IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

OPTIMORPHIX, INC., ***Plaintiff,*** v. **NVIDIA CORPORATION,** ***Defendant.***	**Civil Action No._____** **JURY TRIAL DEMANDED**

COMPLAINT FOR PATENT INFRINGEMENT

OptiMorphix, Inc. ("OptiMorphix" or "Plaintiff") brings this action and makes the following allegations of patent infringement relating to U.S. Patent Nos.: 7,136,353 (the "'353 Patent"); 8,521,901 (the "'901 Patent"); 7,616,559 (the "'559 Patent"); 9,191,664 (the "'664 Patent"); 7,987,285 (the "'285 Patent"); 7,991,904 (the "'904 Patent"); 8,230,105 (the "'105 Patent"); 8,255,551 (the "'551 Patent"); 10,412,388 (the "'388 Patent"); 9,894,361 (the "'361 Patent"); and 10,123,015 (the "'015 Patent") (collectively, the "Patents-in-Suit"). Defendant NVIDIA Corporation ("NVIDIA" or "Defendant") infringes the Patents-in-Suit in violation of the patent laws of the United States of America, 35 U.S.C. § 1 *et seq.*

THE PARTIES

1. Plaintiff OptiMorphix, Inc. ("Plaintiff" or "OptiMorphix") is a Delaware corporation that holds a portfolio of over 250 patent assets that were developed at Citrix Systems, Inc. ("Citrix") and Bytemobile, Inc.

2. Bytemobile, Inc. ("Bytemobile") was a global leader in mobile internet solutions for network operators. The company was founded in 2000. Bytemobile's mission was to optimize video and web content services for mobile network operators to improve users' experiences while maximizing the efficiency of network infrastructure.

3. Bytemobile was established during a time when the mobile landscape was evolving rapidly. The advent of 3G technology, coupled with increasingly sophisticated smartphones, led to a surge in demand for data services. However, mobile networks at the time were not optimized to handle this influx, particularly for data-rich services like video streaming. Recognizing this opportunity, Bytemobile sought to create solutions that would enable network operators to deliver high-quality, consistent mobile data services. By 2011, Bytemobile was a "market leader in video and web optimization, with more than 125 cumulative operator deployments in 60 countries.[1]

Andrew Zipern, *Vodafone in Deal with Start-Up Bytemobile*, NYTimes at C4 (January 29, 2002) ("Bytemobile, a wireless data start-up . . . reached a deal with Vodafone, Britain's largest mobile phone operator"); *NTT DoCoMo Launches Bytemobile Optimization Solution in its Core Network*, WIRELESSWATCH IP (October 5, 2004) ("NTT DoCoMo has deployed Bytemobile's optimization solution in its core network"); *China Mobile Selects Bytemobile for Nationwide Web Gateway Project*, BUSINESS WIRE (July 8, 2009) ("A Bytemobile customer since 2004, CMCC has deployed its web optimization solutions"); *Bytemobile Juices Up Orange*, ESPICOM TELECOMMUNICATION NEWS (October 10, 2002) ("Orange customers will experience faster application performance and Web page downloads"); *ByteMobile Wins 2013 LTE Award for Best LTE Traffic Management Product*, MARKETSCREENER (July 1, 2013) ("ByteMobile technology has been deployed . . . in networks serving nearly two billion subscribers.").

