| 12 HD 1080p60 channels in 1RU | Highest density available reducing cost, footprint, and energy consumption |
| AES 256 bit encryption | Secure unicast or multicast end-to-end video distribution |
| Metadata support | Insert synchronized KLV into the MPEG stream from IP, embedded, or serial data sources |
| SRT and FEC | Maintain video quality over unqualified networks and low cost public internet connections |
| Integrated with Furnace, InStream and CoolSign | Complete end-to-end video solution |

quality or half of the bandwidth, using High Profile H.264." *See* page 1/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

46. Additional portions of the datasheet show that the Haivision Makito X has technical specifications that use H.264 for both "VIDEO ENCODING/DECODING" and "IP NETWORK INTERFACES." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

**VIDEO ENCODING/DECODING**
*Compression Standard:*
H.264 (MPEG-4 AVC part 10)
ISO/IEC 14496-10
Baseline, Main, and High Profiles
Up to Level 4.2 and lower intermediate levels
I, IP, IBP, IBBP framing
Configurable Group of Picture (GOP) size
Configurable frame rate
Region of Interest Coding
*Bit Rates:*
SD/HD from 32 kbps to 25 Mbps
*Rate Control:*
CBR/VBR
*Latency (encoder only):*
Less than 55ms

**IP NETWORK INTERFACES**
*Standard:*
Ethernet 10/100/1000 Base-T, auto-detect, Half/Full-duplex
Static IP/DHCP
*Connector:*
RJ45
*Networking Protocols:*
Unicast streaming
Multicast streaming (IGMP v3)
Multiple unicast streaming
MPEG transport stream over UDP / RTP
RTMP
SAP (RFC 2974)
Direct RTP - H.264 over RTP (RFC 3984)
SRT (Secure Reliable Transport)

47. It also appears that all variations or different models of the Haivision Makito X product utilize H.264, as can be seen by this below listing of the "Makito X Product Portfolio & Ordering Information." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

**Makito X Product Portfolio & Ordering Information ****

| | | |
|---|---|---|
| Makito X Single SDI | S/B-292E-HDSDI1 | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single 3G/HD/SD-SDI and Composite channel |
| Makito X Dual SDI | S/B-292E-HDSDI2 | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting dual 3G/HD/SD-SDI and Composite channels |
| Makito X DVI | S/B-292E-DVI | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single channel DVI-I or Component |
| Makito X Decoder Single Channel | S/B-292D-HD1 | Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting single channel 3G/HD/SD-SDI and HDMI |
| Makito X Decoder Dual Channel | S/B-292D-HD2 | Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting dual channel 3G/HD/SD-SDI and HDMI |

48. The Haivision Makito encoders are also known to be Haivision's hallmark streaming video encoders using H.264, as can be seen by this press release in 2010 (*See* https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-h-264-encodingdecoding-solution/):

# Haivision Introduces the Highest Density HD H.264 Encoding/Decoding Solution

*New MB6 chassis accepts any combination of Makito encoders and decoders to provide up to six HD 1080p60 channels in a single rack unit form factor*

**MONTREAL and CHICAGO — May 19, 2010 —** Haivision Network Video today announced the release of the new MB6 high-density six-slot chassis for the company's Makito™ HD H.264 encoders and decoders. The new chassis affords the highest density available for 1080p60 H.264 encoding, housing up to six Makito encoder blades in a single rack unit (1-7/8 inch).

"The Makito is by far the most compact HD H.264 design with full 1080p60 performance and an incredible encoding latency of less than 55 milliseconds," said Peter Maag, senior vice president at Haivision Network Video. "The MB6 chassis option provides our most dense configuration option and gives our clients full mix and match capabilities with all of our encoder and decoder products within the Makito family."

Delivering secure H.264 HD video combined with flexible distribution features such as Multi-Streaming™ and HiLo-Streaming™ for addressing disparate audiences, the Makito is the ideal platform for contribution head-ends, advanced communications systems, and central decode monitoring stations for the enterprise, education, federal, and medical markets. The MB6 chassis allows users to best configure the mix of Makito encoders and Makito decoders to achieve the functionality they need in a very small footprint. In addition to providing a high level of versatility, the chassis simplifies deployment in any environment by offering three power supply options: standard AC, medical-grade AC, and DC (20-36 VDC).

**About Haivision Network Video**
Based in Montreal and Chicago, Haivision Network Video is a private company and a world leader in delivering the most advanced and intelligent IP video networking technology. Haivision's products are deployed worldwide within the foremost Fortune 100 companies; in the most rigorous military and defense applications; in state-of-the-art healthcare facilities for video collaboration and training; in highly renowned educational institutions for IPTV, teaching, and remote learning; in the most efficient interactive broadcast applications; and within the world's leading TelePresence suites. Haivision distributes its products through value-added resellers, system integrators, distributors, and OEMs worldwide.

49. Nonetheless, the Makito X is not the only encoder that Haivision has. By way of non-limiting example, Haivision also has the KB Series which clearly uses H.264, as can be seen by below (https://www.haivision.com/about/press-releases/haivision-

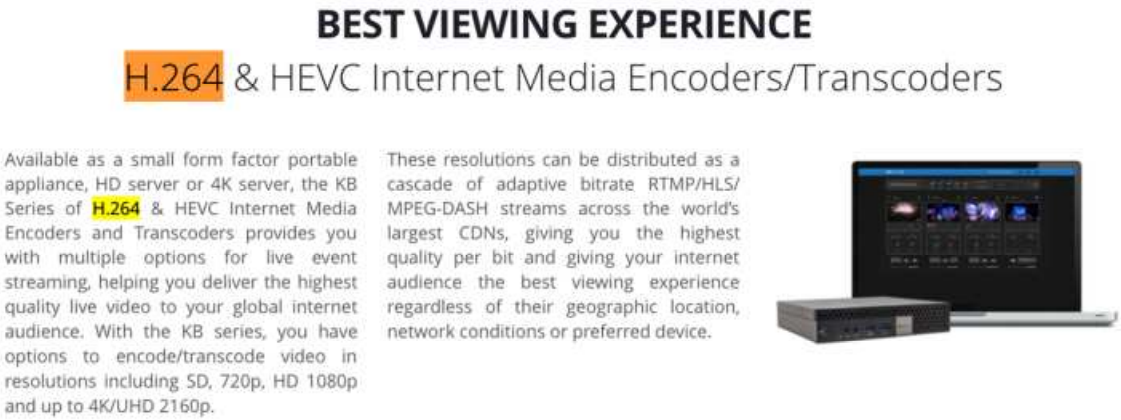
Encoders / Transcoders

## KB Series

H.264, HEVC and 4K encoder and transcoder, on-premise or in the cloud, for internet streaming.

introduces-highest-density-hd-h-264-encodingdecoding-solution/):

*See* https://www.haivision.com/products/kb-series/:




50. In addition, the datasheet for Haivision's KB series H.264 encoders make multiple mentions to using H.264 for "live event streaming" as can be seen by this portion of the Haivision KB series datasheet. *See* page 1/3 of the datasheet available at


**H.264 & HEVC Internet Media Encoders/Transcoders for Powerful Live Event Streaming**

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global internet audience.

**Hardware Acceleration & ABR Cascades** The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or HEVC encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth savings

| Features | Benefits |
|---|---|
| H.264/HEVC encoding/transcoding | High efficiency video compression over constrained networks for live events contribution |
| H.264/HEVC ABR Cascades | Seamless viewing experience at the player level with dynamic bitrate/resolution tuning |
| SRT protocol | AES encrypted, packet loss resilient live video transport from source encoder to cloud hosted transcoder |
| Extensive CDN Support | Ensure reliable streaming over Akamai, Limelight and other Adobe and Wowza based services |
| 608/708 closed captioning | Support digital television closed captioning standards |
| Small Form Factor (option) | High powered processing in a portable appliance with the KB Mini |
| 360-degree Virtual Reality (option) | Power virtual reality viewing experiences with the KB 4K |

http://www3.haivision.com/Datasheet_KB:

51. There are also various other portions of the Haivision KB Series datasheet that mention the product's usage of H.264 and being able to provide a "H.264" viewing experience. *See* page 2/3 of the datasheet available at

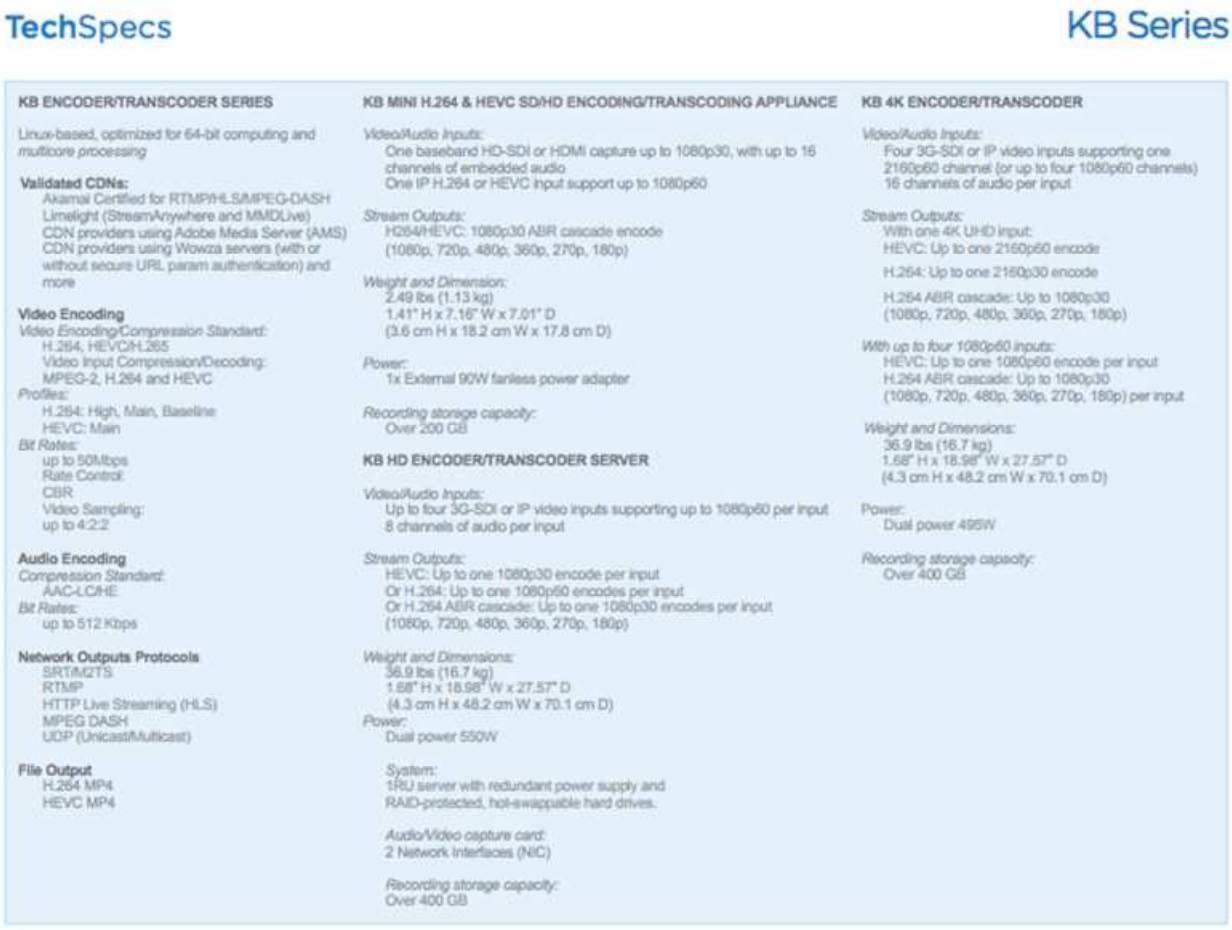

**Flexible Deployment Options** The KB Series offers flexible deployment and hardware acceleration options for every live event streaming scenario:

- The award-winning **KB Mini Encoder/Transcoder** is a portable all-in-one H.264/HEVC encoder, ideal for live event streaming from anywhere with an internet connection. Leveraging Intel CPU and GPU hybrid processing to deliver H.264/HEVC cascades up to 1080p, the KB Mini gives you big power in a small form factor appliance.
- A rackmountable server, the **KB Encoder/Transcoder Server** features redundant power supplies, RAID configurations and support for up to four 1080p video input channels. The KB Encoder/Transcoder Server is ideal for enterprise-grade internet streaming and fits within your existing enterprise infrastructure.
- The **KB 4K Encoder/Transcoder** has all the benefits of the KB Encoder/Transcoder Server, with hardware accelerated HEVC encoding to fuel the highest quality streaming events, supporting up to 4K **H.264**/HEVC viewing experiences with the ability to capture 4K/UHD 2160p over 1x 12G-SDI or 4x 3G-SDI interfaces.

http://www3.haivision.com/Datasheet_KB:

52. One page of the datasheet for Haivision's KB Series also shows H.264 being used for numerous applications, such as: for a "KB Mini" model device ("KB MINI H.264 & HEVD SD/HD ENCODING/TRANSCODING APPLIANCE"), for an IP "input support up to 1080p60" ("One IP H.264 or HEVC input support up to 1080p60"),

for "Stream Outputs" that are "Up to one 2160p30 encode" ("H.264: Up to one 2160p30 encode") and for an "ABR cascade: Up to 1080p30" ("H.264: Up to 1080p30") (also "With up to four 1080p60 inputs"), for "Video Encoding," a "Video Encoding/Compression Standard" ("H.264, HEVC/H.265" and "MPEG-2, H.264 and HEVC"), a "Profile" ("H.264: High, Main, Baseline"), and for the "Stream Outputs" of the "KB HD ENCODER/TRANSCODER SERVER", also "Up to one 1080p60 encodes per input" ("Or H.264: Up to one 1080p60 encodes per input") and for an an H.264



TechSpecs KB Series

**KB ENCODER/TRANSCODER SERIES**

Linux-based, optimized for 64-bit computing and *multicore processing*

**Validated CDNs:**
Akamai Certified for RTMP/HLS/MPEG-DASH
Limelight (StreamAnywhere and MMDLive)
CDN providers using Adobe Media Server (AMS)
CDN providers using Wowza servers (with or without secure URL param authentication) and more

**Video Encoding**
*Video Encoding/Compression Standard:*
H.264, HEVC/H.265
Video Input Compression/Decoding:
MPEG-2, H.264 and HEVC
*Profiles:*
H.264: High, Main, Baseline
HEVC: Main
*Bit Rates:*
up to 50Mbps
Rate Control:
CBR
Video Sampling:
up to 4:2:2

**Audio Encoding**
*Compression Standard:*
AAC-LC/HE
*Bit Rates:*
up to 512 Kbps

**Network Outputs Protocols**
SRT/M2TS
RTMP
HTTP Live Streaming (HLS)
MPEG DASH
UDP (Unicast/Multicast)

**File Output**
H.264 MP4
HEVC MP4

**KB MINI H.264 & HEVC SD/HD ENCODING/TRANSCODING APPLIANCE**

*Video/Audio Inputs:*
One baseband HD-SDI or HDMI capture up to 1080p30, with up to 16 channels of embedded audio
One IP H.264 or HEVC input support up to 1080p60

*Stream Outputs:*
H264/HEVC: 1080p30 ABR cascade encode
(1080p, 720p, 480p, 360p, 270p, 180p)

*Weight and Dimension:*
2.49 lbs (1.13 kg)
1.41" H x 7.16" W x 7.01" D
(3.6 cm H x 18.2 cm W x 17.8 cm D)

*Power:*
1x External 90W fanless power adapter

*Recording storage capacity:*
Over 200 GB

**KB HD ENCODER/TRANSCODER SERVER**

*Video/Audio Inputs:*
Up to four 3G-SDI or IP video inputs supporting up to 1080p60 per input
8 channels of audio per input

*Stream Outputs:*
HEVC: Up to one 1080p30 encode per input
Or H.264: Up to one 1080p60 encodes per input
Or H.264 ABR cascade: Up to one 1080p30 encodes per input
(1080p, 720p, 480p, 360p, 270p, 180p)

*Weight and Dimensions:*
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

*Power:*
Dual power 550W

*System:*
1RU server with redundant power supply and RAID-protected, hot-swappable hard drives.

*Audio/Video capture card:*
2 Network Interfaces (NIC)

*Recording storage capacity:*
Over 400 GB

**KB 4K ENCODER/TRANSCODER**

*Video/Audio Inputs:*
Four 3G-SDI or IP video inputs supporting one 2160p60 channel (or up to four 1080p60 channels)
16 channels of audio per input

*Stream Outputs:*
With one 4K UHD input:
HEVC: Up to one 2160p60 encode
H.264: Up to one 2160p30 encode
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p)

*With up to four 1080p60 inputs:*
HEVC: Up to one 1080p60 encode per input
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p) per input

*Weight and Dimensions:*
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

*Power:*
Dual power 495W

*Recording storage capacity:*
Over 400 GB

"ABR cascade," "Up to one 1080p30 encodes per input" ("Or H.264 ABR cascade: Up to one 1080p30 encodes per input") and finally as a "File Output" form ("H.264/MP4"). *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

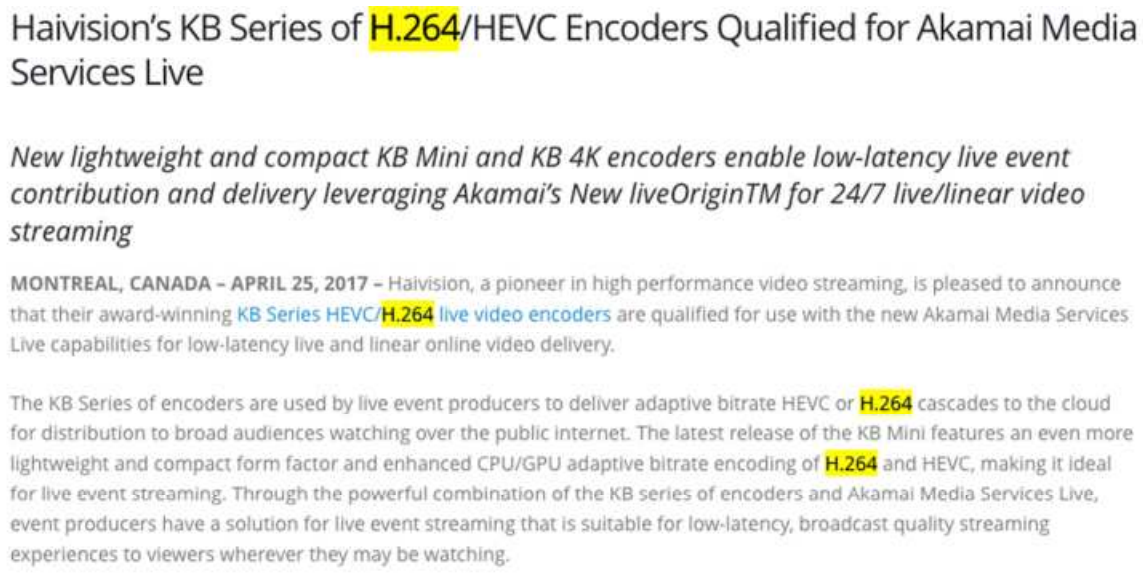
53. It also appears that all or most variations or different models of the Haivision KB product utilize H.264, as can be seen by this below listing of the "KB Product Portfolio & Ordering Information." *See* page 3/3 of the datasheet available at

**KB Product Portfolio & Ordering Information ****

| | | |
|---|---|---|
| KB Mini H.264 & HEVC SD/HD Encoding/Transcoding Appliance | S-KB-SFF2-1 | 1 baseband capture up to 1080p30 or 1 IP input up to 1080p60 |
| KB Encoder/Transcoder Server | S-KB-1/2/4 | KB Enterprise Class H.264 & HEVC SD/HD |
| KB 4K Encoder/Transcoder | S-KB-4 | KB Enterprise Class UHD Encoding/Transcoding Appliance |
| KB Mini Server Rack - Single Unit | RU-SFF-1 | Rack mount for single KB Mini appliance |
| KB Mini Server Rack - Dual Unit | RU-SFF-2 | Rack mount for two KB Mini appliances |

http://www3.haivision.com/Datasheet_KB:

54. The Haivision KB Series also appears to be an "award-winning" HEVC.H.264 live video encoder for Haivision, as can be seen by this recent press release available at https://www.haivision.com/about/press-releases/haivisions-kb-series-h-



Haivision's KB Series of H.264/HEVC Encoders Qualified for Akamai Media Services Live

*New lightweight and compact KB Mini and KB 4K encoders enable low-latency live event contribution and delivery leveraging Akamai's New liveOriginTM for 24/7 live/linear video streaming*

**MONTREAL, CANADA – APRIL 25, 2017 –** Haivision, a pioneer in high performance video streaming, is pleased to announce that their award-winning KB Series HEVC/H.264 live video encoders are qualified for use with the new Akamai Media Services Live capabilities for low-latency live and linear online video delivery.

The KB Series of encoders are used by live event producers to deliver adaptive bitrate HEVC or H.264 cascades to the cloud for distribution to broad audiences watching over the public internet. The latest release of the KB Mini features an even more lightweight and compact form factor and enhanced CPU/GPU adaptive bitrate encoding of H.264 and HEVC, making it ideal for live event streaming. Through the powerful combination of the KB series of encoders and Akamai Media Services Live, event producers have a solution for live event streaming that is suitable for low-latency, broadcast quality streaming experiences to viewers wherever they may be watching.

264hevc-encoders-qualified-akamai-media-services-live/:

55. The Accused Instrumentalities determine a parameter of at least a portion of a video data block. As shown below, examples of such parameters include bitrate (or max video bitrate) and resolution parameters. Different parameters correspond with different end applications. H.264 provides for multiple different ranges of such parameters, each included in the "profiles" and "levels" defined by the H.264 standard. *See* http://www.axis.com/files/whitepaper/wp_h264_31669_en_0803_lo.pdf at 5:

**4. H.264 profiles and levels**

The joint group involved in defining H.264 focused on creating a simple and clean solution, limiting options and features to a minimum. An important aspect of the standard, as with other video standards, is providing the capabilities in profiles (sets of algorithmic features) and levels (performance classes) that optimally support popular productions and common formats.

H.264 has seven profiles, each targeting a specific class of applications. Each profile defines what feature set the encoder may use and limits the decoder implementation complexity.

Network cameras and video encoders will most likely use a profile called the baseline profile, which is intended primarily for applications with limited computing resources. The baseline profile is the most suitable given the available performance in a real-time encoder that is embedded in a network video product. The profile also enables low latency, which is an important requirement of surveillance video and also particularly important in enabling real-time, pan/tilt/zoom (PTZ) control in PTZ network cameras.

H.264 has 11 levels or degree of capability to limit performance, bandwidth and memory requirements. Each level defines the bit rate and the encoding rate in macroblock per second for resolutions ranging from QCIF to HDTV and beyond. The higher the resolution, the higher the level required.

*See* https://en.wikipedia.org/wiki/H.264/MPEG-4_AVC:

Levels with maximum property values

| Level | Max decoding speed | | Max frame size | | Max video bit rate for video coding layer (VCL) kbit/s | | | Examples for high resolution @ highest frame rate (max stored frames) Toggle additional details |
|---|---|---|---|---|---|---|---|---|
| | Luma samples/s | Macroblocks/s | Luma samples | Macroblocks | Baseline, Extended and Main Profiles | High Profile | High 10 Profile | |
| 1 | 380,160 | 1,485 | 25,344 | 99 | 64 | 80 | 192 | 176×144@15.0 (4) |
| 1b | 380,160 | 1,485 | 25,344 | 99 | 128 | 160 | 384 | 176×144@15.0 (4) |
| 1.1 | 768,000 | 3,000 | 101,376 | 396 | 192 | 240 | 576 | 352×288@7.5 (2) |
| 1.2 | 1,536,000 | 6,000 | 101,376 | 396 | 384 | 480 | 1,152 | 352×288@15.2 (6) |
| 1.3 | 3,041,280 | 11,880 | 101,376 | 396 | 768 | 960 | 2,304 | 352×288@30.0 (6) |
| 2 | 3,041,280 | 11,880 | 101,376 | 396 | 2,000 | 2,500 | 6,000 | 352×288@30.0 (6) |
| 2.1 | 5,068,800 | 19,800 | 202,752 | 792 | 4,000 | 5,000 | 12,000 | 352×576@25.0 (6) |
| 2.2 | 5,184,000 | 20,250 | 414,720 | 1,620 | 4,000 | 5,000 | 12,000 | 720×576@12.5 (5) |
| 3 | 10,368,000 | 40,500 | 414,720 | 1,620 | 10,000 | 12,500 | 30,000 | 720×576@25.0 (5) |
| 3.1 | 27,648,000 | 108,000 | 921,600 | 3,600 | 14,000 | 17,500 | 42,000 | 1,280×720@30.0 (5) |
| 3.2 | 55,296,000 | 216,000 | 1,310,720 | 5,120 | 20,000 | 25,000 | 60,000 | 1,280×1,024@42.2 (4) |
| 4 | 62,914,560 | 245,760 | 2,097,152 | 8,192 | 20,000 | 25,000 | 60,000 | 2,048×1,024@30.0 (4) |
| 4.1 | 62,914,560 | 245,760 | 2,097,152 | 8,192 | 50,000 | 62,500 | 150,000 | 2,048×1,024@30.0 (4) |
| 4.2 | 133,693,440 | 522,240 | 2,228,224 | 8,704 | 50,000 | 62,500 | 150,000 | 2,048×1,080@60.0 (4) |
| 5 | 150,994,944 | 589,824 | 5,652,480 | 22,080 | 135,000 | 168,750 | 405,000 | 3,672×1,536@26.7 (5) |
| 5.1 | 251,658,240 | 983,040 | 9,437,184 | 36,864 | 240,000 | 300,000 | 720,000 | 4,096×2,304@26.7 (5) |
| 5.2 | 530,841,600 | 2,073,600 | 9,437,184 | 36,864 | 240,000 | 300,000 | 720,000 | 4,096×2,304@56.3 (5) |

56. A video data block is organized by the group of pictures (GOP) structure, which is a "collection of successive pictures within a coded video stream." *See* https://en.wikipedia.org/wiki/Group_of_pictures. A GOP structure can contain intra coded pictures (I picture or I frame), predictive coded pictures (P picture or P frame), bipredictive coded pictures (B picture or B frame) and direct coded pictures (D picture or D frames, or DC direct coded pictures which are used only in MPEG-1 video). *See* https://en.wikipedia.org/wiki/Video_compression_picture_types (for descriptions of I frames, P frames and B frames); https://en.wikipedia.org/wiki/MPEG-1#D-frames (for descriptions of D frames). Thus, at least a portion of a video data block would also make up a GOP structure and could also contain I frames, P frames, B frames and/or D frames. The GOP structure also reflects the size of a video data block, and the GOP structure can be controlled and used to fine-tune other parameters (*e.g.* bitrate, max video bitrate and resolution parameters) or even be considered as a parameter by itself.

57. Based on the bitrate and/or resolution parameter identified (e.g. bitrate, max video bitrate, resolution, GOP structure or frame type within a GOP structure), any H.264-compliant system such as the Accused Instrumentalities would determine which profile (*e.g.*, "baseline," "extended," "main", or "high") corresponds with that parameter, then select between at least two asymmetric compressors. If baseline or extended is the corresponding profile, then the system will select a Context-Adaptive Variable Length Coding ("CAVLC") entropy encoder. If main or high is the corresponding profile, then the system will select a Context-Adaptive Binary Arithmetic Coding ("CABAC") entropy encoder. Both encoders are asymmetric compressors because it takes a longer period of time for them to compress data than to decompress data. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

| | Baseline | Extended | Main | High | High 10 |
|---|---|---|---|---|---|
| I and P Slices | Yes | Yes | Yes | Yes | Yes |
| B Slices | No | Yes | Yes | Yes | Yes |
| SI and SP Slices | No | Yes | No | No | No |
| Multiple Reference Frames | Yes | Yes | Yes | Yes | Yes |
| In-Loop Deblocking Filter | Yes | Yes | Yes | Yes | Yes |
| CAVLC Entropy Coding | Yes | Yes | Yes | Yes | Yes |
| CABAC Entropy Coding | No | No | Yes | Yes | Yes |
| Flexible Macroblock Ordering (FMO) | Yes | Yes | No | No | No |
| Arbitrary Slice Ordering (ASO) | Yes | Yes | No | No | No |
| Redundant Slices (RS) | Yes | Yes | No | No | No |
| Data Partitioning | No | Yes | No | No | No |
| Interlaced Coding (PicAFF, MBAFF) | No | Yes | Yes | Yes | Yes |
| 4:2:0 Chroma Format | Yes | Yes | Yes | Yes | Yes |
| Monochrome Video Format (4:0:0) | No | No | No | Yes | Yes |
| 4:2:2 Chroma Format | No | No | No | No | No |
| 4:4:4 Chroma Format | No | No | No | No | No |
| 8 Bit Sample Depth | Yes | Yes | Yes | Yes | Yes |
| 9 and 10 Bit Sample Depth | No | No | No | No | Yes |
| 11 to 14 Bit Sample Depth | No | No | No | No | No |
| 8×8 vs. 4×4 Transform Adaptivity | No | No | No | Yes | Yes |
| Quantization Scaling Matrices | No | No | No | Yes | Yes |
| Separate Cb and Cr QP control | No | No | No | Yes | Yes |
| Separate Color Plane Coding | No | No | No | No | No |
| Predictive Lossless Coding | No | No | No | No | No |

*See* http://web.cs.ucla.edu/classes/fall03/cs218/paper/H.264_MPEG4_Tutorial.pdf at 7:

The following table summarizes the two major types of entropy coding: Variable Length Coding (VLC) and Context Adaptive Binary Arithmetic Coding (CABAC). CABAC offers superior coding efficiency over VLC by adapting to the changing probability distribution of symbols, by exploiting correlation between symbols, and by adaptively exploiting bit correlations using arithmetic coding. H.264 also supports Context Adaptive Variable Length Coding (CAVLC) which offers superior entropy coding over VLC without the full cost of CABAC.

**H.264 Entropy Coding – Comparison of Approaches**

| Characteristics | Variable Length Coding (VLC) | Context Adaptive Binary Arithmetic Coding(CABAC) |
|---|---|---|
| • Where it is used | MPEG-2, MPEG-4 ASP | H.264/MPEG-4 AVC (high efficiency option) |
| • Probability distribution | **Static** - Probabilities never change | **Adaptive** - Adjusts probabilities based on actual data |
| • Leverages correlation between symbols | **No** - Conditional probabilities ignored | **Yes** - Exploits symbol correlations by using "contexts" |
| • Non-integer code words | **No** - Low coding efficiency forhigh probability symbols | **Yes** - Exploits "arithmetic coding" which generates non-integer code words for higher efficiency |

Moreover, the H.264 Standard requires a bit-flag descriptor, which is set to determine the correct decoder for the corresponding encoder. As shown below, if the flag = 0, then CAVLC must have been selected as the encoder; if the flag = 1, then CABAC must have been selected as the encoder. *See* https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-H.264-201304-S!!PDF-E&type=items (Rec. ITU-T H.264 (04/2013)) at 80:

**entropy_coding_mode_flag** selects the entropy decoding method to be applied for the syntax elements for which two descriptors appear in the syntax tables as follows:

- If entropy_coding_mode_flag is equal to 0, the method specified by the left descriptor in the syntax table is applied (Exp-Golomb coded, see clause 9.1 or CAVLC, see clause 9.2).
- Otherwise (entropy_coding_mode_flag is equal to 1), the method specified by the right descriptor in the syntax table is applied (CABAC, see clause 9.3).

58. The Accused Instrumentalities compress the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks, which can be organized in a GOP structure (see above). After its selection, the asymmetric compressor (CAVLC or CABAC) will compress the video

data to provide various compressed data blocks, which can also be organized in a GOP structure. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

**Entropy Coding**

For entropy coding, H.264 may use an enhanced VLC, a more complex context-adaptive variable-length coding (CAVLC) or an ever more complex Context-adaptive binary-arithmetic coding (CABAC) which are complex techniques to losslessly compress syntax elements in the video stream knowing the probabilities of syntax elements in a given context. The use of CABAC can improve the compression of around 5-7%. CABAC may requires a 30-40% of total processing power to be accomplished.

*See*

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.602.1581&rep=rep1&type=pdf

at 13:

Typical compression ratios to maintain excellent quality are:

- 10:1 for general images using JPEG
- 30:1 for general video using H.263 and MPEG-2
- 60:1 for general video using H.264 and WMV9

*See* http://www.ijera.com/papers/Vol3_issue4/BM34399403.pdf at 2:

Most visual communication systems today use Baseline Profile. Baseline is the simplest H.264 profile and defines, for example, zigzag scanning of the picture and using 4:2:0 (YUV video formats) chrominance sampling. In Baseline Profile, the picture is split in blocks consisting of 4x4 pixels, and each block is processed separately. Another important element of the Baseline Profile is the use of Universal Variable Length Coding (UVLC) and Context Adaptive Variable Length Coding (CAVLC) entropy coding techniques.

The Extended and Main Profiles includes the functionality of the Baseline Profile and add improvements to the predictions algorithms. Since transmitting every single frame (think 30 frames per second for good quality video) is not feasible if you are trying to reduce the bit rate 1000-2000 times, temporal and motion prediction are heavily used in H.264, and allow transmitting only the difference between one frame and the previous frames. The result is spectacular efficiency gain, especially for scenes with little change and motion.

The High Profile is the most powerful profile in H.264, and it allows most efficient coding of video. For example, large coding gain achieved through the use of Context Adaptive Binary Arithmetic Coding (CABAC) encoding which is more efficient than the UVLC/CAVLC used in Baseline Profile.

The High Profile also uses adaptive transform that decides on the fly if 4x4 or 8x8-pixel blocks should be used. For example, 4x4 blocks are used for the parts of the picture that are dense with detail, while parts that have little detail are transformed using 8x8 blocks.

59. On information and belief, the Accused Instrumentalities store at least a portion of the one or more compressed data blocks in buffers, hard disk, or other forms of memory/storage.

60. On information and belief, Defendants also directly infringe and continue to infringe other claims of the ’477 patent, for similar reasons as explained above with respect to Claim 1 of the ’477 patent.

61. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, *e.g.*, in the manner specified in the H.264 standard.

62. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods claimed by the ’477 patent.

63. On information and belief, Defendants have had knowledge of the ’477 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendants knew of the ’477 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendants will have known and intended (since receiving such notice) that its continued actions would actively induce and contribute to the infringement of the claims of the ’477 patent.

64. Upon information and belief, Defendants’ affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, *e.g.*, through training, demonstrations, brochures, installation and user guides, have induced and continue to induce users of the Accused Instrumentalities to use them in their normal and

customary way to infringe the ’477 patent by practicing a system, comprising: a plurality of different asymmetric data compression encoders, wherein each asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to utilize one or more data compression algorithms, and wherein a first asymmetric data compression encoder of the plurality of different asymmetric data compression encoders is configured to compress data blocks containing video or image data at a higher data compression rate than a second asymmetric data compression encoder of the plurality of different asymmetric data compression encoders; and one or more processors configured to: determine one or more data parameters, at least one of the determined one or more data parameters relating to a throughput of a communications channel measured in bits per second; and select one or more asymmetric data compression encoders from among the plurality of different asymmetric data compression encoders based upon, at least in part, the determined one or more data parameters. For example, Defendants adopted H.264 in their encoder devices and streaming services. For similar reasons, Defendants also induce their customers to use the Accused Instrumentalities to infringe other claims of the ’477 patent. Defendants specifically intended and were aware that these normal and customary activities would infringe the ’477 patent. Defendants performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the ’477 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendants engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendants have induced and continue to induce users of the Accused Instrumentalities to

use the Accused Instrumentalities in their ordinary and customary way to infringe the '477 patent, knowing that such use constitutes infringement of the '477 patent. Accordingly, Defendants have been, and currently are, inducing infringement of the '477 patent, in violation of 35 U.S.C. § 271(b).

65. Defendants have also infringed, and continue to infringe, claims of the '477 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process, or using the systems, of the '477 patent, and constitute a material part of the invention. Defendants know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the '477 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendants have been, and currently are, contributorily infringing the '477 patent, in violation of 35 U.S.C. § 271(c).

66. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the Accused Instrumentalities' compression features, Defendants have injured Realtime and are liable to Realtime for infringement of the '477 patent pursuant to 35 U.S.C. § 271.

67. As a result of Defendants' infringement of the '477 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendants' infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendants, together with interest and costs as fixed by the Court.

## COUNT III

## INFRINGEMENT OF U.S. PATENT NO. 8,929,442

68. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

69. Plaintiff Realtime is the owner by assignment of United States Patent No. 8,929,442 ("the '442 patent") entitled "System and method for video and audio data distribution." The '442 patent was duly and legally issued by the United States Patent and Trademark Office on January 6, 2015. A true and correct copy of the '442 patent is included as Exhibit C.

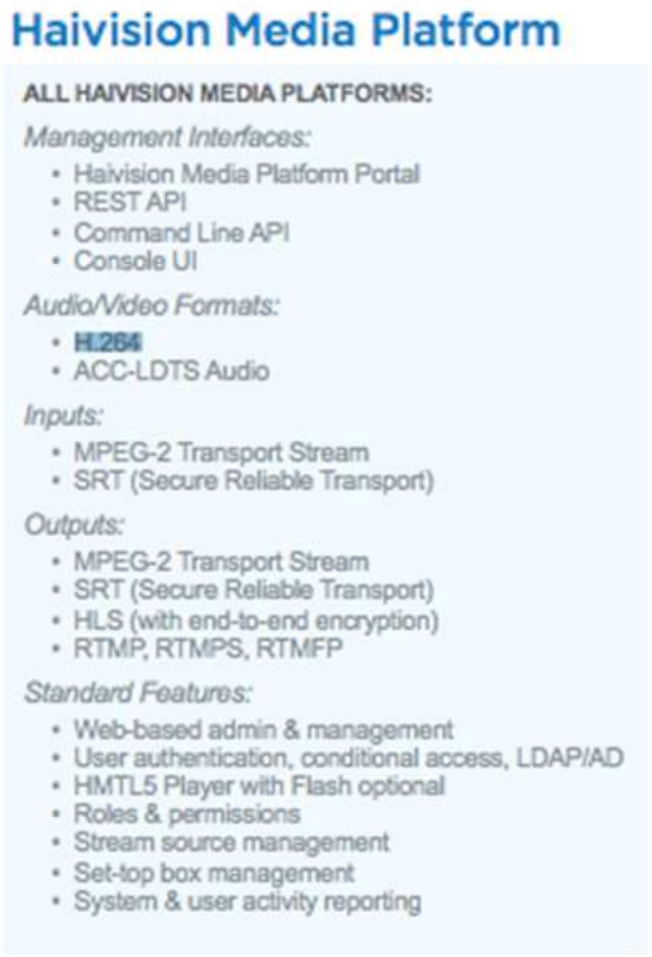
70. On information and belief, Defendants have made, used, offered for sale, sold and/or imported into the United States products that infringe the '442 patent, and continue to do so. By way of illustrative example, these infringing products include, without limitation, Defendants' video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the '442 patent ("Accused Instrumentalities").

71. On information and belief, Defendants have directly infringed and continue to infringe the '442 patent, for example, through its own use and testing of the

Accused Instrumentalities, which when used, practices the apparatus claimed by Claim 8 of the '442 patent, namely, an apparatus, comprising: a data decompression system configured to decompress a compressed data block; and a storage medium configured to store at least a portion of the decompressed data block, wherein at least a portion of a data block having video or audio data was compressed with one or more compression algorithms selected from among a plurality of compression algorithms based upon a throughput of a communication channel and a parameter or an attribute of the at least the portion of the data block to create at least the compressed data block, and wherein at least one of the plurality of compression algorithms is asymmetric. Upon information and belief, Defendants use the Accused Instrumentalities to practice infringing methods for their own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

72. For example, the Accused Instrumentalities utilize the H.264 video compression standard, as well as Secure Reliable Transport (SRT) technology. "SRT detects the real-time network performance between the encode / decode / transcode endpoints. The endpoints can be dynamically adjusted for optimal stream performance and quality." *See, e.g.*, https://www.haivision.com/products/srt-secure-reliable-transport/. At least Haivision's Makito X and KB series devices use H.264 and SRT. *Id.* On information and belief, all of the Accused Instrumentalities detect real-time network performance between the encode / decode / transcode endpoints and dynamically select a compression technique for optimal stream performance.

73. Furthermore, as can be seen by the highlighted text in the below graphic, "All Haivision Media Platforms" support "H.264" as an "Audio/Video Format". *See*




page 7/8 of the datasheet available at http://www3.haivision.com/hmp-datasheet:

74. In addition, from this below webpage listing a Haivision product, "Haivision's award-winning Makito X H.264 encoder transports secure, low latency HD video over any network at extremely low bitrates, making it ideal for live, interactive and bandwidth constrained applications." *See* https://www.haivision.com/products/makito-series/makito-x-h264/ (with "H.264 encoder" being highlighted):


75. This portion of the datasheet also shows that Haivision's Makito X "supports High Profile H.264 encoding." *See* page 1/2 of the datasheet available at


http://www3.haivision.com/datasheet-makito-x:

76. Further portions of the datasheet show that the Haivision Makito X has among its features the ability to perform "Highly efficient encoding" at "Up to twice the quality or half of the bandwidth, using High Profile H.264." *See* page 1/2 of the

| Features | Benefits |
|---|---|
| Low end-to-end latency | Supports mission-critical distribution and interactive communication challenge |
| 4 HD encoding engines | Flexible encoding & compression, adapting to different network environments & applications |
| Multiple destinations per stream | Target different systems, networks, users, and platforms individually |
| Highly efficient encoding | Up to twice the quality or half of the bandwidth, using High Profile H.264 |
| 12 HD 1080p60 channels in 1RU | Highest density available reducing cost, footprint, and energy consumption |
| AES 256 bit encryption | Secure unicast or multicast end-to-end video distribution |
| Metadata support | Insert synchronized KLV into the MPEG stream from IP, embedded, or serial data sources |
| SRT and FEC | Maintain video quality over unqualified networks and low cost public internet connections |
| Integrated with Furnace, InStream and CoolSign | Complete end-to-end video solution |

datasheet available at http://www3.haivision.com/datasheet-makito-x:

77. Additional portions of the datasheet show that the Haivision Makito X has technical specifications that use H.264 for both "VIDEO ENCODING/DECODING" and "IP NETWORK INTERFACES." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

**VIDEO ENCODING/DECODING**
*Compression Standard:*
H.264 (MPEG-4 AVC part 10)
ISO/IEC 14496-10
Baseline, Main, and High Profiles
Up to Level 4.2 and lower intermediate levels
I, IP, IBP, IBBP framing
Configurable Group of Picture (GOP) size
Configurable frame rate
Region of Interest Coding
*Bit Rates:*
SD/HD from 32 kbps to 25 Mbps
*Rate Control:*
CBR/VBR
*Latency (encoder only):*
Less than 55ms

**IP NETWORK INTERFACES**
*Standard:*
Ethernet 10/100/1000 Base-T, auto-detect, Half/Full-duplex
Static IP/DHCP
*Connector:*
RJ45
*Networking Protocols:*
Unicast streaming
Multicast streaming (IGMP v3)
Multiple unicast streaming
MPEG transport stream over UDP / RTP
RTMP
SAP (RFC 2974)
Direct RTP - H.264 over RTP (RFC 3984)
SRT (Secure Reliable Transport)

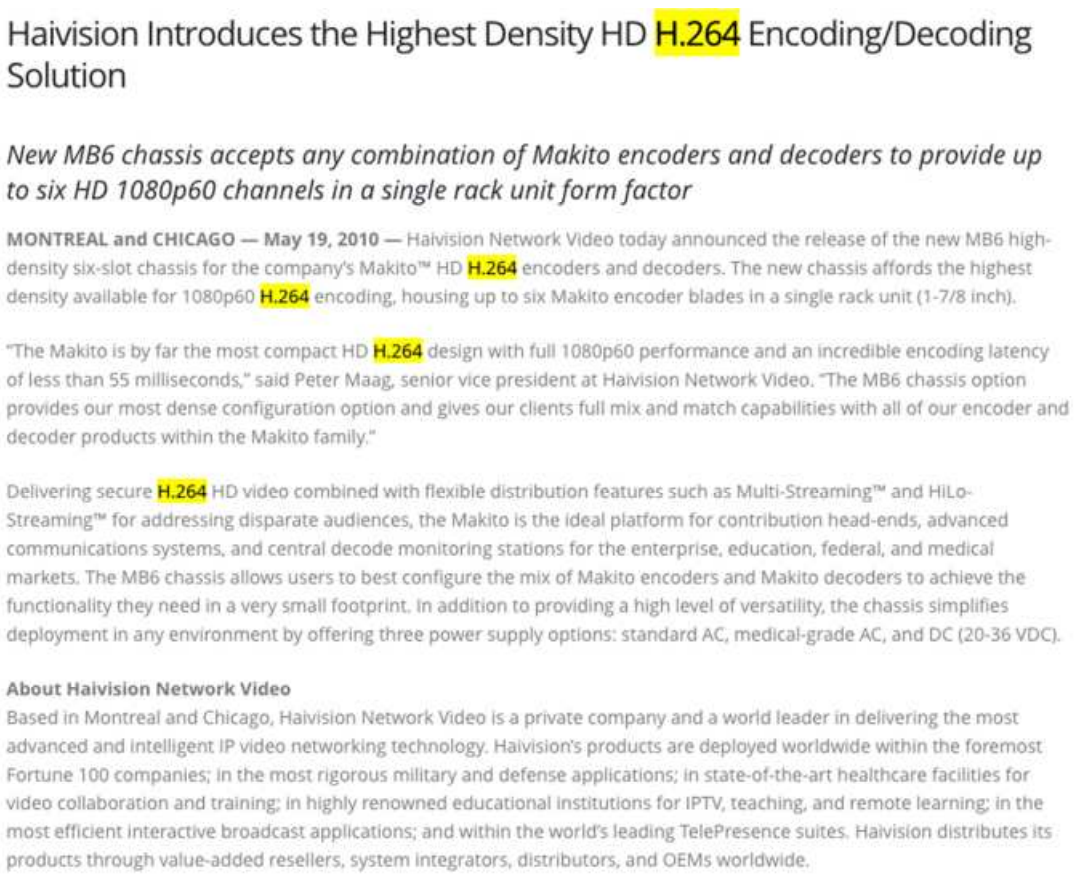
78. It also appears that all variations or different models of the Haivision Makito X product utilize H.264, as can be seen by this below listing of the "Makito X Product Portfolio & Ordering Information." *See* page 2/2 of the datasheet available at

**Makito X Product Portfolio & Ordering Information ****

| | | |
|---|---|---|
| Makito X Single SDI | S/B-292E-HDSDI1 | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single 3G/HD/SD-SDI and Composite channel |
| Makito X Dual SDI | S/B-292E-HDSDI2 | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting dual 3G/HD/SD-SDI and Composite channels |
| Makito X DVI | S/B-292E-DVI | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single channel DVI-I or Component |
| Makito X Decoder Single Channel | S/B-292D-HD1 | Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting single channel 3G/HD/SD-SDI and HDMI |
| Makito X Decoder Dual Channel | S/B-292D-HD2 | Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting dual channel 3G/HD/SD-SDI and HDMI |

http://www3.haivision.com/datasheet-makito-x:

79. The Haivision Makito encoders are also known to be Haivision's hallmark streaming video encoders using H.264, as can be seen by this press release in 2010 (*See* https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-



## Haivision Introduces the Highest Density HD H.264 Encoding/Decoding Solution

*New MB6 chassis accepts any combination of Makito encoders and decoders to provide up to six HD 1080p60 channels in a single rack unit form factor*

**MONTREAL and CHICAGO — May 19, 2010 —** Haivision Network Video today announced the release of the new MB6 high-density six-slot chassis for the company's Makito™ HD H.264 encoders and decoders. The new chassis affords the highest density available for 1080p60 H.264 encoding, housing up to six Makito encoder blades in a single rack unit (1-7/8 inch).

"The Makito is by far the most compact HD H.264 design with full 1080p60 performance and an incredible encoding latency of less than 55 milliseconds," said Peter Maag, senior vice president at Haivision Network Video. "The MB6 chassis option provides our most dense configuration option and gives our clients full mix and match capabilities with all of our encoder and decoder products within the Makito family."

Delivering secure H.264 HD video combined with flexible distribution features such as Multi-Streaming™ and HiLo-Streaming™ for addressing disparate audiences, the Makito is the ideal platform for contribution head-ends, advanced communications systems, and central decode monitoring stations for the enterprise, education, federal, and medical markets. The MB6 chassis allows users to best configure the mix of Makito encoders and Makito decoders to achieve the functionality they need in a very small footprint. In addition to providing a high level of versatility, the chassis simplifies deployment in any environment by offering three power supply options: standard AC, medical-grade AC, and DC (20-36 VDC).

**About Haivision Network Video**
Based in Montreal and Chicago, Haivision Network Video is a private company and a world leader in delivering the most advanced and intelligent IP video networking technology. Haivision's products are deployed worldwide within the foremost Fortune 100 companies; in the most rigorous military and defense applications; in state-of-the-art healthcare facilities for video collaboration and training; in highly renowned educational institutions for IPTV, teaching, and remote learning; in the most efficient interactive broadcast applications; and within the world's leading TelePresence suites. Haivision distributes its products through value-added resellers, system integrators, distributors, and OEMs worldwide.

h-264-encodingdecoding-solution/):

80. Nonetheless, the Makito X is not the only encoder that Haivision has. By way of non-limiting example, Haivision also has the KB Series which clearly uses H.264, as can be seen by below (https://www.haivision.com/about/press-releases/haivision-

Encoders / Transcoders

KB Series

H.264, HEVC and 4K encoder and transcoder, on-premise or in the cloud, for internet streaming.

introduces-highest-density-hd-h-264-encodingdecoding-solution/):

*See* https://www.haivision.com/products/kb-series/:

**BEST VIEWING EXPERIENCE**

H.264 & HEVC Internet Media Encoders/Transcoders

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global internet audience. With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p.

These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/ MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

81. In addition, the datasheet for Haivision's KB series H.264 encoders make multiple mentions to using H.264 for "live event streaming" as can be seen by this portion of the Haivision KB series datasheet. *See* page 1/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:


## H.264 & HEVC Internet Media Encoders/Transcoders for Powerful Live Event Streaming

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global Internet audience.

**Hardware Acceleration & ABR Cascades** The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or HEVC encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth savings offered by HEVC.