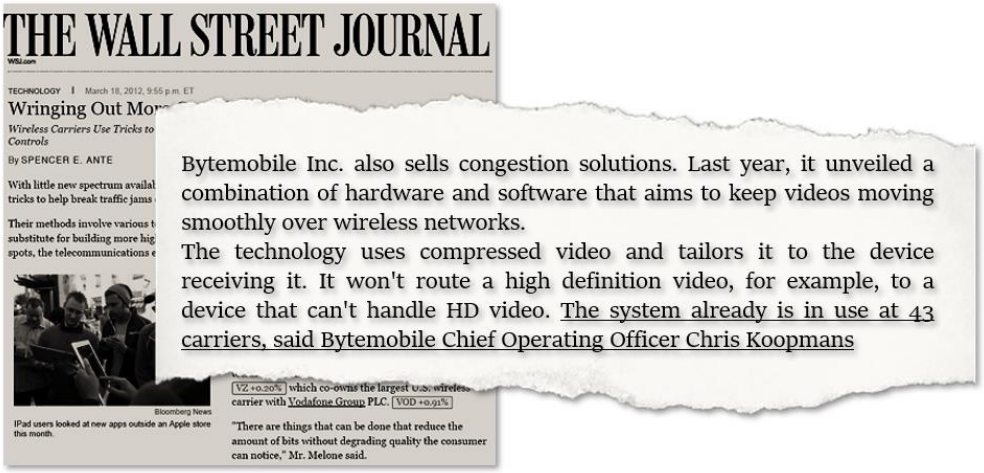
[1] *Bytemobile: Importance of Video and Web Optimizations*, TELECOM REVIEW at 58 (2011); *see also Bytemobile Secures Its 36th Video Optimisation Win for MNO Deployment*, TOTAL TELECOM & TOTAL TELECOM MAGAZINE (March 21, 2011).

4. Bytemobile products, such as the Unison platform and the T3100 Adaptive Traffic Manager, were designed to optimize mobile data traffic in real-time, ensuring a high-quality mobile internet experience for end-users. This approach was groundbreaking at the time and set the stage for many of the mobile data optimization techniques used today.

5. Bytemobile's innovative technologies and customer-centric approach led to rapid growth and success. Bytemobile's innovative product portfolio included: the T3100 Adaptive Traffic Manager which was designed to handle high volumes of traffic efficiently and provide real-time optimization, compression, and management of mobile data; Bytemobile's T2000 Series Video Cache, which supported transparent caching of content; and Bytemobile's T1000 Series Traffic Director, which enabled traffic steering and load balancing for high availability of applications.

Bytemobile Adaptive Traffic Management Product Family, BYTEMOBILE DATA SHEET at 1-2 (2014).

6. Bytemobile's groundbreaking technologies also included products for data optimization. Bytemobile's data optimization solutions were designed to compress and accelerate data transfer. By reducing the size of data packets without compromising quality, these technologies allowed faster data transmission and minimized network congestion. Bytemobile also offered solutions to analyze and manage network traffic, allowing network operators to identify patterns, allocate bandwidth intelligently, and prioritize different types of content.


THE WALL STREET JOURNAL

WSJ.com

TECHNOLOGY | March 18, 2012, 9:55 p.m. ET

Wringing Out Mor

Wireless Carriers Use Tricks to Controls

By SPENCER E. ANTE

With little new spectrum availal tricks to help break traffic jams

Their methods involve various substitute for building more hig spots, the telecommunications

Bytemobile Inc. also sells congestion solutions. Last year, it unveiled a combination of hardware and software that aims to keep videos moving smoothly over wireless networks.

The technology uses compressed video and tailors it to the device receiving it. It won't route a high definition video, for example, to a device that can't handle HD video. The system already is in use at 43 carriers, said Bytemobile Chief Operating Officer Chris Koopmans

VZ +0.20% which co-owns the largest U.S. wireless carrier with Vodafone Group PLC. VOD +0.91%

Bloomberg News

IPad users looked at new apps outside an Apple store this month.

"There are things that can be done that reduce the amount of bits without degrading quality the consumer can notice," Mr. Melone said.

Spencer E. Ante, *Wringing Out More Capacity*, WALL STREET JOURNAL at B3 (March 19, 2012) (emphasis added).

7. In July 2012, Bytemobile was acquired by Citrix Systems, Inc. ("Citrix") for $435 million. Bytemobile "became part of [Citrix's] Enterprise division and extend[ed] [Citrix's] industry reach into the mobile and cloud markets."[2]

8. OptiMorphix owns a portfolio of patents developed at Bytemobile and later Citrix. Highlighting the importance of the patents-in-suit is the fact that the OptiMorphix's patent portfolio has been cited by over 4,800 U.S. and international patents and patent applications assigned to a wide variety of the largest companies operating in the networking, content delivery, and cloud computing fields. OptiMorphix's patents have been cited by companies such as:

[2] CITRIX SYSTEMS, INC. 2012 ANNUAL REPORT at 33 (2013).