**Best Viewing Experience on Every Device** With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p. These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

**Get the Most Out of your Uplink Connection to the Cloud** When your internet connection at the source isn't very reliable, and bandwidth is limited, simply send your video streams to a transcoder in the cloud to take care of adaptive bitrate (ABR) distribution. With support for HEVC, the KB Series uses up to 50% less bandwidth than H.264. Additionally Haivision's SRT (Secure Reliable Transport) technology makes low-cost, readily available public internet connections secure and reliable for live video transport from the source to the cloud, getting the most out of your available uplink bandwidth.

| Features | Benefits |
|---|---|
| H.264/HEVC encoding/transcoding | High efficiency video compression over constrained networks for live events contribution |
| H.264/HEVC ABR Cascades | Seamless viewing experience at the player level with dynamic bitrate/resolution tuning |
| SRT protocol | AES encrypted, packet loss resilient live video transport from source encoder to cloud hosted transcoder |
| Extensive CDN Support | Ensure reliable streaming over Akamai, Limelight and other Adobe and Wowza based services |
| 608/708 closed captioning | Support digital television closed captioning standards |
| Small Form Factor (option) | High powered processing in a portable appliance with the KB Mini |
| 360-degree Virtual Reality (option) | Power virtual reality viewing experiences with the KB 4K |

82. There are also various other portions of the Haivision KB Series datasheet that mention the product's usage of H.264 and being able to provide a "H.264" viewing experience. *See* page 2/3 of the datasheet available at

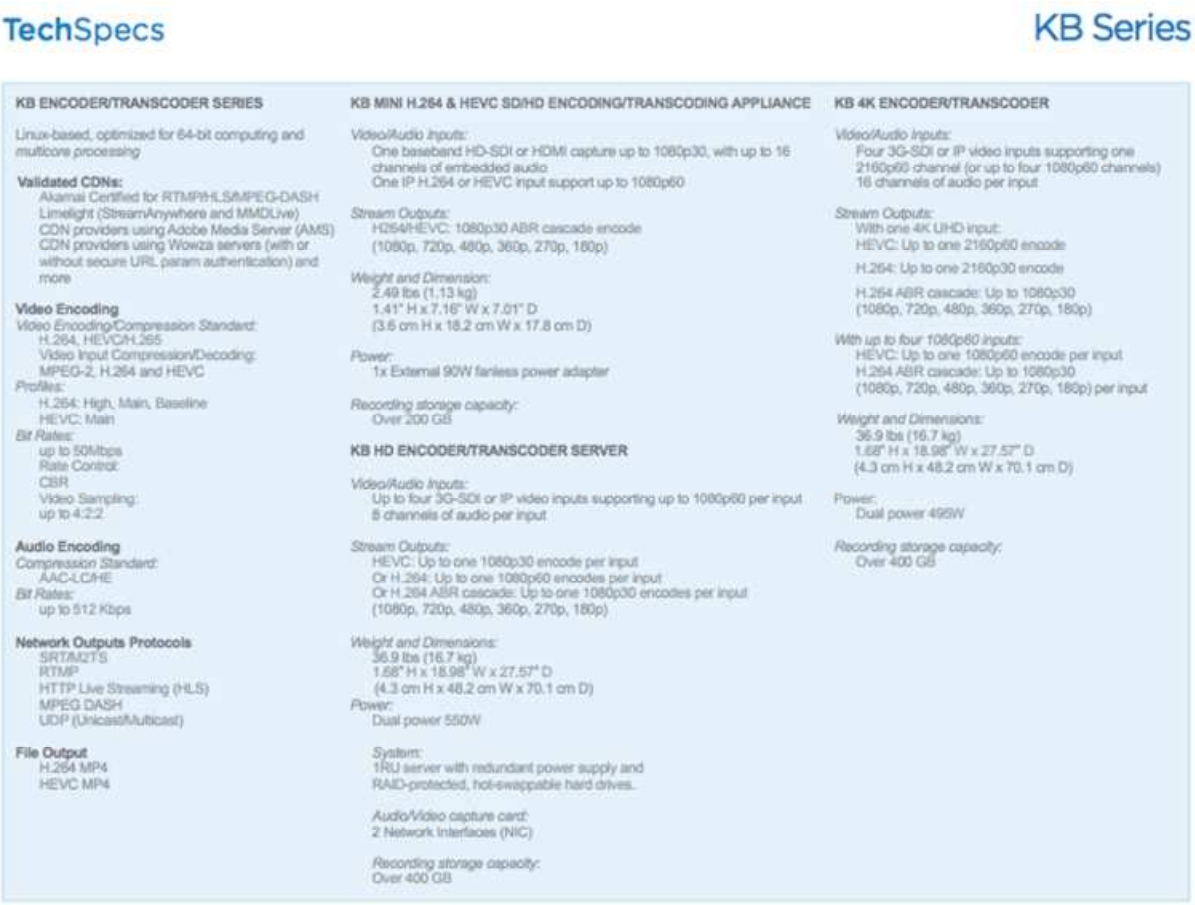

**Flexible Deployment Options** The KB Series offers flexible deployment and hardware acceleration options for every live event streaming scenario:

- The award-winning **KB Mini Encoder/Transcoder** is a portable all-in-one H.264/HEVC encoder, ideal for live event streaming from anywhere with an internet connection. Leveraging Intel CPU and GPU hybrid processing to deliver H.264/HEVC cascades up to 1080p, the KB Mini gives you big power in a small form factor appliance.
- A rackmountable server, the **KB Encoder/Transcoder Server** features redundant power supplies, RAID configurations and support for up to four 1080p video input channels. The KB Encoder/Transcoder Server is ideal for enterprise-grade internet streaming and fits within your existing enterprise infrastructure.
- The **KB 4K Encoder/Transcoder** has all the benefits of the KB Encoder/Transcoder Server, with hardware accelerated HEVC encoding to fuel the highest quality streaming events, supporting up to 4K **H.264**/HEVC viewing experiences with the ability to capture 4K/UHD 2160p over 1x 12G-SDI or 4x 3G-SDI interfaces.

http://www3.haivision.com/Datasheet_KB:

83. One page of the datasheet for Haivision's KB Series also shows H.264 being used for numerous applications, such as: for a "KB Mini" model device ("KB MINI H.264 & HEVD SD/HD ENCODING/TRANSCODING APPLIANCE"), for an IP "input support up to 1080p60" ("One IP H.264 or HEVC input support up to 1080p60"), for "Stream Outputs" that are "Up to one 2160p30 encode" ("H.264: Up to one 2160p30 encode") and for an "ABR cascade: Up to 1080p30" ("H.264: Up to 1080p30") (also

"With up to four 1080p60 inputs"), for "Video Encoding," a "Video Encoding/Compression Standard" ("H.264, HEVC/H.265" and "MPEG-2, H.264 and HEVC"), a "Profile" ("H.264: High, Main, Baseline"), and for the "Stream Outputs" of the "KB HD ENCODER/TRANSCODER SERVER", also "Up to one 1080p60 encodes per input" ("Or H.264: Up to one 1080p60 encodes per input") and for an an H.264 "ABR cascade," "Up to one 1080p30 encodes per input" ("Or H.264 ABR cascade: Up to



TechSpecs KB Series

KB ENCODER/TRANSCODER SERIES

Linux-based, optimized for 64-bit computing and multicore processing

Validated CDNs:
Akamai Certified for RTMP/HLS/MPEG-DASH
Limelight (StreamAnywhere and MMDLive)
CDN providers using Adobe Media Server (AMS)
CDN providers using Wowza servers (with or without secure URL param authentication) and more

Video Encoding
Video Encoding/Compression Standard:
H.264, HEVC/H.265
Video Input Compression/Decoding:
MPEG-2, H.264 and HEVC
Profiles:
H.264: High, Main, Baseline
HEVC: Main
Bit Rates:
up to 50Mbps
Rate Control:
CBR
Video Sampling:
up to 4:2:2

Audio Encoding
Compression Standard:
AAC-LC/HE
Bit Rates:
up to 512 Kbps

Network Outputs Protocols
SRT/M2TS
RTMP
HTTP Live Streaming (HLS)
MPEG DASH
UDP (Unicast/Multicast)

File Output
H.264 MP4
HEVC MP4

KB MINI H.264 & HEVC SD/HD ENCODING/TRANSCODING APPLIANCE

Video/Audio Inputs:
One baseband HD-SDI or HDMI capture up to 1080p30, with up to 16 channels of embedded audio
One IP H.264 or HEVC input support up to 1080p60

Stream Outputs:
H264/HEVC: 1080p30 ABR cascade encode
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimension:
2.49 lbs (1.13 kg)
1.41" H x 7.16" W x 7.01" D
(3.6 cm H x 18.2 cm W x 17.8 cm D)

Power:
1x External 90W fanless power adapter

Recording storage capacity:
Over 200 GB

KB HD ENCODER/TRANSCODER SERVER

Video/Audio Inputs:
Up to four 3G-SDI or IP video inputs supporting up to 1080p60 per input
8 channels of audio per input

Stream Outputs:
HEVC: Up to one 1080p30 encode per input
Or H.264: Up to one 1080p60 encodes per input
Or H.264 ABR cascade: Up to one 1080p30 encodes per input
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

Power:
Dual power 550W

System:
1RU server with redundant power supply and RAID-protected, hot-swappable hard drives.

Audio/Video capture card:
2 Network Interfaces (NIC)

Recording storage capacity:
Over 400 GB

KB 4K ENCODER/TRANSCODER

Video/Audio Inputs:
Four 3G-SDI or IP video inputs supporting one 2160p60 channel (or up to four 1080p60 channels)
16 channels of audio per input

Stream Outputs:
With one 4K UHD input:
HEVC: Up to one 2160p60 encode
H.264: Up to one 2160p30 encode
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p)

With up to four 1080p60 inputs:
HEVC: Up to one 1080p60 encode per input
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p) per input

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

Power:
Dual power 495W

Recording storage capacity:
Over 400 GB

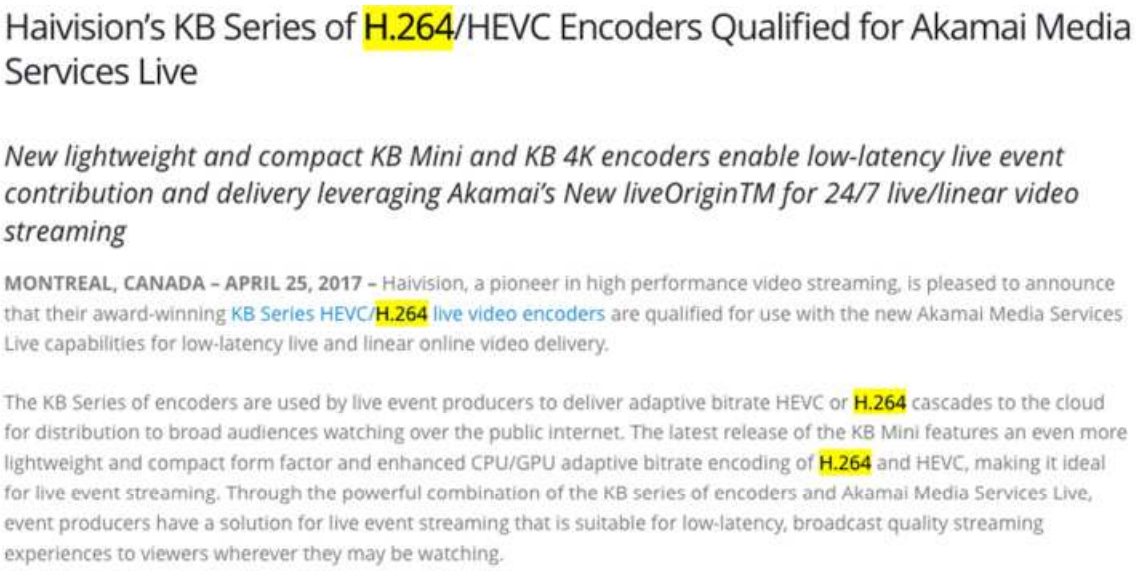
one 1080p30 encodes per input") and finally as a "File Output" form ("H.264/MP4"). *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

84. It also appears that all or most variations or different models of the Haivision KB product utilize H.264, as can be seen by this below listing of the "KB Product Portfolio & Ordering Information." *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

**KB Product Portfolio & Ordering Information ****

| | | |
|---|---|---|
| KB Mini H.264 & HEVC SD/HD Encoding/Transcoding Appliance | S-KB-SFF2-1 | 1 baseband capture up to 1080p30 or 1 IP input up to 1080p60 |
| KB Encoder/Transcoder Server | S-KB-1/2/4 | KB Enterprise Class H.264 & HEVC SD/HD |
| KB 4K Encoder/Transcoder | S-KB-4 | KB Enterprise Class UHD Encoding/Transcoding Appliance |
| KB Mini Server Rack - Single Unit | RU-SFF-1 | Rack mount for single KB Mini appliance |
| KB Mini Server Rack - Dual Unit | RU-SFF-2 | Rack mount for two KB Mini appliances |

85. The Haivision KB Series also appears to be an "award-winning" HEVC.H.264 live video encoder for Haivision, as can be seen by this recent press release available at https://www.haivision.com/about/press-releases/haivisions-kb-series-h-264hevc-encoders-qualified-akamai-media-services-live/:



Haivision's KB Series of H.264/HEVC Encoders Qualified for Akamai Media Services Live

*New lightweight and compact KB Mini and KB 4K encoders enable low-latency live event contribution and delivery leveraging Akamai's New liveOriginTM for 24/7 live/linear video streaming*

**MONTREAL, CANADA – APRIL 25, 2017 –** Haivision, a pioneer in high performance video streaming, is pleased to announce that their award-winning KB Series HEVC/H.264 live video encoders are qualified for use with the new Akamai Media Services Live capabilities for low-latency live and linear online video delivery.

The KB Series of encoders are used by live event producers to deliver adaptive bitrate HEVC or H.264 cascades to the cloud for distribution to broad audiences watching over the public internet. The latest release of the KB Mini features an even more lightweight and compact form factor and enhanced CPU/GPU adaptive bitrate encoding of H.264 and HEVC, making it ideal for live event streaming. Through the powerful combination of the KB series of encoders and Akamai Media Services Live, event producers have a solution for live event streaming that is suitable for low-latency, broadcast quality streaming experiences to viewers wherever they may be watching.

86. The Accused Instrumentalities determine a parameter of at least a portion of a video data block. As shown below, examples of such parameters include bitrate (or

max video bitrate) and resolution parameters. Different parameters correspond with different end applications. H.264 provides for multiple different ranges of such parameters, each included in the "profiles" and "levels" defined by the H.264 standard. *See* http://www.axis.com/files/whitepaper/wp_h264_31669_en_0803_lo.pdf at 5:

**4. H.264 profiles and levels**

The joint group involved in defining H.264 focused on creating a simple and clean solution, limiting options and features to a minimum. An important aspect of the standard, as with other video standards, is providing the capabilities in profiles (sets of algorithmic features) and levels (performance classes) that optimally support popular productions and common formats.

H.264 has seven profiles, each targeting a specific class of applications. Each profile defines what feature set the encoder may use and limits the decoder implementation complexity.

Network cameras and video encoders will most likely use a profile called the baseline profile, which is intended primarily for applications with limited computing resources. The baseline profile is the most suitable given the available performance in a real-time encoder that is embedded in a network video product. The profile also enables low latency, which is an important requirement of surveillance video and also particularly important in enabling real-time, pan/tilt/zoom (PTZ) control in PTZ network cameras.

H.264 has 11 levels or degree of capability to limit performance, bandwidth and memory requirements. Each level defines the bit rate and the encoding rate in macroblock per second for resolutions ranging from QCIF to HDTV and beyond. The higher the resolution, the higher the level required.

*See* https://en.wikipedia.org/wiki/H.264/MPEG-4_AVC:

Levels with maximum property values

| Level | Max decoding speed | | Max frame size | | Max video bit rate for video coding layer (VCL) kbit/s | | | Examples for high resolution @ highest frame rate (max stored frames) Toggle additional details |
|---|---|---|---|---|---|---|---|---|
| | Luma samples/s | Macroblocks/s | Luma samples | Macroblocks | Baseline, Extended and Main Profiles | High Profile | High 10 Profile | |
| 1 | 380,160 | 1,485 | 25,344 | 99 | 64 | 80 | 192 | 176×144@15.0 (4) |
| 1b | 380,160 | 1,485 | 25,344 | 99 | 128 | 160 | 384 | 176×144@15.0 (4) |
| 1.1 | 768,000 | 3,000 | 101,376 | 396 | 192 | 240 | 576 | 352×288@7.5 (2) |
| 1.2 | 1,536,000 | 6,000 | 101,376 | 396 | 384 | 480 | 1,152 | 352×288@15.2 (6) |
| 1.3 | 3,041,280 | 11,880 | 101,376 | 396 | 768 | 960 | 2,304 | 352×288@30.0 (6) |
| 2 | 3,041,280 | 11,880 | 101,376 | 396 | 2,000 | 2,500 | 6,000 | 352×288@30.0 (6) |
| 2.1 | 5,068,800 | 19,800 | 202,752 | 792 | 4,000 | 5,000 | 12,000 | 352×576@25.0 (6) |
| 2.2 | 5,184,000 | 20,250 | 414,720 | 1,620 | 4,000 | 5,000 | 12,000 | 720×576@12.5 (5) |
| 3 | 10,368,000 | 40,500 | 414,720 | 1,620 | 10,000 | 12,500 | 30,000 | 720×576@25.0 (5) |
| 3.1 | 27,648,000 | 108,000 | 921,600 | 3,600 | 14,000 | 17,500 | 42,000 | 1,280×720@30.0 (5) |
| 3.2 | 55,296,000 | 216,000 | 1,310,720 | 5,120 | 20,000 | 25,000 | 60,000 | 1,280×1,024@42.2 (4) |
| 4 | 62,914,560 | 245,760 | 2,097,152 | 8,192 | 20,000 | 25,000 | 60,000 | 2,048×1,024@30.0 (4) |
| 4.1 | 62,914,560 | 245,760 | 2,097,152 | 8,192 | 50,000 | 62,500 | 150,000 | 2,048×1,024@30.0 (4) |
| 4.2 | 133,693,440 | 522,240 | 2,228,224 | 8,704 | 50,000 | 62,500 | 150,000 | 2,048×1,080@60.0 (4) |
| 5 | 150,994,944 | 589,824 | 5,652,480 | 22,080 | 135,000 | 168,750 | 405,000 | 3,672×1,536@26.7 (5) |
| 5.1 | 251,658,240 | 983,040 | 9,437,184 | 36,864 | 240,000 | 300,000 | 720,000 | 4,096×2,304@26.7 (5) |
| 5.2 | 530,841,600 | 2,073,600 | 9,437,184 | 36,864 | 240,000 | 300,000 | 720,000 | 4,096×2,304@56.3 (5) |

87. A video data block is organized by the group of pictures (GOP) structure, which is a "collection of successive pictures within a coded video stream." *See* https://en.wikipedia.org/wiki/Group_of_pictures. A GOP structure can contain intra coded pictures (I picture or I frame), predictive coded pictures (P picture or P frame), bipredictive coded pictures (B picture or B frame) and direct coded pictures (D picture or D frames, or DC direct coded pictures which are used only in MPEG-1 video). *See* https://en.wikipedia.org/wiki/Video_compression_picture_types (for descriptions of I frames, P frames and B frames); https://en.wikipedia.org/wiki/MPEG-1#D-frames (for descriptions of D frames). Thus, at least a portion of a video data block would also make up a GOP structure and could also contain I frames, P frames, B frames and/or D frames. The GOP structure also reflects the size of a video data block, and the GOP structure can be controlled and used to fine-tune other parameters (*e.g.* bitrate, max video bitrate and resolution parameters) or even be considered as a parameter by itself.

88. Based on the bitrate and/or resolution parameter identified (*e.g.* bitrate, max video bitrate, resolution, GOP structure or frame type within a GOP structure), any H.264-compliant system such as the Accused Instrumentalities would determine which profile (*e.g.*, "baseline," "extended," "main", or "high") corresponds with that parameter, then select between at least two asymmetric compressors. If baseline or extended is the corresponding profile, then the system will select a Context-Adaptive Variable Length Coding ("CAVLC") entropy encoder. If main or high is the corresponding profile, then the system will select a Context-Adaptive Binary Arithmetic Coding ("CABAC") entropy encoder. Both encoders are asymmetric compressors because it takes a longer period of time for them to compress data than to decompress data. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

| | Baseline | Extended | Main | High | High 10 |
|---|---|---|---|---|---|
| I and P Slices | Yes | Yes | Yes | Yes | Yes |
| B Slices | No | Yes | Yes | Yes | Yes |
| SI and SP Slices | No | Yes | No | No | No |
| Multiple Reference Frames | Yes | Yes | Yes | Yes | Yes |
| In-Loop Deblocking Filter | Yes | Yes | Yes | Yes | Yes |
| CAVLC Entropy Coding | Yes | Yes | Yes | Yes | Yes |
| CABAC Entropy Coding | No | No | Yes | Yes | Yes |
| Flexible Macroblock Ordering (FMO) | Yes | Yes | No | No | No |
| Arbitrary Slice Ordering (ASO) | Yes | Yes | No | No | No |
| Redundant Slices (RS) | Yes | Yes | No | No | No |
| Data Partitioning | No | Yes | No | No | No |
| Interlaced Coding (PicAFF, MBAFF) | No | Yes | Yes | Yes | Yes |
| 4:2:0 Chroma Format | Yes | Yes | Yes | Yes | Yes |
| Monochrome Video Format (4:0:0) | No | No | No | Yes | Yes |
| 4:2:2 Chroma Format | No | No | No | No | No |
| 4:4:4 Chroma Format | No | No | No | No | No |
| 8 Bit Sample Depth | Yes | Yes | Yes | Yes | Yes |
| 9 and 10 Bit Sample Depth | No | No | No | No | Yes |
| 11 to 14 Bit Sample Depth | No | No | No | No | No |
| 8×8 vs. 4×4 Transform Adaptivity | No | No | No | Yes | Yes |
| Quantization Scaling Matrices | No | No | No | Yes | Yes |
| Separate Cb and Cr QP control | No | No | No | Yes | Yes |
| Separate Color Plane Coding | No | No | No | No | No |
| Predictive Lossless Coding | No | No | No | No | No |

*See* http://web.cs.ucla.edu/classes/fall03/cs218/paper/H.264_MPEG4_Tutorial.pdf at 7:

The following table summarizes the two major types of entropy coding: Variable Length Coding (VLC) and Context Adaptive Binary Arithmetic Coding (CABAC). CABAC offers superior coding efficiency over VLC by adapting to the changing probability distribution of symbols, by exploiting correlation between symbols, and by adaptively exploiting bit correlations using arithmetic coding. H.264 also supports Context Adaptive Variable Length Coding (CAVLC) which offers superior entropy coding over VLC without the full cost of CABAC.

**H.264 Entropy Coding – Comparison of Approaches**

| Characteristics | Variable Length Coding (VLC) | Context Adaptive Binary Arithmetic Coding(CABAC) |
|---|---|---|
| • Where it is used | MPEG-2, MPEG-4 ASP | H.264/MPEG-4 AVC (high efficiency option) |
| • Probability distribution | **Static** - Probabilities never change | **Adaptive** - Adjusts probabilities based on actual data |
| • Leverages correlation between symbols | **No** - Conditional probabilities ignored | **Yes** - Exploits symbol correlations by using "contexts" |
| • Non-integer code words | **No** - Low coding efficiency forhigh probability symbols | **Yes** - Exploits "arithmetic coding" which generates non-integer code words for higher efficiency |

Moreover, the H.264 Standard requires a bit-flag descriptor, which is set to determine the correct decoder for the corresponding encoder. As shown below, if the flag = 0, then CAVLC must have been selected as the encoder; if the flag = 1, then CABAC must have been selected as the encoder. *See* https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-H.264-201304-S!!PDF-E&type=items (Rec. ITU-T H.264 (04/2013)) at 80:

**entropy_coding_mode_flag** selects the entropy decoding method to be applied for the syntax elements for which two descriptors appear in the syntax tables as follows:

- If entropy_coding_mode_flag is equal to 0, the method specified by the left descriptor in the syntax table is applied (Exp-Golomb coded, see clause 9.1 or CAVLC, see clause 9.2).
- Otherwise (entropy_coding_mode_flag is equal to 1), the method specified by the right descriptor in the syntax table is applied (CABAC, see clause 9.3).

89. The Accused Instrumentalities compress the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks, which can be organized in a GOP structure (see above). After its selection, the asymmetric compressor (CAVLC or CABAC) will compress the video

data to provide various compressed data blocks, which can also be organized in a GOP structure. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

**Entropy Coding**

For entropy coding, H.264 may use an enhanced VLC, a more complex context-adaptive variable-length coding (CAVLC) or an ever more complex Context-adaptive binary-arithmetic coding (CABAC) which are complex techniques to losslessly compress syntax elements in the video stream knowing the probabilities of syntax elements in a given context. The use of CABAC can improve the compression of around 5-7%. CABAC may requires a 30-40% of total processing power to be accomplished.

*See*

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.602.1581&rep=rep1&type=pdf

at 13:

Typical compression ratios to maintain excellent quality are:

- 10:1 for general images using JPEG
- 30:1 for general video using H.263 and MPEG-2
- 60:1 for general video using H.264 and WMV9

*See* http://www.ijera.com/papers/Vol3_issue4/BM34399403.pdf at 2:

Most visual communication systems today use Baseline Profile. Baseline is the simplest H.264 profile and defines, for example, zigzag scanning of the picture and using 4:2:0 (YUV video formats) chrominance sampling. In Baseline Profile, the picture is split in blocks consisting of 4x4 pixels, and each block is processed separately. Another important element of the Baseline Profile is the use of Universal Variable Length Coding (UVLC) and Context Adaptive Variable Length Coding (CAVLC) entropy coding techniques.

The Extended and Main Profiles includes the functionality of the Baseline Profile and add improvements to the predictions algorithms. Since transmitting every single frame (think 30 frames per second for good quality video) is not feasible if you are trying to reduce the bit rate 1000-2000 times, temporal and motion prediction are heavily used in H.264, and allow transmitting only the difference between one frame and the previous frames. The result is spectacular efficiency gain, especially for scenes with little change and motion.

The High Profile is the most powerful profile in H.264, and it allows most efficient coding of video. For example, large coding gain achieved through the use of Context Adaptive Binary Arithmetic Coding (CABAC) encoding which is more efficient than the UVLC/CAVLC used in Baseline Profile.

The High Profile also uses adaptive transform that decides on the fly if 4x4 or 8x8-pixel blocks should be used. For example, 4x4 blocks are used for the parts of the picture that are dense with detail, while parts that have little detail are transformed using 8x8 blocks.

90. On information and belief, the Accused Instrumentalities store at least a portion of the one or more compressed data blocks in buffers, hard disk, or other forms of memory/storage.

91. On information and belief, Defendants also directly infringe and continue to infringe other claims of the ’442 patent, for similar reasons as explained above with respect to Claim 8 of the ’442 patent.

92. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, *e.g.*, in the manner specified in the H.264 standard.

93. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods claimed by the ’442 patent.

94. On information and belief, Defendants have had knowledge of the ’442 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendants knew of the ’442 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendants will have known and intended (since receiving such notice) that its continued actions would actively induce and contribute to the infringement of the claims of the ’442 patent.

95. Upon information and belief, Defendants’ affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, *e.g.*, through training, demonstrations, brochures, installation and user guides, have induced and continue to induce users of the Accused Instrumentalities to use them in their normal and

customary way to infringe the ’442 patent by practicing an apparatus, comprising: a data decompression system configured to decompress a compressed data block; and a storage medium configured to store at least a portion of the decompressed data block, wherein at least a portion of a data block having video or audio data was compressed with one or more compression algorithms selected from among a plurality of compression algorithms based upon a throughput of a communication channel and a parameter or an attribute of the at least the portion of the data block to create at least the compressed data block, and wherein at least one of the plurality of compression algorithms is asymmetric. For example, Defendants adopted H.264 in their encoder devices and streaming services. For similar reasons, Defendants also induce their customers to use the Accused Instrumentalities to infringe other claims of the ’442 patent. Defendants specifically intended and were aware that these normal and customary activities would infringe the ’442 patent. Defendants performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the ’442 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendants engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendants have induced and continue to induce users of the Accused Instrumentalities to use the Accused Instrumentalities in their ordinary and customary way to infringe the ’442 patent, knowing that such use constitutes infringement of the ’442 patent. Accordingly, Defendants have been, and currently are, inducing infringement of the ’442 patent, in violation of 35 U.S.C. § 271(b).

96. Defendants have also infringed, and continue to infringe, claims of the ’442 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process, or using the systems, of the ’442 patent, and constitute a material part of the invention. Defendants know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the ’442 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendants have been, and currently are, contributorily infringing the ’442 patent, in violation of 35 U.S.C. § 271(c).

97. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the Accused Instrumentalities’ compression features, Defendants have injured Realtime and are liable to Realtime for infringement of the ’442 patent pursuant to 35 U.S.C. § 271.

98. As a result of Defendants’ infringement of the ’442 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendants’ infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendants, together with interest and costs as fixed by the Court.

## COUNT IV

## INFRINGEMENT OF U.S. PATENT NO. 9,762,907

99. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

100. Plaintiff Realtime is the owner by assignment of United States Patent No.

9,762,907 ("the '907 patent") entitled "System and methods for video and audio data distribution." The '907 patent was duly and legally issued by the United States Patent and Trademark Office on September 12, 2017. A true and correct copy of the '907 patent is included as Exhibit D.

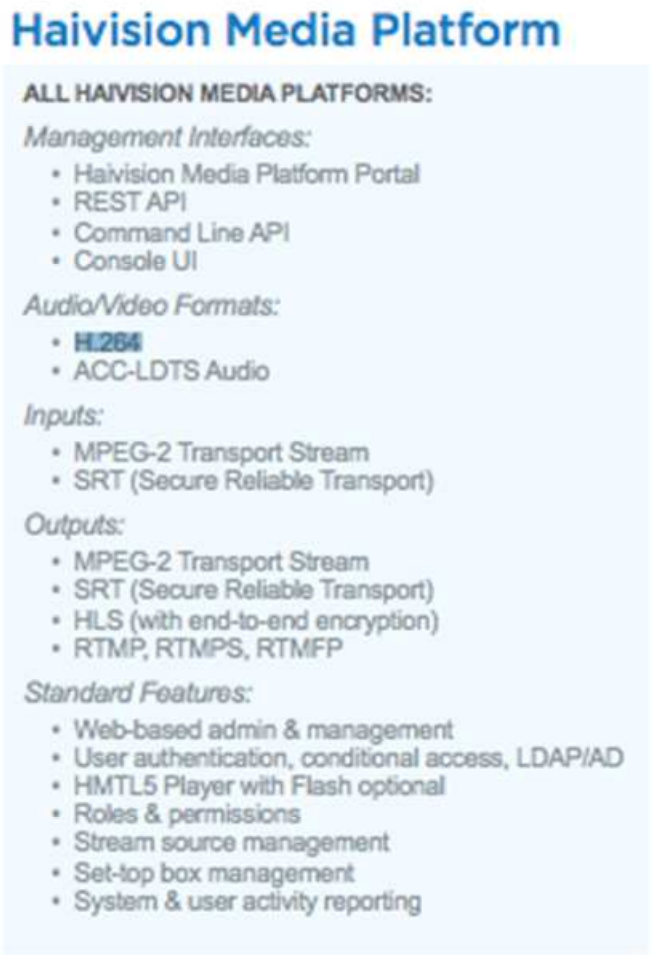
101. On information and belief, Defendants have made, used, offered for sale, sold and/or imported into the United States products that infringe the '907 patent, and continue to do so. By way of illustrative example, these infringing products include, without limitation, Defendants' video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the '907 patent ("Accused Instrumentalities").

102. On information and belief, Defendants have directly infringed and continue to infringe the '907 patent, for example, through its own use and testing of the Accused Instrumentalities, which when used, practices the system claimed by Claim 1 of the '907 patent, namely, a system comprising: one or more different asymmetric data compression algorithms, wherein each algorithm of the one or more different asymmetric data compression algorithms utilizes one or more asymmetric data compression routines of a plurality of different asymmetric data compression routines, wherein a first asymmetric data compression routine of the plurality of different asymmetric data

compression routines is configured to produce compressed data with a higher data rate for a given data throughput than a second asymmetric data compression routine of the plurality of different asymmetric data compression routines; and a processor configured: to analyze one or more data parameters from one or more data blocks containing video data, wherein at least one data parameter relates to an expected or anticipated throughput of a communications channel; and to select two or more different data compression routines from among a plurality of different data compression routines based upon, at least in part, the one or more data parameters relating to the expected or anticipated throughput of the communications channel. Upon information and belief, Defendants use the Accused Instrumentalities to practice infringing methods for their own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

103. For example, the Accused Instrumentalities utilize the H.264 video compression standard, as well as Secure Reliable Transport (SRT) technology. "SRT detects the real-time network performance between the encode / decode / transcode endpoints. The endpoints can be dynamically adjusted for optimal stream performance and quality." *See, e.g.*, https://www.haivision.com/products/srt-secure-reliable-transport/. At least Haivision's Makito X and KB series devices use H.264 and SRT. *Id.* On information and belief, all of the Accused Instrumentalities detect real-time network performance between the encode / decode / transcode endpoints and dynamically select a compression technique for optimal stream performance.

104. Furthermore, as can be seen by the highlighted text in the below graphic, "All Haivision Media Platforms" support "H.264" as an "Audio/Video Format". *See*




page 7/8 of the datasheet available at http://www3.haivision.com/hmp-datasheet:

105. In addition, from this below webpage listing a Haivision product, "Haivision's award-winning Makito X H.264 encoder transports secure, low latency HD video over any network at extremely low bitrates, making it ideal for live, interactive and bandwidth constrained applications." *See* https://www.haivision.com/products/makito-series/makito-x-h264/ (with "H.264 encoder" being highlighted):


106. This portion of the datasheet also shows that Haivision's Makito X "supports High Profile H.264 encoding." *See* page 1/2 of the datasheet available at


http://www3.haivision.com/datasheet-makito-x:

107. Further portions of the datasheet show that the Haivision Makito X has among its features the ability to perform "Highly efficient encoding" at "Up to twice the quality or half of the bandwidth, using High Profile H.264." *See* page 1/2 of the

| Features | Benefits |
|---|---|
| Low end-to-end latency | Supports mission-critical distribution and interactive communication challenge |
| 4 HD encoding engines | Flexible encoding & compression, adapting to different network environments & applications |
| Multiple destinations per stream | Target different systems, networks, users, and platforms individually |
| Highly efficient encoding | Up to twice the quality or half of the bandwidth, using High Profile H.264 |
| 12 HD 1080p60 channels in 1RU | Highest density available reducing cost, footprint, and energy consumption |
| AES 256 bit encryption | Secure unicast or multicast end-to-end video distribution |
| Metadata support | Insert synchronized KLV into the MPEG stream from IP, embedded, or serial data sources |
| SRT and FEC | Maintain video quality over unqualified networks and low cost public internet connections |
| Integrated with Furnace, InStream and CoolSign | Complete end-to-end video solution |

datasheet available at http://www3.haivision.com/datasheet-makito-x:

108. Additional portions of the datasheet show that the Haivision Makito X has technical specifications that use H.264 for both "VIDEO ENCODING/DECODING" and "IP NETWORK INTERFACES." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

**VIDEO ENCODING/DECODING**
*Compression Standard:*
H.264 (MPEG-4 AVC part 10)
ISO/IEC 14496-10
Baseline, Main, and High Profiles
Up to Level 4.2 and lower intermediate levels
I, IP, IBP, IBBP framing
Configurable Group of Picture (GOP) size
Configurable frame rate
Region of Interest Coding
*Bit Rates:*
SD/HD from 32 kbps to 25 Mbps
*Rate Control:*
CBR/VBR
*Latency (encoder only):*
Less than 55ms

**IP NETWORK INTERFACES**
*Standard:*
Ethernet 10/100/1000 Base-T, auto-detect, Half/Full-duplex
Static IP/DHCP
*Connector:*
RJ45
*Networking Protocols:*
Unicast streaming
Multicast streaming (IGMP v3)
Multiple unicast streaming
MPEG transport stream over UDP / RTP
RTMP
SAP (RFC 2974)
Direct RTP - H.264 over RTP (RFC 3984)
SRT (Secure Reliable Transport)

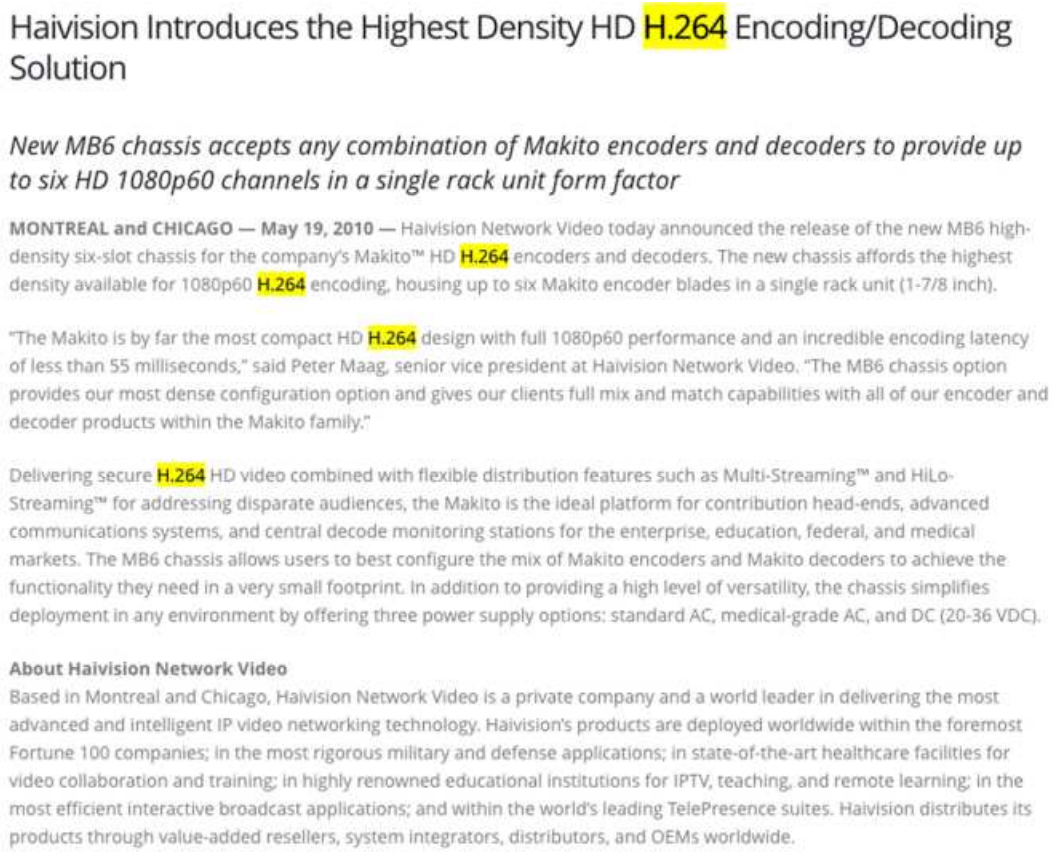
109. It also appears that all variations or different models of the Haivision Makito X product utilize H.264, as can be seen by this below listing of the "Makito X Product Portfolio & Ordering Information." *See* page 2/2 of the datasheet available at

**Makito X Product Portfolio & Ordering Information ****

| | | |
|---|---|---|
| Makito X Single SDI | S/B-292E-HDSDI1 | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single 3G/HD/SD-SDI and Composite channel |
| Makito X Dual SDI | S/B-292E-HDSDI2 | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting dual 3G/HD/SD-SDI and Composite channels |
| Makito X DVI | S/B-292E-DVI | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single channel DVI-I or Component |
| Makito X Decoder Single Channel | S/B-292D-HD1 | Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting single channel 3G/HD/SD-SDI and HDMI |
| Makito X Decoder Dual Channel | S/B-292D-HD2 | Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting dual channel 3G/HD/SD-SDI and HDMI |

http://www3.haivision.com/datasheet-makito-x:

110. The Haivision Makito encoders are also known to be Haivision's hallmark streaming video encoders using H.264, as can be seen by this press release in 2010 (*See* https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-



## Haivision Introduces the Highest Density HD H.264 Encoding/Decoding Solution

*New MB6 chassis accepts any combination of Makito encoders and decoders to provide up to six HD 1080p60 channels in a single rack unit form factor*

**MONTREAL and CHICAGO — May 19, 2010 —** Haivision Network Video today announced the release of the new MB6 high-density six-slot chassis for the company's Makito™ HD H.264 encoders and decoders. The new chassis affords the highest density available for 1080p60 H.264 encoding, housing up to six Makito encoder blades in a single rack unit (1-7/8 inch).

"The Makito is by far the most compact HD H.264 design with full 1080p60 performance and an incredible encoding latency of less than 55 milliseconds," said Peter Maag, senior vice president at Haivision Network Video. "The MB6 chassis option provides our most dense configuration option and gives our clients full mix and match capabilities with all of our encoder and decoder products within the Makito family."

Delivering secure H.264 HD video combined with flexible distribution features such as Multi-Streaming™ and HiLo-Streaming™ for addressing disparate audiences, the Makito is the ideal platform for contribution head-ends, advanced communications systems, and central decode monitoring stations for the enterprise, education, federal, and medical markets. The MB6 chassis allows users to best configure the mix of Makito encoders and Makito decoders to achieve the functionality they need in a very small footprint. In addition to providing a high level of versatility, the chassis simplifies deployment in any environment by offering three power supply options: standard AC, medical-grade AC, and DC (20-36 VDC).

**About Haivision Network Video**
Based in Montreal and Chicago, Haivision Network Video is a private company and a world leader in delivering the most advanced and intelligent IP video networking technology. Haivision's products are deployed worldwide within the foremost Fortune 100 companies; in the most rigorous military and defense applications; in state-of-the-art healthcare facilities for video collaboration and training; in highly renowned educational institutions for IPTV, teaching, and remote learning; in the most efficient interactive broadcast applications; and within the world's leading TelePresence suites. Haivision distributes its products through value-added resellers, system integrators, distributors, and OEMs worldwide.

h-264-encodingdecoding-solution/):

111. Nonetheless, the Makito X is not the only encoder that Haivision has. By way of non-limiting example, Haivision also has the KB Series which clearly uses H.264, as can be seen by below (https://www.haivision.com/about/press-releases/haivision-

Encoders / Transcoders

KB Series

H.264, HEVC and 4K encoder and transcoder, on-premise or in the cloud, for internet streaming.

introduces-highest-density-hd-h-264-encodingdecoding-solution/):

*See* https://www.haivision.com/products/kb-series/:

**BEST VIEWING EXPERIENCE**

H.264 & HEVC Internet Media Encoders/Transcoders

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global internet audience. With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p.

These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/ MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

112. In addition, the datasheet for Haivision's KB series H.264 encoders make multiple mentions to using H.264 for "live event streaming" as can be seen by this

portion of the Haivision KB series datasheet. *See* page 1/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:


## H.264 & HEVC Internet Media Encoders/Transcoders for Powerful Live Event Streaming

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global Internet audience.

**Hardware Acceleration & ABR Cascades** The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or HEVC encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth savings offered by HEVC.

**Best Viewing Experience on Every Device** With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p. These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

**Get the Most Out of your Uplink Connection to the Cloud** When your internet connection at the source isn't very reliable, and bandwidth is limited, simply send your video streams to a transcoder in the cloud to take care of adaptive bitrate (ABR) distribution. With support for HEVC, the KB Series uses up to 50% less bandwidth than H.264. Additionally Haivision's SRT (Secure Reliable Transport) technology makes low-cost, readily available public internet connections secure and reliable for live video transport from the source to the cloud, getting the most out of your available uplink bandwidth.

| Features | Benefits |
|---|---|
| H.264/HEVC encoding/transcoding | High efficiency video compression over constrained networks for live events contribution |
| H.264/HEVC ABR Cascades | Seamless viewing experience at the player level with dynamic bitrate/resolution tuning |
| SRT protocol | AES encrypted, packet loss resilient live video transport from source encoder to cloud hosted transcoder |
| Extensive CDN Support | Ensure reliable streaming over Akamai, Limelight and other Adobe and Wowza based services |
| 608/708 closed captioning | Support digital television closed captioning standards |
| Small Form Factor (option) | High powered processing in a portable appliance with the KB Mini |
| 360-degree Virtual Reality (option) | Power virtual reality viewing experiences with the KB 4K |

113. There are also various other portions of the Haivision KB Series datasheet that mention the product's usage of H.264 and being able to provide a "H.264" viewing

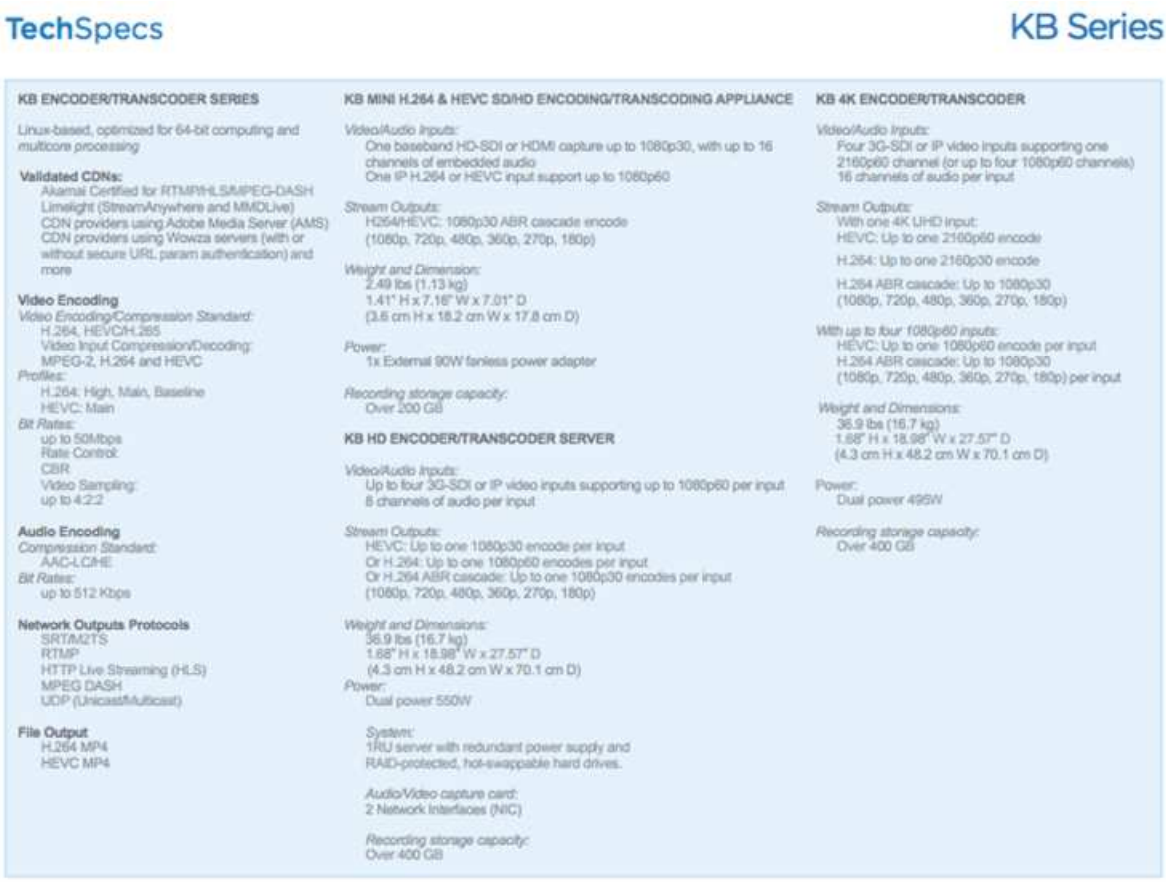
experience. *See* page 2/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:


**Flexible Deployment Options** The KB Series offers flexible deployment and hardware acceleration options for every live event streaming scenario:

- The award-winning **KB Mini Encoder/Transcoder** is a portable all-in-one H.264/HEVC encoder, ideal for live event streaming from anywhere with an internet connection. Leveraging Intel CPU and GPU hybrid processing to deliver H.264/HEVC cascades up to 1080p, the KB Mini gives you big power in a small form factor appliance.
- A rackmountable server, the **KB Encoder/Transcoder Server** features redundant power supplies, RAID configurations and support for up to four 1080p video input channels. The KB Encoder/Transcoder Server is ideal for enterprise-grade internet streaming and fits within your existing enterprise infrastructure.
- The **KB 4K Encoder/Transcoder** has all the benefits of the KB Encoder/Transcoder Server, with hardware accelerated HEVC encoding to fuel the highest quality streaming events, supporting up to 4K H.264/HEVC viewing experiences with the ability to capture 4K/UHD 2160p over 1x 12G-SDI or 4x 3G-SDI interfaces.

114. One page of the datasheet for Haivision's KB Series also shows H.264 being used for numerous applications, such as: for a "KB Mini" model device ("KB MINI H.264 & HEVD SD/HD ENCODING/TRANSCODING APPLIANCE"), for an IP "input support up to 1080p60" ("One IP H.264 or HEVC input support up to 1080p60"), for "Stream Outputs" that are "Up to one 2160p30 encode" ("H.264: Up to one 2160p30 encode") and for an "ABR cascade: Up to 1080p30" ("H.264: Up to 1080p30") (also "With up to four 1080p60 inputs"), for "Video Encoding," a "Video Encoding/Compression Standard" ("H.264, HEVC/H.265" and "MPEG-2, H.264 and HEVC"), a "Profile" ("H.264: High, Main, Baseline"), and for the "Stream Outputs" of

the "KB HD ENCODER/TRANSCODER SERVER", also "Up to one 1080p60 encodes



TechSpecs KB Series

KB ENCODER/TRANSCODER SERIES

Linux-based, optimized for 64-bit computing and multicore processing

Validated CDNs:
Akamai Certified for RTMP/HLS/MPEG-DASH
Limelight (StreamAnywhere and MMDLive)
CDN providers using Adobe Media Server (AMS)
CDN providers using Wowza servers (with or without secure URL param authentication) and more

Video Encoding
Video Encoding/Compression Standard:
H.264, HEVC/H.265
Video Input Compression/Decoding:
MPEG-2, H.264 and HEVC
Profiles:
H.264: High, Main, Baseline
HEVC: Main
Bit Rates:
up to 50Mbps
Rate Control:
CBR
Video Sampling:
up to 4:2:2

Audio Encoding
Compression Standard:
AAC-LC/HE
Bit Rates:
up to 512 Kbps

Network Outputs Protocols
SRT/M2TS
RTMP
HTTP Live Streaming (HLS)
MPEG DASH
UDP (Unicast/Multicast)

File Output
H.264 MP4
HEVC MP4

KB MINI H.264 & HEVC SD/HD ENCODING/TRANSCODING APPLIANCE

Video/Audio Inputs:
One baseband HD-SDI or HDMI capture up to 1080p30, with up to 16 channels of embedded audio
One IP H.264 or HEVC input support up to 1080p60

Stream Outputs:
H264/HEVC: 1080p30 ABR cascade encode
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimension:
2.49 lbs (1.13 kg)
1.41" H x 7.16" W x 7.01" D
(3.6 cm H x 18.2 cm W x 17.8 cm D)

Power:
1x External 90W fanless power adapter

Recording storage capacity:
Over 200 GB

KB HD ENCODER/TRANSCODER SERVER

Video/Audio Inputs:
Up to four 3G-SDI or IP video inputs supporting up to 1080p60 per input
8 channels of audio per input

Stream Outputs:
HEVC: Up to one 1080p30 encode per input
Or H.264: Up to one 1080p60 encodes per input
Or H.264 ABR cascade: Up to one 1080p30 encodes per input
(1080p, 720p, 480p, 360p, 270p, 180p)

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

Power:
Dual power 550W

System:
1RU server with redundant power supply and RAID-protected, hot-swappable hard drives.

Audio/Video capture card:
2 Network Interfaces (NIC)

Recording storage capacity:
Over 400 GB

KB 4K ENCODER/TRANSCODER

Video/Audio Inputs:
Four 3G-SDI or IP video inputs supporting one 2160p60 channel (or up to four 1080p60 channels)
16 channels of audio per input

Stream Outputs:
With one 4K UHD input:
HEVC: Up to one 2160p60 encode
H.264: Up to one 2160p30 encode
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p)

With up to four 1080p60 inputs:
HEVC: Up to one 1080p60 encode per input
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p) per input

Weight and Dimensions:
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

Power:
Dual power 495W

Recording storage capacity:
Over 400 GB

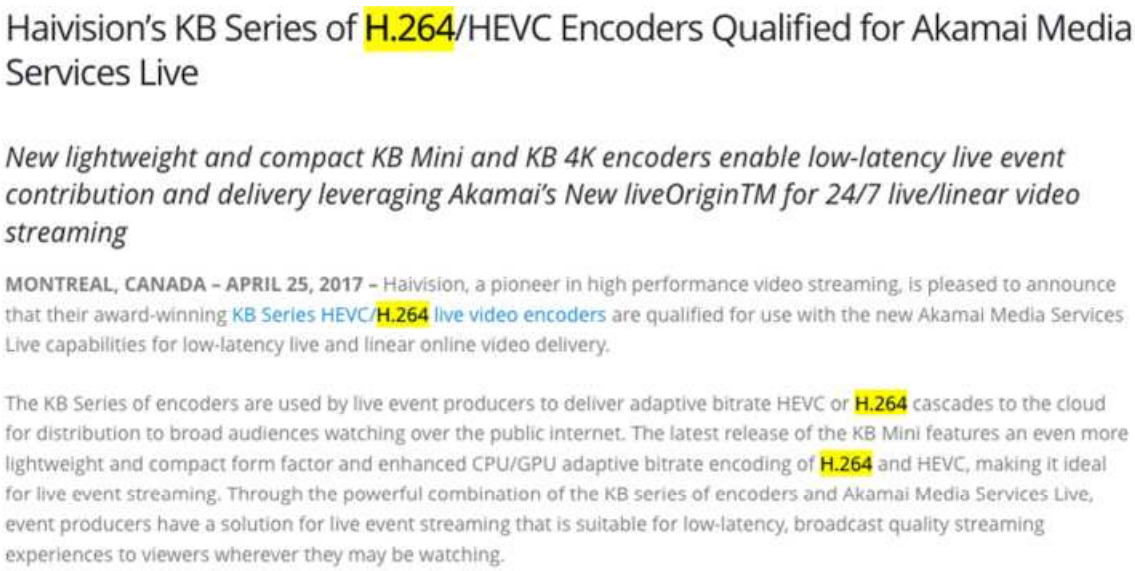
per input" ("Or H.264: Up to one 1080p60 encodes per input") and for an an H.264 "ABR cascade," "Up to one 1080p30 encodes per input" ("Or H.264 ABR cascade: Up to one 1080p30 encodes per input") and finally as a "File Output" form ("H.264/MP4"). *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

115. It also appears that all or most variations or different models of the Haivision KB product utilize H.264, as can be seen by this below listing of the "KB Product Portfolio & Ordering Information." *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

KB Product Portfolio & Ordering Information **

| | | |
|---|---|---|
| KB Mini H.264 & HEVC SD/HD Encoding/Transcoding Appliance | S-KB-SFF2-1 | 1 baseband capture up to 1080p30 or 1 IP input up to 1080p60 |
| KB Encoder/Transcoder Server | S-KB-1/2/4 | KB Enterprise Class H.264 & HEVC SD/HD |
| KB 4K Encoder/Transcoder | S-KB-4 | KB Enterprise Class UHD Encoding/Transcoding Appliance |
| KB Mini Server Rack - Single Unit | RU-SFF-1 | Rack mount for single KB Mini appliance |
| KB Mini Server Rack - Dual Unit | RU-SFF-2 | Rack mount for two KB Mini appliances |

116. The Haivision KB Series also appears to be an "award-winning" HEVC.H.264 live video encoder for Haivision, as can be seen by this recent press release available at https://www.haivision.com/about/press-releases/haivisions-kb-series-h-264hevc-encoders-qualified-akamai-media-services-live/:



Haivision's KB Series of H.264/HEVC Encoders Qualified for Akamai Media Services Live

*New lightweight and compact KB Mini and KB 4K encoders enable low-latency live event contribution and delivery leveraging Akamai's New liveOriginTM for 24/7 live/linear video streaming*

**MONTREAL, CANADA – APRIL 25, 2017 –** Haivision, a pioneer in high performance video streaming, is pleased to announce that their award-winning KB Series HEVC/H.264 live video encoders are qualified for use with the new Akamai Media Services Live capabilities for low-latency live and linear online video delivery.

The KB Series of encoders are used by live event producers to deliver adaptive bitrate HEVC or H.264 cascades to the cloud for distribution to broad audiences watching over the public internet. The latest release of the KB Mini features an even more lightweight and compact form factor and enhanced CPU/GPU adaptive bitrate encoding of H.264 and HEVC, making it ideal for live event streaming. Through the powerful combination of the KB series of encoders and Akamai Media Services Live, event producers have a solution for live event streaming that is suitable for low-latency, broadcast quality streaming experiences to viewers wherever they may be watching.

117. The Accused Instrumentalities determine a parameter of at least a portion of a video data block. As shown below, examples of such parameters include bitrate (or max video bitrate) and resolution parameters. Different parameters correspond with different end applications. H.264 provides for multiple different ranges of such parameters, each included in the "profiles" and "levels" defined by the H.264 standard. *See* http://www.axis.com/files/whitepaper/wp_h264_31669_en_0803_lo.pdf at 5:

**4. H.264 profiles and levels**

The joint group involved in defining H.264 focused on creating a simple and clean solution, limiting options and features to a minimum. An important aspect of the standard, as with other video standards, is providing the capabilities in profiles (sets of algorithmic features) and levels (performance classes) that optimally support popular productions and common formats.

H.264 has seven profiles, each targeting a specific class of applications. Each profile defines what feature set the encoder may use and limits the decoder implementation complexity.

Network cameras and video encoders will most likely use a profile called the baseline profile, which is intended primarily for applications with limited computing resources. The baseline profile is the most suitable given the available performance in a real-time encoder that is embedded in a network video product. The profile also enables low latency, which is an important requirement of surveillance video and also particularly important in enabling real-time, pan/tilt/zoom (PTZ) control in PTZ network cameras.

H.264 has 11 levels or degree of capability to limit performance, bandwidth and memory requirements. Each level defines the bit rate and the encoding rate in macroblock per second for resolutions ranging from QCIF to HDTV and beyond. The higher the resolution, the higher the level required.

*See* https://en.wikipedia.org/wiki/H.264/MPEG-4_AVC:

Levels with maximum property values

| Level | Max decoding speed | | Max frame size | | Max video bit rate for video coding layer (VCL) kbit/s | | | Examples for high resolution @ highest frame rate (max stored frames) |
|---|---|---|---|---|---|---|---|---|
| | Luma samples/s | Macroblocks/s | Luma samples | Macroblocks | Baseline, Extended and Main Profiles | High Profile | High 10 Profile | Toggle additional details |
| 1 | 380,160 | 1,485 | 25,344 | 99 | 64 | 80 | 192 | 176×144@15.0 (4) |
| 1b | 380,160 | 1,485 | 25,344 | 99 | 128 | 160 | 384 | 176×144@15.0 (4) |
| 1.1 | 768,000 | 3,000 | 101,376 | 396 | 192 | 240 | 576 | 352×288@7.5 (2) |
| 1.2 | 1,536,000 | 6,000 | 101,376 | 396 | 384 | 480 | 1,152 | 352×288@15.2 (6) |
| 1.3 | 3,041,280 | 11,880 | 101,376 | 396 | 768 | 960 | 2,304 | 352×288@30.0 (6) |
| 2 | 3,041,280 | 11,880 | 101,376 | 396 | 2,000 | 2,500 | 6,000 | 352×288@30.0 (6) |
| 2.1 | 5,068,800 | 19,800 | 202,752 | 792 | 4,000 | 5,000 | 12,000 | 352×576@25.0 (6) |
| 2.2 | 5,184,000 | 20,250 | 414,720 | 1,620 | 4,000 | 5,000 | 12,000 | 720×576@12.5 (5) |
| 3 | 10,368,000 | 40,500 | 414,720 | 1,620 | 10,000 | 12,500 | 30,000 | 720×576@25.0 (5) |
| 3.1 | 27,648,000 | 108,000 | 921,600 | 3,600 | 14,000 | 17,500 | 42,000 | 1,280×720@30.0 (5) |
| 3.2 | 55,296,000 | 216,000 | 1,310,720 | 5,120 | 20,000 | 25,000 | 60,000 | 1,280×1,024@42.2 (4) |
| 4 | 62,914,560 | 245,760 | 2,097,152 | 8,192 | 20,000 | 25,000 | 60,000 | 2,048×1,024@30.0 (4) |
| 4.1 | 62,914,560 | 245,760 | 2,097,152 | 8,192 | 50,000 | 62,500 | 150,000 | 2,048×1,024@30.0 (4) |
| 4.2 | 133,693,440 | 522,240 | 2,228,224 | 8,704 | 50,000 | 62,500 | 150,000 | 2,048×1,080@60.0 (4) |
| 5 | 150,994,944 | 589,824 | 5,652,480 | 22,080 | 135,000 | 168,750 | 405,000 | 3,672×1,536@26.7 (5) |
| 5.1 | 251,658,240 | 983,040 | 9,437,184 | 36,864 | 240,000 | 300,000 | 720,000 | 4,096×2,304@26.7 (5) |
| 5.2 | 530,841,600 | 2,073,600 | 9,437,184 | 36,864 | 240,000 | 300,000 | 720,000 | 4,096×2,304@56.3 (5) |

118. A video data block is organized by the group of pictures (GOP) structure, which is a "collection of successive pictures within a coded video stream." *See* https://en.wikipedia.org/wiki/Group_of_pictures. A GOP structure can contain intra

coded pictures (I picture or I frame), predictive coded pictures (P picture or P frame), bipredictive coded pictures (B picture or B frame) and direct coded pictures (D picture or D frames, or DC direct coded pictures which are used only in MPEG-1 video). *See* https://en.wikipedia.org/wiki/Video_compression_picture_types (for descriptions of I frames, P frames and B frames); https://en.wikipedia.org/wiki/MPEG-1#D-frames (for descriptions of D frames). Thus, at least a portion of a video data block would also make up a GOP structure and could also contain I frames, P frames, B frames and/or D frames. The GOP structure also reflects the size of a video data block, and the GOP structure can be controlled and used to fine-tune other parameters (*e.g.* bitrate, max video bitrate and resolution parameters) or even be considered as a parameter by itself.

119. Based on the bitrate and/or resolution parameter identified (*e.g.* bitrate, max video bitrate, resolution, GOP structure or frame type within a GOP structure), any H.264-compliant system such as the Accused Instrumentalities would determine which profile (*e.g.*, "baseline," "extended," "main", or "high") corresponds with that parameter, then select between at least two asymmetric compressors. If baseline or extended is the corresponding profile, then the system will select a Context-Adaptive Variable Length Coding ("CAVLC") entropy encoder. If main or high is the corresponding profile, then the system will select a Context-Adaptive Binary Arithmetic Coding ("CABAC") entropy encoder. Both encoders are asymmetric compressors because it takes a longer period of time for them to compress data than to decompress data. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

| | Baseline | Extended | Main | High | High 10 |
|---|---|---|---|---|---|
| I and P Slices | Yes | Yes | Yes | Yes | Yes |
| B Slices | No | Yes | Yes | Yes | Yes |
| SI and SP Slices | No | Yes | No | No | No |
| Multiple Reference Frames | Yes | Yes | Yes | Yes | Yes |
| In-Loop Deblocking Filter | Yes | Yes | Yes | Yes | Yes |
| CAVLC Entropy Coding | Yes | Yes | Yes | Yes | Yes |
| CABAC Entropy Coding | No | No | Yes | Yes | Yes |
| Flexible Macroblock Ordering (FMO) | Yes | Yes | No | No | No |
| Arbitrary Slice Ordering (ASO) | Yes | Yes | No | No | No |
| Redundant Slices (RS) | Yes | Yes | No | No | No |
| Data Partitioning | No | Yes | No | No | No |
| Interlaced Coding (PicAFF, MBAFF) | No | Yes | Yes | Yes | Yes |
| 4:2:0 Chroma Format | Yes | Yes | Yes | Yes | Yes |
| Monochrome Video Format (4:0:0) | No | No | No | Yes | Yes |
| 4:2:2 Chroma Format | No | No | No | No | No |
| 4:4:4 Chroma Format | No | No | No | No | No |
| 8 Bit Sample Depth | Yes | Yes | Yes | Yes | Yes |
| 9 and 10 Bit Sample Depth | No | No | No | No | Yes |
| 11 to 14 Bit Sample Depth | No | No | No | No | No |
| 8×8 vs. 4×4 Transform Adaptivity | No | No | No | Yes | Yes |
| Quantization Scaling Matrices | No | No | No | Yes | Yes |
| Separate Cb and Cr QP control | No | No | No | Yes | Yes |
| Separate Color Plane Coding | No | No | No | No | No |
| Predictive Lossless Coding | No | No | No | No | No |

*See* http://web.cs.ucla.edu/classes/fall03/cs218/paper/H.264_MPEG4_Tutorial.pdf at 7:

The following table summarizes the two major types of entropy coding: Variable Length Coding (VLC) and Context Adaptive Binary Arithmetic Coding (CABAC). CABAC offers superior coding efficiency over VLC by adapting to the changing probability distribution of symbols, by exploiting correlation between symbols, and by adaptively exploiting bit correlations using arithmetic coding. H.264 also supports Context Adaptive Variable Length Coding (CAVLC) which offers superior entropy coding over VLC without the full cost of CABAC.

**H.264 Entropy Coding – Comparison of Approaches**

| Characteristics | Variable Length Coding (VLC) | Context Adaptive Binary Arithmetic Coding(CABAC) |
|---|---|---|
| • Where it is used | MPEG-2, MPEG-4 ASP | H.264/MPEG-4 AVC (high efficiency option) |
| • Probability distribution | **Static** - Probabilities never change | **Adaptive** - Adjusts probabilities based on actual data |
| • Leverages correlation between symbols | **No** - Conditional probabilities ignored | **Yes** - Exploits symbol correlations by using "contexts" |
| • Non-integer code words | **No** - Low coding efficiency forhigh probability symbols | **Yes** - Exploits "arithmetic coding" which generates non-integer code words for higher efficiency |

Moreover, the H.264 Standard requires a bit-flag descriptor, which is set to determine the correct decoder for the corresponding encoder. As shown below, if the flag = 0, then CAVLC must have been selected as the encoder; if the flag = 1, then CABAC must have been selected as the encoder. *See* https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-H.264-201304-S!!PDF-E&type=items (Rec. ITU-T H.264 (04/2013)) at 80:

**entropy_coding_mode_flag** selects the entropy decoding method to be applied for the syntax elements for which two descriptors appear in the syntax tables as follows:

- If entropy_coding_mode_flag is equal to 0, the method specified by the left descriptor in the syntax table is applied (Exp-Golomb coded, see clause 9.1 or CAVLC, see clause 9.2).
- Otherwise (entropy_coding_mode_flag is equal to 1), the method specified by the right descriptor in the syntax table is applied (CABAC, see clause 9.3).

120. The Accused Instrumentalities compress the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks, which can be organized in a GOP structure (see above). After its selection, the asymmetric compressor (CAVLC or CABAC) will compress the video

data to provide various compressed data blocks, which can also be organized in a GOP structure. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

**Entropy Coding**

For entropy coding, H.264 may use an enhanced VLC, a more complex context-adaptive variable-length coding (CAVLC) or an ever more complex Context-adaptive binary-arithmetic coding (CABAC) which are complex techniques to losslessly compress syntax elements in the video stream knowing the probabilities of syntax elements in a given context. The use of CABAC can improve the compression of around 5-7%. CABAC may requires a 30-40% of total processing power to be accomplished.

*See*

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.602.1581&rep=rep1&type=pdf

at 13:

Typical compression ratios to maintain excellent quality are:

- 10:1 for general images using JPEG
- 30:1 for general video using H.263 and MPEG-2
- 60:1 for general video using H.264 and WMV9

*See* http://www.ijera.com/papers/Vol3_issue4/BM34399403.pdf at 2:

Most visual communication systems today use Baseline Profile. Baseline is the simplest H.264 profile and defines, for example, zigzag scanning of the picture and using 4:2:0 (YUV video formats) chrominance sampling. In Baseline Profile, the picture is split in blocks consisting of 4x4 pixels, and each block is processed separately. Another important element of the Baseline Profile is the use of Universal Variable Length Coding (UVLC) and Context Adaptive Variable Length Coding (CAVLC) entropy coding techniques.

The Extended and Main Profiles includes the functionality of the Baseline Profile and add improvements to the predictions algorithms. Since transmitting every single frame (think 30 frames per second for good quality video) is not feasible if you are trying to reduce the bit rate 1000-2000 times, temporal and motion prediction are heavily used in H.264, and allow transmitting only the difference between one frame and the previous frames. The result is spectacular efficiency gain, especially for scenes with little change and motion.

The High Profile is the most powerful profile in H.264, and it allows most efficient coding of video. For example, large coding gain achieved through the use of Context Adaptive Binary Arithmetic Coding (CABAC) encoding which is more efficient than the UVLC/CAVLC used in Baseline Profile.

The High Profile also uses adaptive transform that decides on the fly if 4x4 or 8x8-pixel blocks should be used. For example, 4x4 blocks are used for the parts of the picture that are dense with detail, while parts that have little detail are transformed using 8x8 blocks.

121. On information and belief, the Accused Instrumentalities store at least a portion of the one or more compressed data blocks in buffers, hard disk, or other forms of memory/storage.

122. On information and belief, Defendants also directly infringe and continue to infringe other claims of the ’907 patent, for similar reasons as explained above with respect to Claim 1 of the ’907 patent.

123. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, *e.g.*, in the manner specified in the H.264 standard.

124. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods claimed by the ’907 patent.

125. On information and belief, Defendants have had knowledge of the ’907 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendants knew of the ’907 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendants will have known and intended (since receiving such notice) that its continued actions would actively induce and contribute to the infringement of the claims of the ’907 patent.

126. Upon information and belief, Defendants’ affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, *e.g.*, through training, demonstrations, brochures, installation and user guides, have induced and continue to induce users of the Accused Instrumentalities to use them in their normal and

customary way to infringe the ’907 patent by practicing a system comprising: one or more different asymmetric data compression algorithms, wherein each algorithm of the one or more different asymmetric data compression algorithms utilizes one or more asymmetric data compression routines of a plurality of different asymmetric data compression routines, wherein a first asymmetric data compression routine of the plurality of different asymmetric data compression routines is configured to produce compressed data with a higher data rate for a given data throughput than a second asymmetric data compression routine of the plurality of different asymmetric data compression routines; and a processor configured: to analyze one or more data parameters from one or more data blocks containing video data, wherein at least one data parameter relates to an expected or anticipated throughput of a communications channel; and to select two or more different data compression routines from among a plurality of different data compression routines based upon, at least in part, the one or more data parameters relating to the expected or anticipated throughput of the communications channel. For example, Defendants adopted H.264 in their encoder devices and streaming services. For similar reasons, Defendants also induce their customers to use the Accused Instrumentalities to infringe other claims of the ’907 patent. Defendants specifically intended and were aware that these normal and customary activities would infringe the ’907 patent. Defendants performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the ’907 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendants engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendants have

induced and continue to induce users of the Accused Instrumentalities to use the Accused Instrumentalities in their ordinary and customary way to infringe the ’907 patent, knowing that such use constitutes infringement of the ’907 patent. Accordingly, Defendants have been, and currently are, inducing infringement of the ’907 patent, in violation of 35 U.S.C. § 271(b).

127. Defendants have also infringed, and continue to infringe, claims of the ’907 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process, or using the systems, of the ’907 patent, and constitute a material part of the invention. Defendants know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the ’907 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendants have been, and currently are, contributorily infringing the ’907 patent, in violation of 35 U.S.C. § 271(c).

128. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the Accused Instrumentalities’ compression features, Defendants have injured Realtime and are liable to Realtime for infringement of the ’907 patent pursuant to 35 U.S.C. § 271.

129. As a result of Defendants’ infringement of the ’907 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendants’ infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendants, together with interest and costs as fixed by the Court.

## COUNT V

## INFRINGEMENT OF U.S. PATENT NO. 7,386,046

130. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

131. Plaintiff Realtime is the owner by assignment of United States Patent No. 7,386,046 ("the '046 patent") entitled "Bandwidth sensitive data compression and decompression." The '046 patent was duly and legally issued by the United States Patent and Trademark Office on June 10, 2008. A true and correct copy of the '046 patent is included as Exhibit E.

132. On information and belief, Defendants have made, used, offered for sale, sold and/or imported into the United States products that infringe the '046 patent, and continue to do so. By way of illustrative example, these infringing products include, without limitation, Defendants' video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the '046 patent ("Accused Instrumentalities").

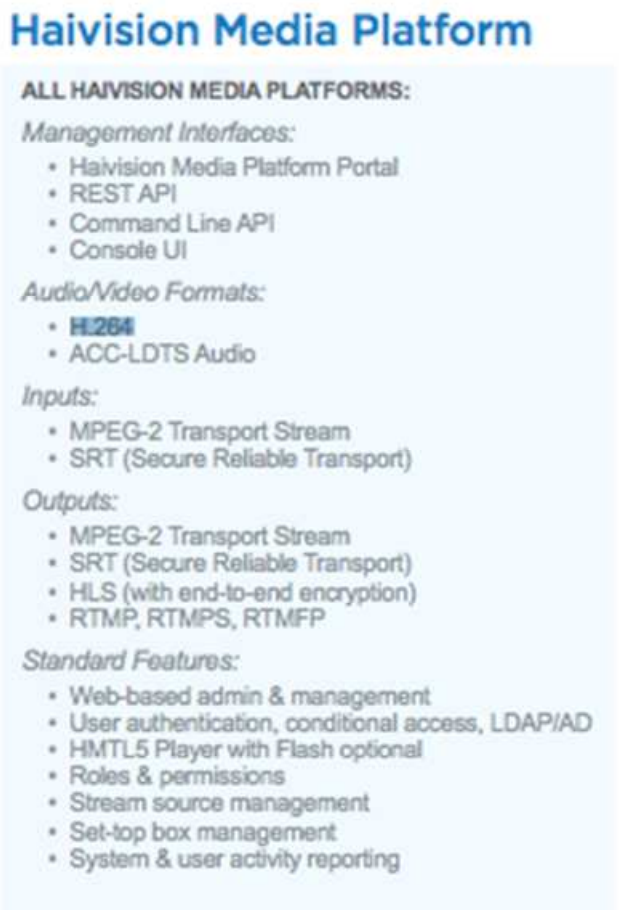
133. On information and belief, Defendants have directly infringed and continue to infringe the '046 patent, for example, through its own use and testing of the

Accused Instrumentalities, which when used, practices the system claimed by Claim 40 of the '046 patent, namely, a system, comprising: a data compression system for compressing and decompressing data input; a plurality of compression routines selectively utilized by the data compression system, wherein a first one of the plurality of compression routines includes a first compression algorithm and a second one of the plurality of compression routines includes a second compression algorithm; and a controller for tracking throughput and generating a control signal to select a compression routine based on the throughput, wherein said tracking throughput comprises tracking a number of pending access requests to a storage device; and wherein when the controller determines that the throughput falls below a predetermined throughput threshold, the controller commands the data compression engine to use one of the plurality of compression routines to provide a faster rate of compression so as to increase the throughput. Upon information and belief, Defendants use the Accused Instrumentalities to practice infringing methods for its own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

134. For example, the Accused Instrumentalities utilize the H.264 video compression standard, as well as Secure Reliable Transport (SRT) technology. "SRT detects the real-time network performance between the encode / decode / transcode endpoints. The endpoints can be dynamically adjusted for optimal stream performance and quality." *See, e.g.*, https://www.haivision.com/products/srt-secure-reliable-transport/. At least Haivision's Makito X and KB series devices use H.264 and SRT. *Id.* On information and belief, all of the Accused Instrumentalities detect real-time network

performance between the encode / decode / transcode endpoints and dynamically select a compression technique for optimal stream performance.

135. Furthermore, as can be seen by the highlighted text in the below graphic, "All Haivision Media Platforms" support "H.264" as an "Audio/Video Format". *See*



## Haivision Media Platform

**ALL HAIVISION MEDIA PLATFORMS:**

*Management Interfaces:*

- Haivision Media Platform Portal
- REST API
- Command Line API
- Console UI

*Audio/Video Formats:*

- H.264
- ACC-LDTS Audio

*Inputs:*

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)

*Outputs:*

- MPEG-2 Transport Stream
- SRT (Secure Reliable Transport)
- HLS (with end-to-end encryption)
- RTMP, RTMPS, RTMFP

*Standard Features:*

- Web-based admin & management
- User authentication, conditional access, LDAP/AD
- HMTL5 Player with Flash optional
- Roles & permissions
- Stream source management
- Set-top box management
- System & user activity reporting

page 7/8 of the datasheet available at http://www3.haivision.com/hmp-datasheet:

136. In addition, from this below webpage listing a Haivision product, "Haivision's award-winning Makito X H.264 encoder transports secure, low latency HD video over any network at extremely low bitrates, making it ideal for live, interactive and

bandwidth constrained applications." *See* https://www.haivision.com/products/makito-series/makito-x-h264/ (with "H.264 encoder" being highlighted):


137. This portion of the datasheet also shows that Haivision's Makito X "supports High Profile H.264 encoding." *See* page 1/2 of the datasheet available at


http://www3.haivision.com/datasheet-makito-x:

138. Further portions of the datasheet show that the Haivision Makito X has among its features the ability to perform "Highly efficient encoding" at "Up to twice the quality or half of the bandwidth, using High Profile H.264." *See* page 1/2 of the

| Features | Benefits |
|---|---|
| Low end-to-end latency | Supports mission-critical distribution and interactive communication challenge |
| 4 HD encoding engines | Flexible encoding & compression, adapting to different network environments & applications |
| Multiple destinations per stream | Target different systems, networks, users, and platforms individually |
| Highly efficient encoding | Up to twice the quality or half of the bandwidth, using High Profile H.264 |
| 12 HD 1080p60 channels in 1RU | Highest density available reducing cost, footprint, and energy consumption |
| AES 256 bit encryption | Secure unicast or multicast end-to-end video distribution |
| Metadata support | Insert synchronized KLV into the MPEG stream from IP, embedded, or serial data sources |
| SRT and FEC | Maintain video quality over unqualified networks and low cost public internet connections |
| Integrated with Furnace, InStream and CoolSign | Complete end-to-end video solution |

datasheet available at http://www3.haivision.com/datasheet-makito-x:

139. Additional portions of the datasheet show that the Haivision Makito X has technical specifications that use H.264 for both "VIDEO ENCODING/DECODING" and "IP NETWORK INTERFACES." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

**VIDEO ENCODING/DECODING**
*Compression Standard:*
H.264 (MPEG-4 AVC part 10)
ISO/IEC 14496-10
Baseline, Main, and High Profiles
Up to Level 4.2 and lower intermediate levels
I, IP, IBP, IBBP framing
Configurable Group of Picture (GOP) size
Configurable frame rate
Region of Interest Coding
*Bit Rates:*
SD/HD from 32 kbps to 25 Mbps
*Rate Control:*
CBR/VBR
*Latency (encoder only):*
Less than 55ms

**IP NETWORK INTERFACES**
*Standard:*
Ethernet 10/100/1000 Base-T, auto-detect, Half/Full-duplex
Static IP/DHCP
*Connector:*
RJ45
*Networking Protocols:*
Unicast streaming
Multicast streaming (IGMP v3)
Multiple unicast streaming
MPEG transport stream over UDP / RTP
RTMP
SAP (RFC 2974)
Direct RTP - H.264 over RTP (RFC 3984)
SRT (Secure Reliable Transport)

140. It also appears that all variations or different models of the Haivision Makito X product utilize H.264, as can be seen by this below listing of the "Makito X Product Portfolio & Ordering Information." *See* page 2/2 of the datasheet available at http://www3.haivision.com/datasheet-makito-x:

**Makito X Product Portfolio & Ordering Information ****

| | | |
|---|---|---|
| Makito X Single SDI | S/B-292E-HDSDI1 | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single 3G/HD/SD-SDI and Composite channel |
| Makito X Dual SDI | S/B-292E-HDSDI2 | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting dual 3G/HD/SD-SDI and Composite channels |
| Makito X DVI | S/B-292E-DVI | Makito X Encoder Appliance (S) or Blade (B) HD H.264 IP video encoder supporting a single channel DVI-I or Component |
| Makito X Decoder Single Channel | S/B-292D-HD1 | Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting single channel 3G/HD/SD-SDI and HDMI |
| Makito X Decoder Dual Channel | S/B-292D-HD2 | Makito X Decoder Appliance (S) or Blade (B) HD H.264 IP Video decoder supporting dual channel 3G/HD/SD-SDI and HDMI |

141. The Haivision Makito encoders are also known to be Haivision's hallmark streaming video encoders using H.264, as can be seen by this press release in 2010 (*See* https://www.haivision.com/about/press-releases/haivision-introduces-highest-density-hd-

## Haivision Introduces the Highest Density HD H.264 Encoding/Decoding Solution

*New MB6 chassis accepts any combination of Makito encoders and decoders to provide up to six HD 1080p60 channels in a single rack unit form factor*

**MONTREAL and CHICAGO — May 19, 2010 —** Haivision Network Video today announced the release of the new MB6 high-density six-slot chassis for the company's Makito™ HD H.264 encoders and decoders. The new chassis affords the highest density available for 1080p60 H.264 encoding, housing up to six Makito encoder blades in a single rack unit (1-7/8 inch).

"The Makito is by far the most compact HD H.264 design with full 1080p60 performance and an incredible encoding latency of less than 55 milliseconds," said Peter Maag, senior vice president at Haivision Network Video. "The MB6 chassis option provides our most dense configuration option and gives our clients full mix and match capabilities with all of our encoder and decoder products within the Makito family."

Delivering secure H.264 HD video combined with flexible distribution features such as Multi-Streaming™ and HiLo-Streaming™ for addressing disparate audiences, the Makito is the ideal platform for contribution head-ends, advanced communications systems, and central decode monitoring stations for the enterprise, education, federal, and medical markets. The MB6 chassis allows users to best configure the mix of Makito encoders and Makito decoders to achieve the functionality they need in a very small footprint. In addition to providing a high level of versatility, the chassis simplifies deployment in any environment by offering three power supply options: standard AC, medical-grade AC, and DC (20-36 VDC).

**About Haivision Network Video**

Based in Montreal and Chicago, Haivision Network Video is a private company and a world leader in delivering the most advanced and intelligent IP video networking technology. Haivision's products are deployed worldwide within the foremost Fortune 100 companies; in the most rigorous military and defense applications; in state-of-the-art healthcare facilities for video collaboration and training; in highly renowned educational institutions for IPTV, teaching, and remote learning; in the most efficient interactive broadcast applications; and within the world's leading TelePresence suites. Haivision distributes its products through value-added resellers, system integrators, distributors, and OEMs worldwide.

h-264-encodingdecoding-solution/):

142. Nonetheless, the Makito X is not the only encoder that Haivision has. By way of non-limiting example, Haivision also has the KB Series which clearly uses H.264, as can be seen by below (https://www.haivision.com/about/press-releases/haivision-

Encoders / Transcoders

KB Series

H.264, HEVC and 4K encoder and transcoder, on-premise or in the cloud, for internet streaming.

introduces-highest-density-hd-h-264-encodingdecoding-solution/):

*See* https://www.haivision.com/products/kb-series/:

**BEST VIEWING EXPERIENCE**

H.264 & HEVC Internet Media Encoders/Transcoders

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global internet audience. With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p.

These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/ MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

143. In addition, the datasheet for Haivision's KB series H.264 encoders make multiple mentions to using H.264 for "live event streaming" as can be seen by this portion of the Haivision KB series datasheet. *See* page 1/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:


## H.264 & HEVC Internet Media Encoders/Transcoders for Powerful Live Event Streaming

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global Internet audience.

**Hardware Acceleration & ABR Cascades** The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or HEVC encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth savings offered by HEVC.

**Best Viewing Experience on Every Device** With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p. These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

**Get the Most Out of your Uplink Connection to the Cloud** When your internet connection at the source isn't very reliable, and bandwidth is limited, simply send your video streams to a transcoder in the cloud to take care of adaptive bitrate (ABR) distribution. With support for HEVC, the KB Series uses up to 50% less bandwidth than H.264. Additionally Haivision's SRT (Secure Reliable Transport) technology makes low-cost, readily available public internet connections secure and reliable for live video transport from the source to the cloud, getting the most out of your available uplink bandwidth.

| Features | Benefits |
|---|---|
| H.264/HEVC encoding/transcoding | High efficiency video compression over constrained networks for live events contribution |
| H.264/HEVC ABR Cascades | Seamless viewing experience at the player level with dynamic bitrate/resolution tuning |
| SRT protocol | AES encrypted, packet loss resilient live video transport from source encoder to cloud hosted transcoder |
| Extensive CDN Support | Ensure reliable streaming over Akamai, Limelight and other Adobe and Wowza based services |
| 608/708 closed captioning | Support digital television closed captioning standards |
| Small Form Factor (option) | High powered processing in a portable appliance with the KB Mini |
| 360-degree Virtual Reality (option) | Power virtual reality viewing experiences with the KB 4K |

144. There are also various other portions of the Haivision KB Series datasheet that mention the product's usage of H.264 and being able to provide a "H.264" viewing experience. *See* page 2/3 of the datasheet available at

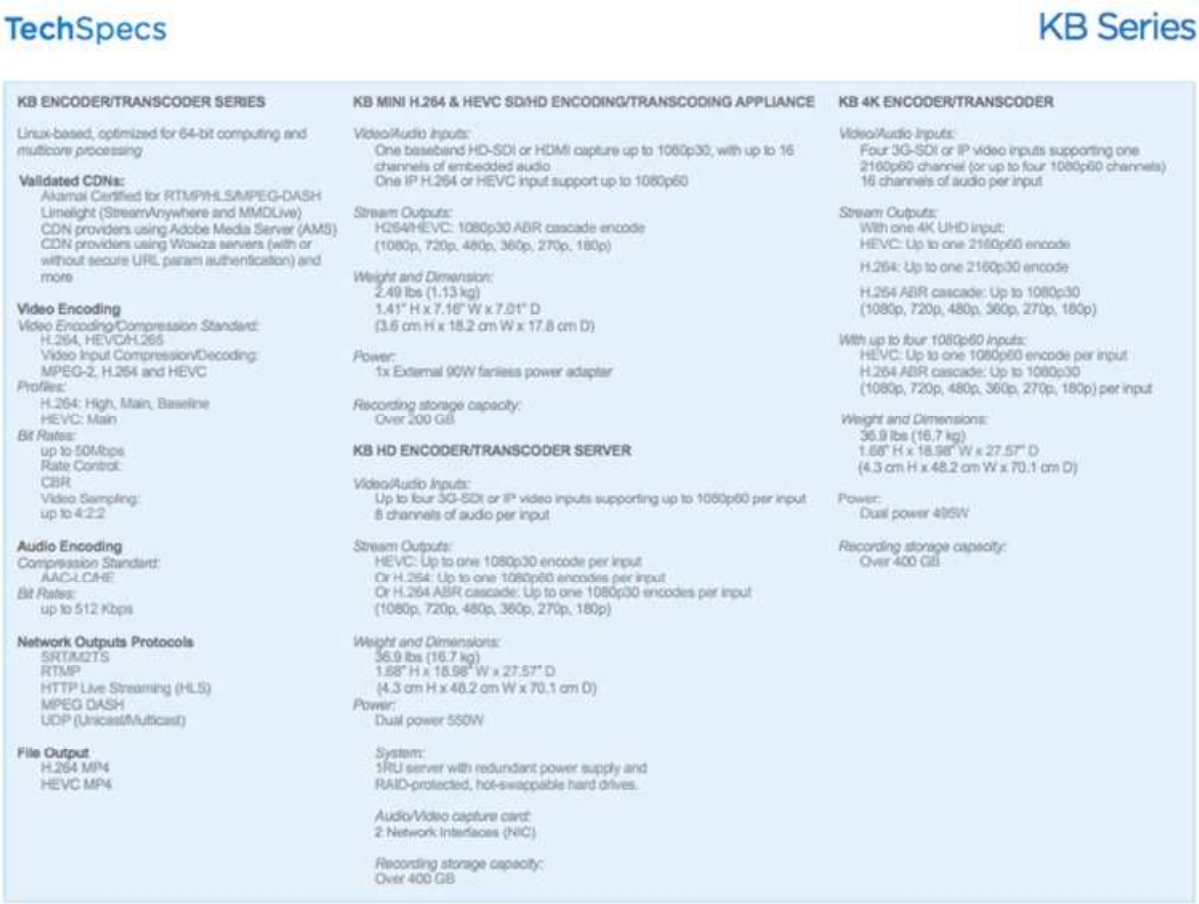

**Flexible Deployment Options** The KB Series offers flexible deployment and hardware acceleration options for every live event streaming scenario:

- The award-winning **KB Mini Encoder/Transcoder** is a portable all-in-one H.264/HEVC encoder, ideal for live event streaming from anywhere with an internet connection. Leveraging Intel CPU and GPU hybrid processing to deliver H.264/HEVC cascades up to 1080p, the KB Mini gives you big power in a small form factor appliance.
- A rackmountable server, the **KB Encoder/Transcoder Server** features redundant power supplies, RAID configurations and support for up to four 1080p video input channels. The KB Encoder/Transcoder Server is ideal for enterprise-grade internet streaming and fits within your existing enterprise infrastructure.
- The **KB 4K Encoder/Transcoder** has all the benefits of the KB Encoder/Transcoder Server, with hardware accelerated HEVC encoding to fuel the highest quality streaming events, supporting up to 4K **H.264**/HEVC viewing experiences with the ability to capture 4K/UHD 2160p over 1x 12G-SDI or 4x 3G-SDI interfaces.

http://www3.haivision.com/Datasheet_KB:

145. One page of the datasheet for Haivision's KB Series also shows H.264 being used for numerous applications, such as: for a "KB Mini" model device ("KB MINI H.264 & HEVD SD/HD ENCODING/TRANSCODING APPLIANCE"), for an IP "input support up to 1080p60" ("One IP H.264 or HEVC input support up to 1080p60"), for "Stream Outputs" that are "Up to one 2160p30 encode" ("H.264: Up to one 2160p30 encode") and for an "ABR cascade: Up to 1080p30" ("H.264: Up to 1080p30") (also

"With up to four 1080p60 inputs"), for "Video Encoding," a "Video Encoding/Compression Standard" ("H.264, HEVC/H.265" and "MPEG-2, H.264 and HEVC"), a "Profile" ("H.264: High, Main, Baseline"), and for the "Stream Outputs" of the "KB HD ENCODER/TRANSCODER SERVER", also "Up to one 1080p60 encodes per input" ("Or H.264: Up to one 1080p60 encodes per input") and for an an H.264 "ABR cascade," "Up to one 1080p30 encodes per input" ("Or H.264 ABR cascade: Up to one 1080p30 encodes per input") and finally as a "File Output" form ("H.264/MP4"). *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:



TechSpecs KB Series

**KB ENCODER/TRANSCODER SERIES**

Linux-based, optimized for 64-bit computing and multicore processing

**Validated CDNs:**
Akamai Certified for RTMP/HLS/MPEG-DASH
Limelight (StreamAnywhere and MMDLive)
CDN providers using Adobe Media Server (AMS)
CDN providers using Wowza servers (with or without secure URL param authentication) and more

**Video Encoding**
*Video Encoding/Compression Standard:*
H.264, HEVC/H.265
Video Input Compression/Decoding:
MPEG-2, H.264 and HEVC
*Profiles:*
H.264: High, Main, Baseline
HEVC: Main
*Bit Rates:*
up to 50Mbps
Rate Control:
CBR
Video Sampling:
up to 4:2:2

**Audio Encoding**
*Compression Standard:*
AAC-LC/HE
*Bit Rates:*
up to 512 Kbps

**Network Outputs Protocols**
SRT/M2TS
RTMP
HTTP Live Streaming (HLS)
MPEG DASH
UDP (Unicast/Multicast)

**File Output**
H.264 MP4
HEVC MP4

**KB MINI H.264 & HEVC SD/HD ENCODING/TRANSCODING APPLIANCE**

*Video/Audio Inputs:*
One baseband HD-SDI or HDMI capture up to 1080p30, with up to 16 channels of embedded audio
One IP H.264 or HEVC input support up to 1080p60

*Stream Outputs:*
H264/HEVC: 1080p30 ABR cascade encode
(1080p, 720p, 480p, 360p, 270p, 180p)

*Weight and Dimension:*
2.49 lbs (1.13 kg)
1.41" H x 7.16" W x 7.01" D
(3.6 cm H x 18.2 cm W x 17.8 cm D)

*Power:*
1x External 90W fanless power adapter

*Recording storage capacity:*
Over 200 GB

**KB HD ENCODER/TRANSCODER SERVER**

*Video/Audio Inputs:*
Up to four 3G-SDI or IP video inputs supporting up to 1080p60 per input
8 channels of audio per input

*Stream Outputs:*
HEVC: Up to one 1080p30 encode per input
Or H.264: Up to one 1080p60 encodes per input
Or H.264 ABR cascade: Up to one 1080p30 encodes per input
(1080p, 720p, 480p, 360p, 270p, 180p)

*Weight and Dimensions:*
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

*Power:*
Dual power 550W

*System:*
1RU server with redundant power supply and RAID-protected, hot-swappable hard drives.

*Audio/Video capture card:*
2 Network Interfaces (NIC)

*Recording storage capacity:*
Over 400 GB

**KB 4K ENCODER/TRANSCODER**

*Video/Audio Inputs:*
Four 3G-SDI or IP video inputs supporting one 2160p60 channel (or up to four 1080p60 channels)
16 channels of audio per input

*Stream Outputs:*
With one 4K UHD input:
HEVC: Up to one 2160p60 encode
H.264: Up to one 2160p30 encode
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p)

*With up to four 1080p60 inputs:*
HEVC: Up to one 1080p60 encode per input
H.264 ABR cascade: Up to 1080p30
(1080p, 720p, 480p, 360p, 270p, 180p) per input

*Weight and Dimensions:*
36.9 lbs (16.7 kg)
1.68" H x 18.98" W x 27.57" D
(4.3 cm H x 48.2 cm W x 70.1 cm D)

*Power:*
Dual power 495W

*Recording storage capacity:*
Over 400 GB

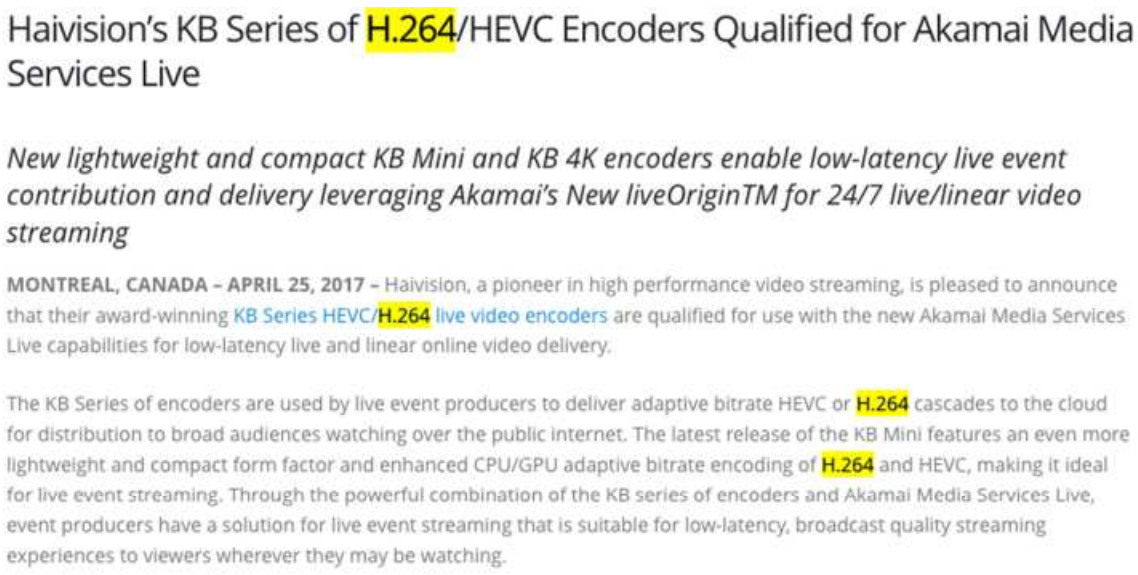
146. It also appears that all or most variations or different models of the Haivision KB product utilize H.264, as can be seen by this below listing of the "KB

**KB Product Portfolio & Ordering Information ****

| | | |
|---|---|---|
| KB Mini H.264 & HEVC SD/HD Encoding/Transcoding Appliance | S-KB-SFF2-1 | 1 baseband capture up to 1080p30 or 1 IP input up to 1080p60 |
| KB Encoder/Transcoder Server | S-KB-1/2/4 | KB Enterprise Class H.264 & HEVC SD/HD |
| KB 4K Encoder/Transcoder | S-KB-4 | KB Enterprise Class UHD Encoding/Transcoding Appliance |
| KB Mini Server Rack - Single Unit | RU-SFF-1 | Rack mount for single KB Mini appliance |
| KB Mini Server Rack - Dual Unit | RU-SFF-2 | Rack mount for two KB Mini appliances |

Product Portfolio & Ordering Information." *See* page 3/3 of the datasheet available at http://www3.haivision.com/Datasheet_KB:

147. The Haivision KB Series also appears to be an "award-winning" HEVC.H.264 live video encoder for Haivision, as can be seen by this recent press release available at https://www.haivision.com/about/press-releases/haivisions-kb-series-h-264hevc-encoders-qualified-akamai-media-services-live/:



Haivision's KB Series of H.264/HEVC Encoders Qualified for Akamai Media Services Live

*New lightweight and compact KB Mini and KB 4K encoders enable low-latency live event contribution and delivery leveraging Akamai's New liveOriginTM for 24/7 live/linear video streaming*

**MONTREAL, CANADA – APRIL 25, 2017 –** Haivision, a pioneer in high performance video streaming, is pleased to announce that their award-winning KB Series HEVC/H.264 live video encoders are qualified for use with the new Akamai Media Services Live capabilities for low-latency live and linear online video delivery.

The KB Series of encoders are used by live event producers to deliver adaptive bitrate HEVC or H.264 cascades to the cloud for distribution to broad audiences watching over the public internet. The latest release of the KB Mini features an even more lightweight and compact form factor and enhanced CPU/GPU adaptive bitrate encoding of H.264 and HEVC, making it ideal for live event streaming. Through the powerful combination of the KB series of encoders and Akamai Media Services Live, event producers have a solution for live event streaming that is suitable for low-latency, broadcast quality streaming experiences to viewers wherever they may be watching.

148. The Accused Instrumentalities determine a parameter of at least a portion of a video data block. As shown below, examples of such parameters include bitrate (or max video bitrate) and resolution parameters. Different parameters correspond with different end applications. H.264 provides for multiple different ranges of such parameters, each included in the "profiles" and "levels" defined by the H.264 standard. *See* http://www.axis.com/files/whitepaper/wp_h264_31669_en_0803_lo.pdf at 5:

### 4. H.264 profiles and levels

The joint group involved in defining H.264 focused on creating a simple and clean solution, limiting options and features to a minimum. An important aspect of the standard, as with other video standards, is providing the capabilities in profiles (sets of algorithmic features) and levels (performance classes) that optimally support popular productions and common formats.

H.264 has seven profiles, each targeting a specific class of applications. Each profile defines what feature set the encoder may use and limits the decoder implementation complexity.

Network cameras and video encoders will most likely use a profile called the baseline profile, which is intended primarily for applications with limited computing resources. The baseline profile is the most suitable given the available performance in a real-time encoder that is embedded in a network video product. The profile also enables low latency, which is an important requirement of surveillance video and also particularly important in enabling real-time, pan/tilt/zoom (PTZ) control in PTZ network cameras.

H.264 has 11 levels or degree of capability to limit performance, bandwidth and memory requirements. Each level defines the bit rate and the encoding rate in macroblock per second for resolutions ranging from QCIF to HDTV and beyond. The higher the resolution, the higher the level required.

*See* https://en.wikipedia.org/wiki/H.264/MPEG-4_AVC:

Levels with maximum property values

| Level | Max decoding speed | | Max frame size | | Max video bit rate for video coding layer (VCL) kbit/s | | | Examples for high resolution @ highest frame rate (max stored frames) |
|---|---|---|---|---|---|---|---|---|
| | Luma samples/s | Macroblocks/s | Luma samples | Macroblocks | Baseline, Extended and Main Profiles | High Profile | High 10 Profile | Toggle additional details |
| 1 | 380,160 | 1,485 | 25,344 | 99 | 64 | 80 | 192 | 176×144@15.0 (4) |
| 1b | 380,160 | 1,485 | 25,344 | 99 | 128 | 160 | 384 | 176×144@15.0 (4) |
| 1.1 | 768,000 | 3,000 | 101,376 | 396 | 192 | 240 | 576 | 352×288@7.5 (2) |
| 1.2 | 1,536,000 | 6,000 | 101,376 | 396 | 384 | 480 | 1,152 | 352×288@15.2 (6) |
| 1.3 | 3,041,280 | 11,880 | 101,376 | 396 | 768 | 960 | 2,304 | 352×288@30.0 (6) |
| 2 | 3,041,280 | 11,880 | 101,376 | 396 | 2,000 | 2,500 | 6,000 | 352×288@30.0 (6) |
| 2.1 | 5,068,800 | 19,800 | 202,752 | 792 | 4,000 | 5,000 | 12,000 | 352×576@25.0 (6) |
| 2.2 | 5,184,000 | 20,250 | 414,720 | 1,620 | 4,000 | 5,000 | 12,000 | 720×576@12.5 (5) |
| 3 | 10,368,000 | 40,500 | 414,720 | 1,620 | 10,000 | 12,500 | 30,000 | 720×576@25.0 (5) |
| 3.1 | 27,648,000 | 108,000 | 921,600 | 3,600 | 14,000 | 17,500 | 42,000 | 1,280×720@30.0 (5) |
| 3.2 | 55,296,000 | 216,000 | 1,310,720 | 5,120 | 20,000 | 25,000 | 60,000 | 1,280×1,024@42.2 (4) |
| 4 | 62,914,560 | 245,760 | 2,097,152 | 8,192 | 20,000 | 25,000 | 60,000 | 2,048×1,024@30.0 (4) |
| 4.1 | 62,914,560 | 245,760 | 2,097,152 | 8,192 | 50,000 | 62,500 | 150,000 | 2,048×1,024@30.0 (4) |
| 4.2 | 133,693,440 | 522,240 | 2,228,224 | 8,704 | 50,000 | 62,500 | 150,000 | 2,048×1,080@60.0 (4) |
| 5 | 150,994,944 | 589,824 | 5,652,480 | 22,080 | 135,000 | 168,750 | 405,000 | 3,672×1,536@26.7 (5) |
| 5.1 | 251,658,240 | 983,040 | 9,437,184 | 36,864 | 240,000 | 300,000 | 720,000 | 4,096×2,304@26.7 (5) |
| 5.2 | 530,841,600 | 2,073,600 | 9,437,184 | 36,864 | 240,000 | 300,000 | 720,000 | 4,096×2,304@56.3 (5) |

149. A video data block is organized by the group of pictures (GOP) structure, which is a "collection of successive pictures within a coded video stream." *See* https://en.wikipedia.org/wiki/Group_of_pictures. A GOP structure can contain intra

coded pictures (I picture or I frame), predictive coded pictures (P picture or P frame), bipredictive coded pictures (B picture or B frame) and direct coded pictures (D picture or D frames, or DC direct coded pictures which are used only in MPEG-1 video). *See* https://en.wikipedia.org/wiki/Video_compression_picture_types (for descriptions of I frames, P frames and B frames); https://en.wikipedia.org/wiki/MPEG-1#D-frames (for descriptions of D frames). Thus, at least a portion of a video data block would also make up a GOP structure and could also contain I frames, P frames, B frames and/or D frames. The GOP structure also reflects the size of a video data block, and the GOP structure can be controlled and used to fine-tune other parameters (e.g. bitrate, max video bitrate and resolution parameters) or even be considered as a parameter by itself.

150. Based on the bitrate and/or resolution parameter identified (e.g. bitrate, max video bitrate, resolution, GOP structure or frame type within a GOP structure), any H.264-compliant system such as the Accused Instrumentalities would determine which profile (e.g., "baseline," "extended," "main", or "high") corresponds with that parameter, then select between at least two asymmetric compressors. If baseline or extended is the corresponding profile, then the system will select a Context-Adaptive Variable Length Coding ("CAVLC") entropy encoder. If main or high is the corresponding profile, then the system will select a Context-Adaptive Binary Arithmetic Coding ("CABAC") entropy encoder. Both encoders are asymmetric compressors because it takes a longer period of time for them to compress data than to decompress data. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

| | Baseline | Extended | Main | High | High 10 |
|---|---|---|---|---|---|
| I and P Slices | Yes | Yes | Yes | Yes | Yes |
| B Slices | No | Yes | Yes | Yes | Yes |
| SI and SP Slices | No | Yes | No | No | No |
| Multiple Reference Frames | Yes | Yes | Yes | Yes | Yes |
| In-Loop Deblocking Filter | Yes | Yes | Yes | Yes | Yes |
| CAVLC Entropy Coding | Yes | Yes | Yes | Yes | Yes |
| CABAC Entropy Coding | No | No | Yes | Yes | Yes |
| Flexible Macroblock Ordering (FMO) | Yes | Yes | No | No | No |
| Arbitrary Slice Ordering (ASO) | Yes | Yes | No | No | No |
| Redundant Slices (RS) | Yes | Yes | No | No | No |
| Data Partitioning | No | Yes | No | No | No |
| Interlaced Coding (PicAFF, MBAFF) | No | Yes | Yes | Yes | Yes |
| 4:2:0 Chroma Format | Yes | Yes | Yes | Yes | Yes |
| Monochrome Video Format (4:0:0) | No | No | No | Yes | Yes |
| 4:2:2 Chroma Format | No | No | No | No | No |
| 4:4:4 Chroma Format | No | No | No | No | No |
| 8 Bit Sample Depth | Yes | Yes | Yes | Yes | Yes |
| 9 and 10 Bit Sample Depth | No | No | No | No | Yes |
| 11 to 14 Bit Sample Depth | No | No | No | No | No |
| 8×8 vs. 4×4 Transform Adaptivity | No | No | No | Yes | Yes |
| Quantization Scaling Matrices | No | No | No | Yes | Yes |
| Separate Cb and Cr QP control | No | No | No | Yes | Yes |
| Separate Color Plane Coding | No | No | No | No | No |
| Predictive Lossless Coding | No | No | No | No | No |

*See* http://web.cs.ucla.edu/classes/fall03/cs218/paper/H.264_MPEG4_Tutorial.pdf at 7:

The following table summarizes the two major types of entropy coding: Variable Length Coding (VLC) and Context Adaptive Binary Arithmetic Coding (CABAC). CABAC offers superior coding efficiency over VLC by adapting to the changing probability distribution of symbols, by exploiting correlation between symbols, and by adaptively exploiting bit correlations using arithmetic coding. H.264 also supports Context Adaptive Variable Length Coding (CAVLC) which offers superior entropy coding over VLC without the full cost of CABAC.

**H.264 Entropy Coding – Comparison of Approaches**

| Characteristics | Variable Length Coding (VLC) | Context Adaptive Binary Arithmetic Coding(CABAC) |
|---|---|---|
| • Where it is used | MPEG-2, MPEG-4 ASP | H.264/MPEG-4 AVC (high efficiency option) |
| • Probability distribution | **Static** - Probabilities never change | **Adaptive** - Adjusts probabilities based on actual data |
| • Leverages correlation between symbols | **No** - Conditional probabilities ignored | **Yes** - Exploits symbol correlations by using "contexts" |
| • Non-integer code words | **No** - Low coding efficiency forhigh probability symbols | **Yes** - Exploits "arithmetic coding" which generates non-integer code words for higher efficiency |

Moreover, the H.264 Standard requires a bit-flag descriptor, which is set to determine the correct decoder for the corresponding encoder. As shown below, if the flag = 0, then CAVLC must have been selected as the encoder; if the flag = 1, then CABAC must have been selected as the encoder. *See* https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-H.264-201304-S!!PDF-E&type=items (Rec. ITU-T H.264 (04/2013)) at 80:

**entropy_coding_mode_flag** selects the entropy decoding method to be applied for the syntax elements for which two descriptors appear in the syntax tables as follows:

- If entropy_coding_mode_flag is equal to 0, the method specified by the left descriptor in the syntax table is applied (Exp-Golomb coded, see clause 9.1 or CAVLC, see clause 9.2).
- Otherwise (entropy_coding_mode_flag is equal to 1), the method specified by the right descriptor in the syntax table is applied (CABAC, see clause 9.3).

151. The Accused Instrumentalities compress the at least the portion of the data block with the selected one or more asymmetric compressors to provide one or more compressed data blocks, which can be organized in a GOP structure (see above). After its selection, the asymmetric compressor (CAVLC or CABAC) will compress the video

data to provide various compressed data blocks, which can also be organized in a GOP structure. *See* https://sonnati.wordpress.com/2007/10/29/how-h-264-works-part-ii/:

**Entropy Coding**

For entropy coding, H.264 may use an enhanced VLC, a more complex context-adaptive variable-length coding (CAVLC) or an ever more complex Context-adaptive binary-arithmetic coding (CABAC) which are complex techniques to losslessly compress syntax elements in the video stream knowing the probabilities of syntax elements in a given context. The use of CABAC can improve the compression of around 5-7%. CABAC may requires a 30-40% of total processing power to be accomplished.

*See*

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.602.1581&rep=rep1&type=pdf

at 13:

Typical compression ratios to maintain excellent quality are:

- 10:1 for general images using JPEG
- 30:1 for general video using H.263 and MPEG-2
- 60:1 for general video using H.264 and WMV9

*See* http://www.ijera.com/papers/Vol3_issue4/BM34399403.pdf at 2:

Most visual communication systems today use Baseline Profile. Baseline is the simplest H.264 profile and defines, for example, zigzag scanning of the picture and using 4:2:0 (YUV video formats) chrominance sampling. In Baseline Profile, the picture is split in blocks consisting of 4x4 pixels, and each block is processed separately. Another important element of the Baseline Profile is the use of Universal Variable Length Coding (UVLC) and Context Adaptive Variable Length Coding (CAVLC) entropy coding techniques.

The Extended and Main Profiles includes the functionality of the Baseline Profile and add improvements to the predictions algorithms. Since transmitting every single frame (think 30 frames per second for good quality video) is not feasible if you are trying to reduce the bit rate 1000-2000 times, temporal and motion prediction are heavily used in H.264, and allow transmitting only the difference between one frame and the previous frames. The result is spectacular efficiency gain, especially for scenes with little change and motion.

The High Profile is the most powerful profile in H.264, and it allows most efficient coding of video. For example, large coding gain achieved through the use of Context Adaptive Binary Arithmetic Coding (CABAC) encoding which is more efficient than the UVLC/CAVLC used in Baseline Profile.

The High Profile also uses adaptive transform that decides on the fly if 4x4 or 8x8-pixel blocks should be used. For example, 4x4 blocks are used for the parts of the picture that are dense with detail, while parts that have little detail are transformed using 8x8 blocks.

152. On information and belief, the Accused Instrumentalities store at least a portion of the one or more compressed data blocks in buffers, hard disk, or other forms of memory/storage.

153. On information and belief, Defendants also directly infringe and continue to infringe other claims of the ’046 patent, for similar reasons as explained above with respect to Claim 40 of the ’046 patent.

154. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, e.g., in the manner specified in the H.264 standard.

155. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods claimed by the ’046 patent.

156. On information and belief, Defendants have had knowledge of the ’046 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendants knew of the ’046 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendants will have known and intended (since receiving such notice) that its continued actions would actively induce and contribute to the infringement of the claims of the ’046 patent.

157. Upon information and belief, Defendants’ affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, *e.g.*, through training, demonstrations, brochures, installation and user guides, have induced and continue to induce users of the Accused Instrumentalities to use them in their normal and

customary way to infringe the ’046 patent by practicing a system, comprising: a data compression system for compressing and decompressing data input; a plurality of compression routines selectively utilized by the data compression system, wherein a first one of the plurality of compression routines includes a first compression algorithm and a second one of the plurality of compression routines includes a second compression algorithm; and a controller for tracking throughput and generating a control signal to select a compression routine based on the throughput, wherein said tracking throughput comprises tracking a number of pending access requests to a storage device; and wherein when the controller determines that the throughput falls below a predetermined throughput threshold, the controller commands the data compression engine to use one of the plurality of compression routines to provide a faster rate of compression so as to increase the throughput. For example, Defendants adopted H.264 in their encoder devices and streaming services. For similar reasons, Defendants also induce their customers to use the Accused Instrumentalities to infringe other claims of the ’046 patent. Defendants specifically intended and were aware that these normal and customary activities would infringe the ’046 patent. Defendants performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the ’046 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendants engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendants have induced and continue to induce users of the Accused Instrumentalities to use the Accused Instrumentalities in their ordinary and customary way to infringe the ’046 patent, knowing that such use constitutes infringement of the

’046 patent. Accordingly, Defendants have been, and currently are, inducing infringement of the ’046 patent, in violation of 35 U.S.C. § 271(b).

158. Defendants have also infringed, and continue to infringe, claims of the ’046 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process, or using the systems, of the ’046 patent, and constitute a material part of the invention. Defendants know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the ’046 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendants have been, and currently are, contributorily infringing the ’046 patent, in violation of 35 U.S.C. § 271(c).

159. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the Accused Instrumentalities’ compression features, Defendants have injured Realtime and are liable to Realtime for infringement of the ’046 patent pursuant to 35 U.S.C. § 271.

160. As a result of Defendants’ infringement of the ’046 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendants’ infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendants, together with interest and costs as fixed by the Court.

## COUNT VI

## INFRINGEMENT OF U.S. PATENT NO. 8,634,462

161. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

162. Plaintiff Realtime is the owner by assignment of United States Patent No. 8,634,462 ("the '462 patent") entitled "Quantization for Hybrid Video Coding." The '462 patent was duly and legally issued by the United States Patent and Trademark Office on January 21, 2014. A true and correct copy of the '462 patent is included as Exhibit F.

163. On information and belief, Defendants have made, used, offered for sale, sold and/or imported into the United States products that infringe the '462 patent, and continues to do so. By way of illustrative example, these infringing products include, without limitation, Defendants' video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the '462 patent ("Accused Instrumentalities").

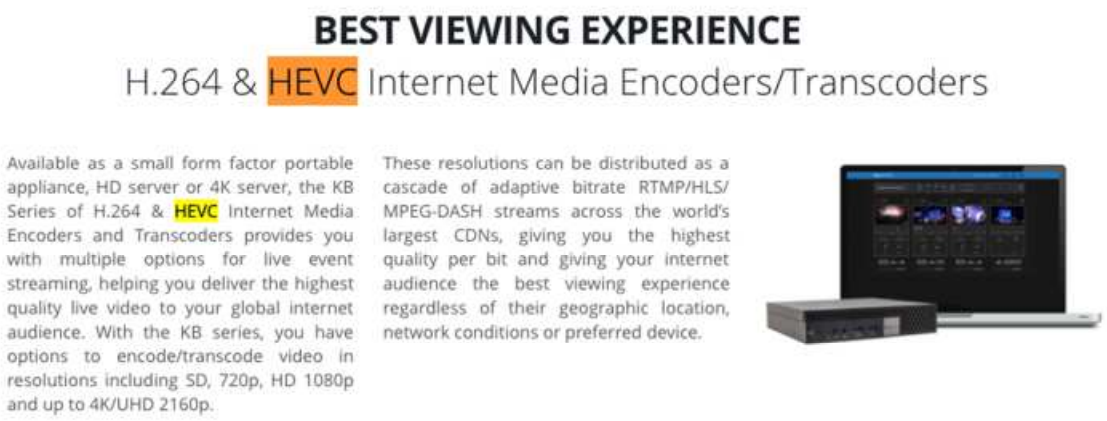
164. On information and belief, Defendants have directly infringed and continue to infringe the '462 patent, for example, through their own use and testing of the Accused Instrumentalities, which when used, practices the method claimed by Claim 1 of

the ’462 patent, namely, a method for coding a video signal using hybrid coding, comprising: reducing temporal redundancy by block based motion compensated prediction in order to establish a prediction error signal; performing quantization on samples of the prediction error signal or on coefficients resulting from a transformation of the prediction error signal into the frequency domain to obtain quantized values, representing quantized samples or quantized coefficients respectively, wherein the prediction error signal includes a plurality of subblocks each including a plurality of quantized values; calculating a first quantization efficiency for the quantized values of at least one subblock of the plurality of subblocks; setting the quantized values of the at least one subblock to all zeroes; calculating a second quantization efficiency for the at least one subblock while all of the quantized values are zeroes; selecting which of the first and second quantization efficiencies is a higher efficiency; and selecting, for further proceeding, the at least one subblock with the quantized values prior to setting the quantized values of the at least one subblock to all zeroes if the first quantization efficiency is higher and selecting the at least one subblock with the quantized values set to zero, for further proceeding, if the second quantization efficiency is higher. Upon information and belief, Defendants use the Accused Instrumentalities to practice infringing methods for their own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

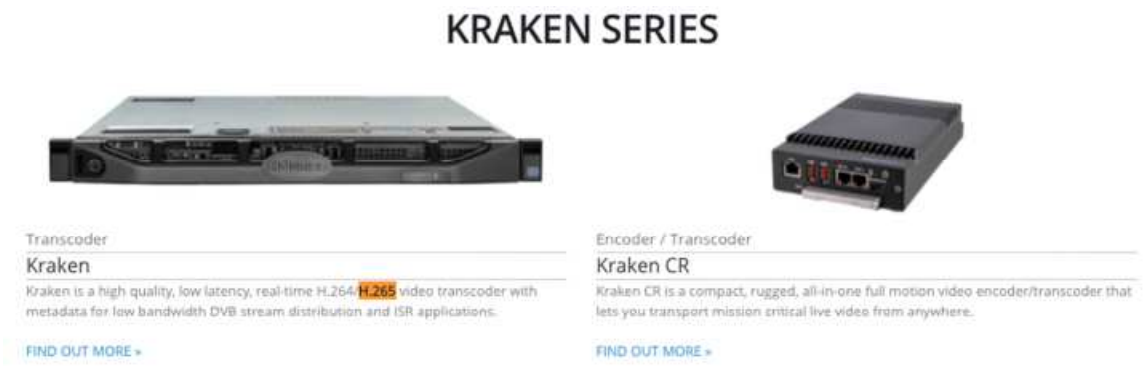
165. For example, a website maintained by Defendants advertising the “Makito X HEVC” product states that the “Makito X HEVC video encoder transports secure, high quality, live HEVC/H.265 and AVC/H.264 video over any network at extremely low bit

rates." *See* https://www.haivision.com/products/makito-series/makito-x-hevc/ (emphasis added):

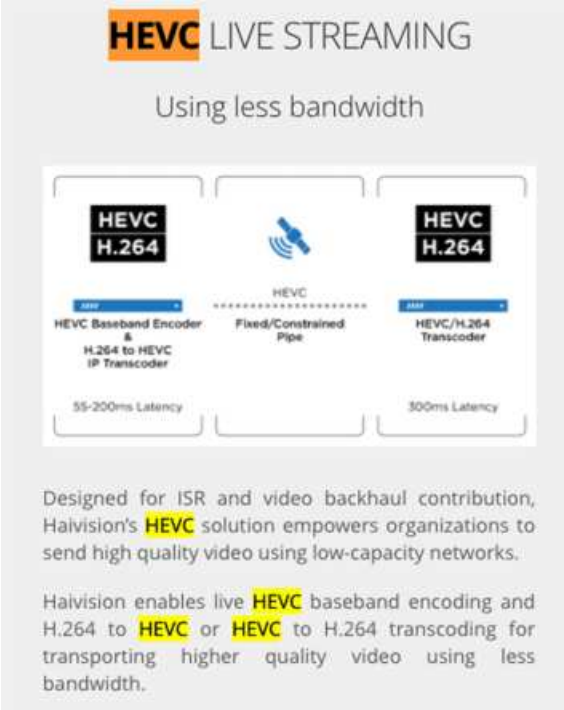

166. Another website maintained by Defendants advertising the KB Series of "H.264 & **HEVC** Internet Media Encoders Transcoders" states that "With support for **HEVC,** the KB series uses up to 50% less bandwidth than H.264" and further stating that: "The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or **HEVC** encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth savings offered by **HEVC**." *See* https://www.haivision.com/products/kb-series/ (emphasis added):




167. Another website maintained by Defendants mentions that the Kraken transcoder product "is a high-quality, low latency, real-time H.264/**H.265** video transcoder with metadata for low bandwidth DVB stream distribution and ISR applications." *See* *https://www.haivision.com/products/kraken-series/* (emphasis added) (image below). A website describing the Kraken transcoder product in more detail further states that "Kraken **HEVC** transcoding allows you to deliver substantially increased video quality over satellite and other constrained networks (typically in the 1 Mbps to 3 Mbps bandwidth range). Kraken receives high bitrate H.264 streams, which it then converts to **HEVC** for transport, and reconverts from **HEVC** to H.264 for onward distribution through less constrained ecosystems. Kraken **HEVC** transcoding reduces up to 50% of bandwidth compared to H.264 while maintaining high picture quality." *See* https://www.haivision.com/products/kraken-series/kraken/ (emphasis added).




168. Moreover, on the product website further describing the Kraken transcoder product, there is a section describing the feature of "HEVC Live Streaming" which states that "Designed for ISR and video backhaul contribution, Haivision's **HEVC** solution empowers organizations to send high quality video using low-capacity networks. Haivision enables live **HEVC** baseband encoding and H.264 to **HEVC** or **HEVC** to H.264 transcoding for transporting higher quality video using less bandwidth." *See* https://www.haivision.com/products/kraken-series/kraken/ (emphasis added):



169. A website further describing the Kraken CR encoder/transcoder product also states that "With Kraken CR **HEVC** encoding/transcoding, bandwidth is reduced by up to 50% over traditional H.264 solutions when transporting live video over constrained networks. **HEVC** streams can be played back directly on standards compliant players and decoders for monitoring or analysis purposes. Additionally, once the stream reaches its destination, a Haivision transcoder can be used to convert the stream from **HEVC** to H.264 for compatibility within existing distribution infrastructures." *See* https://www.haivision.com/products/kraken-series/kraken-cr/ (emphasis added).

170. The Accused Instrumentalities performs a method for coding a video signal using hybrid coding. For example, the aim of the coding process is the production of a bitstream, as defined in definition 3.12 of the ITU-T H.265 Series H: Audiovisual and Multimedia Systems, "Infrastructure of audiovisual services – Coding of moving video" High efficiency video coding ("HEVC Spec"): "bitstream: A sequence of bits, in the form of a NAL unit stream or a byte stream, that forms the representation of coded pictures and associated data forming one or more coded video sequences (CVSs)." *See also, e.g.,* "Overview of the High Efficiency Video Coding (HEVC) Standard" by Gary J. Sullivan, Fellow, IEEE, Jens-Rainer Ohm, Member, IEEE, Woo-Jin Han, Member, IEEE, and Thomas Wiegand, Fellow, IEEE, published in IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 22, NO. 12, DECEMBER 2012 ("IEEE HEVC) ("The video coding layer of HEVC employs the same hybrid approach (inter-/intrapicture prediction and 2-D transform coding) used in all video compression standards since H.261"). *See also, e.g.,* HEVC Spec at 0.7 "Overview of the design characteristics."

171. The Accused Instrumentalities reduce temporal redundancy by block based motion compensated prediction in order to establish a prediction error signal. For example, clause 8.5.3 Decoding process for prediction units in inter prediction mode and the subclauses thereof of the HEVC Spec describe the block based motion compensation techniques used in the decoding process. *See also, e.g.,* IEEE HEVC at 1651-1652 6) Motion compensation: Quarter-sample precision is used for the MVs, and 7-tap or 8-tap filters are used for interpolation of fractional-sample positions (compared to six-tap filtering of half-sample positions followed by linear interpolation for quarter-sample positions in H.264/MPEG-4 AVC). Similar to H.264/MPEG-4 AVC, multiple reference pictures are used. For each PB, either one or two motion vectors can be transmitted, resulting either in unipredictive or bipredictive coding, respectively. As in H.264/MPEG-4 AVC, a scaling and offset operation may be applied to the prediction signal(s) in a manner known as weighted prediction.").

172. The Accused Instrumentalities perform quantization on samples of the prediction error signal or on coefficients resulting from a transformation of the prediction error signal into the frequency domain to obtain quantized values, representing quantized samples or quantized coefficients respectively. For example, the quantization parameter and the scaling (inverse quantization) are defined in definitions 3.112 (page 10) and 3.131 (page 11), respectively, the usage of the scaling process in the decoding being described in clause and 8.6 Scaling, transformation and array construction process prior to deblocking filter process of the HEVC Spec. *See also, e.g.,* IEEE HEVC at 1652 ("8) Quantization control: As in H.264/MPEG-4 AVC, uniform reconstruction quantization

(URQ) is used in HEVC, with quantization scaling matrices supported for the various transform block sizes.").

173. The Accused Instrumentalities perform a method wherein the prediction error signal includes a plurality of subblocks each including a plurality of quantized values. For example, the quantized samples or transform coefficients from the subblock are scaled and transformed as described in above mentioned clause 8.6 of the HEVC Spec. *See also, e.g.,* IEEE HEVC at 1652 ("Prediction units and prediction blocks (PBs): The decision whether to code a picture area using interpicture or intrapicture prediction is made at the CU level. A PU partitioning structure has its root at the CU level. Depending on the basic prediction-type decision, the luma and chroma CBs can then be further split in size and predicted from luma and chroma prediction blocks (PBs). HEVC supports variable PB sizes from 64×64 down to 4×4 samples.").

174. The Accused Instrumentalities perform a method of calculating a first quantization efficiency for the quantized values of at least one subblock of the plurality of subblocks; setting the quantized values of the at least one subblock to all zeroes; calculating a second quantization efficiency for the at least one subblock while all of the quantized values are zeroes; selecting which of the first and second quantization efficiencies is a higher efficiency; and selecting, for further proceeding, the at least one subblock with the quantized values prior to setting the quantized values of the at least one subblock to all zeroes if the first quantization efficiency is higher and selecting the at least one subblock with the quantized values set to zero, for further proceeding, if the second quantization efficiency is higher. For example, the bitstream resulting from the encoding as described in this last item of the claim contains all the relevant information

as needed by the decoder for proper decoding. If the coefficients of the subblock are set to zero as a consequence of the efficiency calculation, the coded_sub_block_flag, as described in clause 7.4.9.11 Residual coding semantics, HEVC Spec, is set to 0, indicating that all the 16 coefficients of the coded sub block have been set to 0: "coded_sub_block_flag[ xS ][ yS ] specifies the following for the sub-block at location ( xS, yS ) within the current transform block, where a sub-block is a (4x4) array of 16 transform coefficient levels: – If coded_sub_block_flag[ xS ][ yS ] is equal to 0, the 16 transform coefficient levels of the sub-block at location ( xS, yS ) are inferred to be equal to 0."

175. When coded_sub_block_flag[ xS ][ yS ] has not been set equal to 0, the position in the array of non 0 coefficients can be determined as follows:

– Otherwise (coded_sub_block_flag[ xS ][ yS ] is equal to 1), the following applies:

– If ( xS, yS ) is equal to ( 0, 0 ) and ( LastSignificantCoeffX, LastSignificantCoeffY ) is not equal to ( 0, 0 ), at least one of the 16 sig_coeff_flag syntax elements is present for the sub-block at location ( xS, yS ).

– Otherwise, at least one of the 16 transform coefficient levels of the sub-block at location ( xS, yS ) has a non zero value.

When coded_sub_block_flag[ xS ][ yS ] is not present, it is inferred as follows:

– If one or more of the following conditions are true, coded_sub_block_flag[ xS ][ yS ] is inferred to be equal to 1:

– ( xS, yS ) is equal to ( 0, 0 )

– ( xS, yS ) is equal to ( LastSignificantCoeffX >> 2 , LastSignificantCoeffY >> 2 )

– Otherwise, coded_sub_block_flag[ xS ][ yS ] is inferred to be equal to 0.

HEVC Spec at 7.4.9.11 Residual coding semantics. Therefore, even though the coding algorithms than can be used for reaching specific efficiency targets are not specified by the HEVC Spec (as stated in clause 0.7), this particular combination of choices produces a valid bitstream that has to be decoded by a conformant decoder.

176. The infringement of the Accused Instrumentalities is also shown by way of considering the reference software (*see, e.g.*, https://hevc.hhi.fraunhofer.de/). Setting the flag RDOQ=true in the encoder configuration file enables rate-distortion-optimized quantization for transformed TUs. This feature is implemented in the HM reference software as function xRateDistOptQuant in file TComTrQuant.cpp. In the function xRateDistOptQuant, the efficiency for setting all quantized values to zero is calculated and stored in the variable d64BestCost. In the variable iBestLastIdxP1, a 0 is stored indicating that all values starting from the 0th position are set to zero. Afterwards, the efficiency for keeping quantized values unequal to zero is calculated and stored in the variable totalCost. The variable iBestLastIdxP1 is adjusted correspondingly to values unequal to 0. The two efficiencies d64BestCost and totalCost are compared, and selecting for further proceeding either quantized values, which are all set to zero or quantized values, which are not all set to zero. All values starting from the position defined by the variable iBestLastIdxP1 are set to zero.

177. Calculation of the efficiency for setting all quantized values to zero and

```
Double  d64BestCost         = 0;
Int     ui16CtxCbf          = 0;
Int     iBestLastIdxP1      = 0;
if( !pcCU->isIntra( uiAbsPartIdx ) && isLuma(compID) && pcCU->getTransformIdx( uiAbsPartIdx ) == 0 )
{
  ui16CtxCbf   = 0;
  d64BestCost  = d64BlockUncodedCost + xGetICost( m_pcEstBitsSbac->blockRootCbpBits[ ui16CtxCbf ][ 0 ] );
  d64BaseCost += xGetICost( m_pcEstBitsSbac->blockRootCbpBits[ ui16CtxCbf ][ 1 ] );
}
else
{
  ui16CtxCbf   = pcCU->getCtxQtCbf( rTu, channelType );
  ui16CtxCbf  += getCBFContextOffset(compID);
  d64BestCost  = d64BlockUncodedCost + xGetICost( m_pcEstBitsSbac->blockCbpBits[ ui16CtxCbf ][ 0 ] );
  d64BaseCost += xGetICost( m_pcEstBitsSbac->blockCbpBits[ ui16CtxCbf ][ 1 ] );
}
```

storing the result in the variable d64BestCost:

HEVC Reference Software (https://hevc.hhi.fraunhofer.de/).

178. Calculating the efficiency for keeping quantized values unequal to zero and storing the result in the variable totalCost:

```
Bool bFoundLast = false;
for (Int iCGScanPos = iCGLastScanPos; iCGScanPos >= 0; iCGScanPos--)
{
  UInt uiCGBlkPos = codingParameters.scanCG[ iCGScanPos ];

  d64BaseCost -= pdCostCoeffGroupSig [ iCGScanPos ];
  if (uiSigCoeffGroupFlag[ uiCGBlkPos ])
  {
    for (Int iScanPosinCG = uiCGSize-1; iScanPosinCG >= 0; iScanPosinCG--)
    {
      iScanPos = iCGScanPos*uiCGSize + iScanPosinCG;

      if (iScanPos > iLastScanPos) continue;
      UInt   uiBlkPos     = codingParameters.scan[iScanPos];

      if( piDstCoeff[ uiBlkPos ] )
      {
        UInt   uiPosY       = uiBlkPos >> uiLog2BlockWidth;
        UInt   uiPosX       = uiBlkPos - ( uiPosY << uiLog2BlockWidth );

        Double d64CostLast= codingParameters.scanType == SCAN_VER ? xGetRateLast( uiPosY, uiPosX, compID ) :
                                                                    xGetRateLast( uiPosX, uiPosY, compID );
        Double totalCost = d64BaseCost + d64CostLast - pdCostSig[ iScanPos ];
```

HEVC Reference Software (https://hevc.hhi.fraunhofer.de/).

179. Comparing the two efficiencies d64BestCost and totalCost:

```
if( totalCost < d64BestCost )
{
  iBestLastIdxP1  = iScanPos + 1;
  d64BestCost     = totalCost;
}
```

HEVC Reference Software (https://hevc.hhi.fraunhofer.de/).

180. Selecting for further proceeding either quantized values, which are all set

```
//===== clean uncoded coefficients =====
for ( Int scanPos = iBestLastIdxP1; scanPos <= iLastScanPos; scanPos++ )
{
  piDstCoeff[ codingParameters.scan[ scanPos ] ] = 0;
}
```

to zero or quantized values, which are not all set to zero:

HEVC Reference Software (https://hevc.hhi.fraunhofer.de/).

181. On information and belief, Defendants also directly infringe and continue to infringe other claims of the ’462 patent, for similar reasons as explained above with respect to Claim 1 of the ’462 patent.

182. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, e.g., in the manner specified in the HEVC (or H.265) standard.

183. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods and/or systems claimed by the ’462 patent.

184. On information and belief, Defendants have had knowledge of the ’462 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendants knew of the ’462 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendants will have known and intended (since receiving such notice) that their continued actions would actively induce and contribute to the infringement of the claims of the ’462 patent.

185. Upon information and belief, Defendants' affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, e.g., through training, demonstrations, brochures, installation and user guides, have induced and continue to induce users of the Accused Instrumentalities to use them in their normal and customary way to infringe the '462 patent by practicing a method for coding a video signal using hybrid coding, comprising: reducing temporal redundancy by block based motion compensated prediction in order to establish a prediction error signal; performing quantization on samples of the prediction error signal or on coefficients resulting from a transformation of the prediction error signal into the frequency domain to obtain quantized values, representing quantized samples or quantized coefficients respectively, wherein the prediction error signal includes a plurality of subblocks each including a plurality of quantized values; calculating a first quantization efficiency for the quantized values of at least one subblock of the plurality of subblocks; setting the quantized values of the at least one subblock to all zeroes; calculating a second quantization efficiency for the at least one subblock while all of the quantized values are zeroes; selecting which of the first and second quantization efficiencies is a higher efficiency; and selecting, for further proceeding, the at least one subblock with the quantized values prior to setting the quantized values of the at least one subblock to all zeroes if the first quantization efficiency is higher and selecting the at least one subblock with the quantized values set to zero, for further proceeding, if the second quantization efficiency is higher. For example, Defendants adopted HEVC (or H.265) as their video codec in their encoder devices, transcoder devices and streaming services. For similar reasons, Defendants also

induce their customers to use the Accused Instrumentalities to infringe other claims of the ’462 patent. Defendants specifically intended and were aware that these normal and customary activities would infringe the ’462 patent. Defendants performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the ’462 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendants engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendants have induced and continue to induce users of the Accused Instrumentalities to use the Accused Instrumentalities in their ordinary and customary way to infringe the ’462 patent, knowing that such use constitutes infringement of the ’462 patent. Accordingly, Defendants have been, and currently are, inducing infringement of the ’462 patent, in violation of 35 U.S.C. § 271(b).

186. Defendants have also infringed, and continue to infringe, claims of the ’462 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process, or using the systems, of the ’462 patent, and constitute a material part of the invention. Defendants know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the ’462 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendants have been, and currently are, contributorily infringing the ’462 patent, in violation of 35 U.S.C. § 271(c).

187. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the

Accused Instrumentalities' compression features, Defendants have injured Realtime and are liable to Realtime for infringement of the '462 patent pursuant to 35 U.S.C. § 271.

188. As a result of Defendants' infringement of the '462 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendants' infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendants, together with interest and costs as fixed by the Court.

## COUNT VII

## INFRINGEMENT OF U.S. PATENT NO. 9,578,298

189. Plaintiff re-alleges and incorporates by reference the foregoing paragraphs, as if fully set forth herein.

190. Plaintiff Realtime is the owner by assignment of United States Patent No. 9,578,298 ("the '298 patent") entitled "Method for Decoding 2D-Compatible Stereoscopic Video Flows." The '298 patent was duly and legally issued by the United States Patent and Trademark Office on February 21, 2017. A true and correct copy of the '298 patent is included as Exhibit G.

191. On information and belief, Defendants have made, used, offered for sale, sold and/or imported into the United States products that infringe the '298 patent, and continue to do so By way of illustrative example, these infringing products include, without limitation, Defendants' video encoding products, such as, *e.g.*, products that use Haivision Media Platform, the Makito X H.264, Makito X HEVC, Makito X with Storage, Makito Air, Makito XCR, and Makito X HARSH, KB Mini, KB Encoder/Transcoder Server, KB 4K Encoder/Transcoder, Kraken Series (S-KR-Base; S-

KR-Base-KLV; S-KR-PREMIUM; S-KR-PREMIUM-KLV; S-KR-ULTRA; S-KR-ULTRA-KLV), Kraken CR, and streaming cloud services, such as, *e.g.*, the Haivision Video Cloud and Connect DVR services, and all versions and variations thereof since the issuance of the ’298 patent (“Accused Instrumentalities”).

192. On information and belief, Defendants have directly infringed and continue to infringe the ’298 patent, for example, through its own use and testing of the Accused Instrumentalities, which when used, practices the method claimed by Claim 1 of the ’298 patent, namely, a method for processing a video stream of digital images, the method comprising the steps of: receiving the video stream which comprises at least one composite frame (FC), each composite frame containing a pair of stereoscopic digital images (L,R) according to a predetermined frame packing format; generating an output video stream which can be reproduced on a visualization apparatus, receiving metadata which determine an area occupied by one of the two images within said composite frame (FC), said metadata indicating either a geometry of the frame packing format or a frame packing type of said composite frame (FC); determining the area in the composite frame (FC) which is occupied by said one image of the stereoscopic pair within the composite frame based on said metadata; decoding only that part of the composite frame (FC) which contains said one image to be displayed, and generating an output frame containing said decoded image. Upon information and belief, Defendants use the Accused Instrumentalities to practice infringing methods for their own internal non-testing business purposes, while testing the Accused Instrumentalities, and while providing technical support and repair services for the Accused Instrumentalities to their customers.

193. For example, a website maintained by Defendants advertising the "Makito X HEVC" product states that the "Makito X HEVC video encoder transports secure, high


quality, live HEVC/H.265 and AVC/H.264 video over any network at extremely low bit rates." *See* https://www.haivision.com/products/makito-series/makito-x-hevc/ (emphasis added):

194. Another website maintained by Defendants advertising the KB Series of "H.264 & **HEVC** Internet Media Encoders Transcoders" states that "With support for **HEVC,** the KB series uses up to 50% less bandwidth than H.264" and further stating that: "The KB Mini and KB 4K internet encoders/transcoders offer Intel-based hardware acceleration enabling real-time H.264 or **HEVC** encoding and adaptive bitrate (ABR) cascades up to 1080p for the KB Mini and 4K/UHD 2160p for the KB 4K. This maximizes stream quality for target devices while taking advantage of the bandwidth

savings offered by **HEVC**." *See* https://www.haivision.com/products/kb-series/ (emphasis added):

**BEST VIEWING EXPERIENCE**

H.264 & HEVC Internet Media Encoders/Transcoders

Available as a small form factor portable appliance, HD server or 4K server, the KB Series of H.264 & HEVC Internet Media Encoders and Transcoders provides you with multiple options for live event streaming, helping you deliver the highest quality live video to your global internet audience. With the KB series, you have options to encode/transcode video in resolutions including SD, 720p, HD 1080p and up to 4K/UHD 2160p.

These resolutions can be distributed as a cascade of adaptive bitrate RTMP/HLS/ MPEG-DASH streams across the world's largest CDNs, giving you the highest quality per bit and giving your internet audience the best viewing experience regardless of their geographic location, network conditions or preferred device.

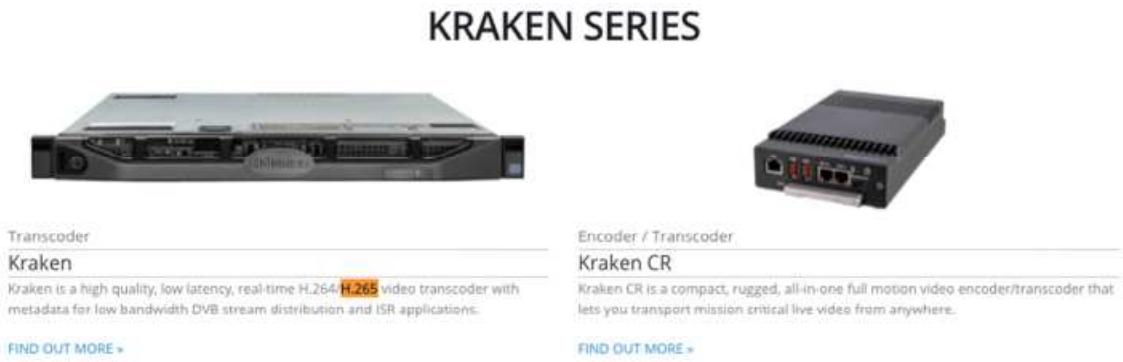
**GET THE MOST OUT OF YOUR UPLINK CONNECTION TO THE CLOUD**

When your internet connection at the source isn't very reliable, and bandwidth is limited, simply send your video streams to a transcoder in the cloud to take care of adaptive bitrate (ABR) distribution.

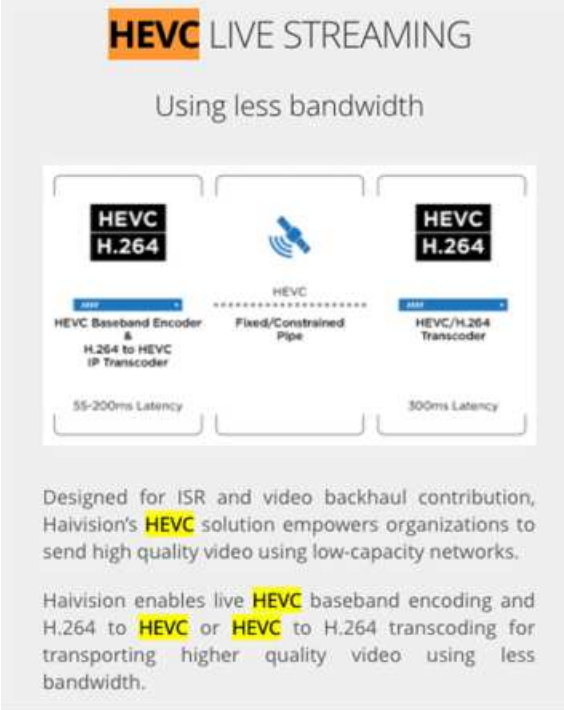
With support for HEVC, the KB Series uses up to 50% less bandwidth than H.264. Additionally Haivision's SRT (Secure Reliable Transport) technology makes low-cost, readily available public internet connections secure and reliable for live video transport from the source to the cloud, getting the most out of your available uplink bandwidth.

195. Another website maintained by Defendants mentions that the Kraken transcoder product "is a high-quality, low latency, real-time H.264/**H.265** video transcoder with metadata for low bandwidth DVB stream distribution and ISR applications." *See https://www.haivision.com/products/kraken-series/* (emphasis added) (image below). A website describing the Kraken transcoder product in more detail further states that "Kraken **HEVC** transcoding allows you to deliver substantially increased video quality over satellite and other constrained networks (typically in the 1 Mbps to 3 Mbps bandwidth range). Kraken receives high bitrate H.264 streams, which it then converts to **HEVC** for transport, and reconverts from **HEVC** to H.264 for onward distribution through less constrained ecosystems. Kraken **HEVC** transcoding reduces up

to 50% of bandwidth compared to H.264 while maintaining high picture quality." *See* https://www.haivision.com/products/kraken-series/kraken/ (emphasis added).




196. Moreover, on the product website further describing the Kraken transcoder product, there is a section describing the feature of "HEVC Live Streaming" which states that "Designed for ISR and video backhaul contribution, Haivision's **HEVC** solution empowers organizations to send high quality video using low-capacity networks. Haivision enables live **HEVC** baseband encoding and H.264 to **HEVC** or **HEVC** to H.264 transcoding for transporting higher quality video using less bandwidth." *See* https://www.haivision.com/products/kraken-series/kraken/ (emphasis added):




197. A website further describing the Kraken CR encoder/transcoder product also states that "With Kraken CR **HEVC** encoding/transcoding, bandwidth is reduced by up to 50% over traditional H.264 solutions when transporting live video over constrained networks. **HEVC** streams can be played back directly on standards compliant players and decoders for monitoring or analysis purposes. Additionally, once the stream reaches its destination, a Haivision transcoder can be used to convert the stream from **HEVC** to H.264 for compatibility within existing distribution infrastructures." *See* https://www.haivision.com/products/kraken-series/kraken-cr/ (emphasis added).

198. The Accused Instrumentalities receive the video stream which comprises at least one composite frame (FC), each composite frame containing a pair of stereoscopic digital images (L,R) according to a predetermined frame packing format. For example, the coded bitstream when it contains a stereoscopic video in one of the frame packing arrangements such as side-by-side or top-and-bottom or segmented

rectangular frame packing format as defined in the following sections of the ITU-T H.265 Series H: Audiovisual and Multimedia Systems, "Infrastructure of audiovisual services – Coding of moving video" High efficiency video coding ("HEVC Spec"): D.2.16 Frame packing arrangement SEI message syntax, D.3.16 Frame packing arrangement SEI message semantics, D.2.29 Segmented rectangular frame packing arrangement SEI message syntax, D.3.29 Segmented rectangular frame packing arrangement SEI message semantics.

199. The Accused Instrumentalities generate an output video stream which can be reproduced on a visualization apparatus. For example, the output of the decoding process as defined above is a sequence of decoded pictures. *See, e.g.,* HEVC Spec at 3.39 ("3.39 decoded picture: A decoded picture is derived by decoding a coded picture"). Decoded pictures are the input of the display process. *Id.* at 3.47 ("3.47 display process: A process not specified in this Specification having, as its input, the cropped decoded pictures that are the output of the decoding process.").

200. The Accused Instrumentalities receive metadata which determine an area occupied by one of the two images within said composite frame, said metadata indicating either a geometry of the frame packing format or a frame packing type of said composite frame. For example, the HEVC spec provides the default display window parameter to support 2D compatible decoding of stereo formats. *See, e.g.,* HEVC Spec ("NOTE 9 – The default display window parameters in the VUI parameters of the SPS can be used by an encoder to indicate to a decoder that does not interpret the frame packing arrangement SEI message that the default display window is an area within only one of the two constituent frames.").

201. The Accused Instrumentalities determine the area in the composite frame (FC) which is occupied by said one image of the stereoscopic pair within the composite frame based on said metadata. For example, the default display window parameter has been defined to support this application. The parameter syntax is defined in clause E.2.1 VUI parameters syntax, the semantics thereof being described in clause E.3.1 VUI parameters semantics. The usage of the Default Display Window for signaling the 2D single view in a stereoscopic frame packing format is illustrated in Note 9 of clause D.3.16 and Note 3 in Clause D.3.29 cited above.

202. The Accused Instrumentalities decode only that part of the composite frame which contains said one image to be displayed. For example, tiles are intended to support independent decoding of different picture regions. Clause 7.4.3.2.1 cited above illustrates the process to convert CTB picture scan in CTB tile scan to enable independent decoding of the tile. *See also* HEVC Spec:

**row_height_minus1**[ i ] plus 1 specifies the height of the i-th tile row in units of coding tree blocks.

The following variables are derived by invoking the coding tree block raster and tile scanning conversion process as specified in clause 6.5.1:

- The list CtbAddrRsToTs[ ctbAddrRs ] for ctbAddrRs ranging from 0 to PicSizeInCtbsY − 1, inclusive, specifying the conversion from a CTB address in the CTB raster scan of a picture to a CTB address in the tile scan,
- the list CtbAddrTsToRs[ ctbAddrTs ] for ctbAddrTs ranging from 0 to PicSizeInCtbsY − 1, inclusive, specifying the conversion from a CTB address in the tile scan to a CTB address in the CTB raster scan of a picture,
- the list TileId[ ctbAddrTs ] for ctbAddrTs ranging from 0 to PicSizeInCtbsY − 1, inclusive, specifying the conversion from a CTB address in tile scan to a tile ID,
- the list ColumnWidthInLumaSamples[ i ] for i ranging from 0 to num_tile_columns_minus1, inclusive, specifying the width of the i-th tile column in units of luma samples,
- the list RowHeightInLumaSamples[ j ] for j ranging from 0 to num_tile_rows_minus1, inclusive, specifying the height of the j-th tile row in units of luma samples.

The values of ColumnWidthInLumaSamples[ i ] for i ranging from 0 to num_tile_columns_minus1, inclusive, and RowHeightInLumaSamples[ j ] for j ranging from 0 to num_tile_rows_minus1, inclusive, shall all be greater than 0.

The array MinTbAddrZs with elements MinTbAddrZs[ x ][ y ] for x ranging from 0 to ( PicWidthInCtbsY << ( CtbLog2SizeY − MinTbLog2SizeY ) ) − 1, inclusive, and y ranging from 0 to ( PicHeightInCtbsY << ( CtbLog2SizeY − MinTbLog2SizeY ) ) − 1, inclusive, specifying the conversion from a location ( x, y ) in units of minimum transform blocks to a transform block address in z-scan order, is derived by invoking the z-scan order array initialization process as specified in clause 6.5.2.

203. The Accused Instrumentalities generate an output frame containing said extracted image. For example, there is an output of the tile decoding process. *See, e.g.*, HEVC Spec at 8.1.1 ("8.1.1 General…Input to this process is a bitstream. Output of this process is a list of decoded pictures.").

204. On information and belief, Defendants also directly infringe and continue to infringe other claims of the '298 patent, for similar reasons as explained above with respect to Claim 1 of the '298 patent.

205. On information and belief, all of the Accused Instrumentalities perform the claimed methods in substantially the same way, e.g., in the manner specified in the HEVC (or H.265) standard.

206. On information and belief, use of the Accused Instrumentalities in their ordinary and customary fashion results in infringement of the methods claimed by the '298 patent.

207. On information and belief, Defendants have had knowledge of the '298 patent since at least the filing of this Complaint or shortly thereafter, and on information and belief, Defendants knew of the '298 patent and knew of its infringement, including by way of this lawsuit. By the time of trial, Defendants will have known and intended (since receiving such notice) that their continued actions would actively induce and contribute to the infringement of the claims of the '298 patent.

208. Upon information and belief, Defendants' affirmative acts of making, using, and selling the Accused Instrumentalities, and providing implementation services and technical support to users of the Accused Instrumentalities, including, e.g., through training, demonstrations, brochures, installation and user guides, have induced and

continue to induce users of the Accused Instrumentalities to use them in their normal and customary way to infringe the ’298 by practicing a method for processing a video stream of digital images, the method comprising the steps of: receiving the video stream which comprises at least one composite frame (FC), each composite frame containing a pair of stereoscopic digital images (L,R) according to a predetermined frame packing format; generating an output video stream which can be reproduced on a visualization apparatus, receiving metadata which determine an area occupied by one of the two images within said composite frame (FC), said metadata indicating either a geometry of the frame packing format or a frame packing type of said composite frame (FC); determining the area in the composite frame (FC) which is occupied by said one image of the stereoscopic pair within the composite frame based on said metadata; decoding only that part of the composite frame (FC) which contains said one image to be displayed, and generating an output frame containing said decoded image. For example, Defendants adopted HEVC (or H.265) as their video codec in their encoder devices, transcoder devices and streaming services. For similar reasons, Defendants also induce their customers to use the Accused Instrumentalities to infringe other claims of the ’298 patent. Defendants specifically intended and were aware that these normal and customary activities would infringe the ’298 patent. Defendants performed the acts that constitute induced infringement, and would induce actual infringement, with the knowledge of the ’298 patent and with the knowledge, or willful blindness to the probability, that the induced acts would constitute infringement. On information and belief, Defendants engaged in such inducement to promote the sales of the Accused Instrumentalities. Accordingly, Defendants have induced and continue to induce users of the Accused Instrumentalities to

use the Accused Instrumentalities in their ordinary and customary way to infringe the ’298 patent, knowing that such use constitutes infringement of the ’298 patent. Accordingly, Defendants have been, and currently are, inducing infringement of the ’298 patent, in violation of 35 U.S.C. § 271(b).

209. Defendants have also infringed, and continue to infringe, claims of the ’298 patent by offering to commercially distribute, commercially distributing, making, and/or importing the Accused Instrumentalities, which are used in practicing the process, or using the systems, of the ’298 patent, and constitute a material part of the invention. Defendants know the components in the Accused Instrumentalities to be especially made or especially adapted for use in infringement of the ’298 patent, not a staple article, and not a commodity of commerce suitable for substantial noninfringing use. Accordingly, Defendants have been, and currently are, contributorily infringing the ’298 patent, in violation of 35 U.S.C. § 271(c).

210. By making, using, offering for sale, selling and/or importing into the United States the Accused Instrumentalities, and touting the benefits of using the Accused Instrumentalities’ compression features, Defendants have injured Realtime and are liable to Realtime for infringement of the ’298 patent pursuant to 35 U.S.C. § 271.

211. As a result of Defendants’ infringement of the ’298 patent, Plaintiff Realtime is entitled to monetary damages in an amount adequate to compensate for Defendants’ infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendants, together with interest and costs as fixed by the Court.

## PRAYER FOR RELIEF

WHEREFORE, Plaintiff Realtime respectfully requests that this Court enter:

a. A judgment in favor of Plaintiff that Defendants have infringed, literally and/or under the doctrine of equivalents, the '535, '477, '442, '907, '046, '462 and '298 patents (the "Asserted Patents");

b. A judgment and order requiring Defendants to pay Plaintiff its damages, costs, expenses, and prejudgment and post-judgment interest for its infringement of the Asserted Patents, as provided under 35 U.S.C. § 284;

c. A judgment and order requiring Defendants to provide an accounting and to pay supplemental damages to Realtime, including without limitation, prejudgment and post-judgment interest;

d. A permanent injunction prohibiting Defendants from further acts of infringement of the Asserted Patents;

e. A judgment and order finding that this is an exceptional case within the meaning of 35 U.S.C. § 285 and awarding to Plaintiff its reasonable attorneys' fees against Defendants; and

f. Any and all other relief as the Court may deem appropriate and just under the circumstances.

**DEMAND FOR JURY TRIAL**

Plaintiff, under Rule 38 of the Federal Rules of Civil Procedure, requests a trial by jury of any issues so triable by right.

January 31, 2018

BAYARD, P.A.

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