- Amazon.com, Inc. (263 citing patents and applications)[3]
- Oracle (59 citing patents and applications)[4]
- Alphabet, Inc. (103 citing patents and applications)[5]
- Broadcom Ltd. (93 citing patents and applications)[6]
- Cisco Systems, Inc. (277 citing patents and applications)[7]
- Lumen Technologies, Inc. (77 citing patents and applications)[8]
- Intel Corporation (45 citing patents and applications)[9]
- Microsoft Corporation (150 citing patents and applications)[10]
- AT&T, Inc. (93 citing patents and applications)[11]
- Verizon Communications, Inc. (31 citing patents and applications)[12]
- Juniper Networks, Inc. (29 citing patents and applications)[13]

9. Defendant NVIDIA Corporation ("NVIDIA"), is a Delaware corporation with its principal place of business at 2788 San Tomas Expressway, Santa Clara, California 95051. NVIDIA may be served through its registered agent, Corporation Service Company, 251 Little Falls Drive, Wilmington, Delaware 19808.

JURISDICTION AND VENUE

10. This action arises under the patent laws of the United States, Title 35 of the United States Code. Accordingly, this Court has exclusive subject matter jurisdiction over this action under 28 U.S.C. §§ 1331 and 1338(a).

11. Venue is proper in this District under 28 U.S.C. §§ 1391(b)-(d) and 1400(b).

12. This Court has personal jurisdiction over NVIDIA because it is organized under the laws of the State of Delaware and it maintains a registered agent in Delaware.

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[3] *See e.g.*, U.S. Patent Nos. 7,817,563; 9,384,204; 9,462,019; 11,343,551; and 11,394,620.
[4] *See e.g.*, U.S. Patent Nos. 7,475,402; 7,574,710; 8,589,610; 8,635,185; and 11,200,240.
[5] *See e.g.*, U.S. Patent Nos. 7,743,003; 8,458,327; 9,166,864; 9,665,617; and 10,733,376.
[6] *See e.g.*, U.S. Patent Nos. 7,636,323; 8,448,214; 9,083,986; 9,357,269; and 10,091,528.
[7] *See e.g.*, U.S. Patent Nos. 7,656,800; 7,930,734; 8,339,954; 9,350,822; and 10,284,484.
[8] *See e.g.*, U.S. Patent Nos. 7,519,353; 8,315,179; 8,989,002; 10,511,533; and 11,233,740.
[9] *See e.g.*, U.S. Patent Nos. 7,394,809; 7,408,932; 9,515,942; 9,923,821; and 10,644,961.
[10] *See e.g.*, U.S. Patent Nos. 8,248,944; 9,071,841; 9,852,118; 10,452,748; and 11,055,47.
[11] *See e.g.*, U.S. Patent Nos. 8,065,374; 8,429,302; 9,558,293; 9,800,638; and 10,491,645.
[12] *See e.g.*, U.S. Patent Nos. 8,149,706; 8,930,559; 9,253,231; 10,003,697; and 10,193,942.
[13] *See e.g.*, U.S. Patent Nos. 8,112,800; 8,509,071; 8,948,174; 9,407,726; and 11,228,631.

THE ASSERTED PATENTS

U.S. PATENT NO. 7,136,353

13. U.S. Patent No. 7,136,353 entitled, *Quality of Service Management for Multiple Connections Within a Network Communication System*, was filed on May 17, 2002. The '353 Patent claims priority to Provisional Application No. 60/309,212, filed on July 31, 2001 and Provisional Application No. 60/291,825, filed on May 18, 2001. The '353 Patent is subject to a 35 U.S.C. § 154(b) term extension of 945 days. A true and correct copy of the '353 Patent is attached hereto as Exhibit 1.

14. The '353 Patent has been in full force and effect since its issuance. OptiMorphix, Inc. owns by assignment the entire right, title, and interest in and to the '353 Patent.

15. The '353 Patent primarily relates to managing the quality of service (QoS) in a network communication system, especially focusing on multiple connections between a sender and a receiver. It introduces a methodology where a host-level transmission rate is allocated among multiple connections based on a ratio of a weight associated with each connection and the sum of the weights associated with the connections. This approach aims to optimize the transmission of data packets, particularly in environments where multiple connections to the same host might compete for bandwidth, ensuring efficient utilization and prioritization of data transmission.

16. The '353 Patent is directed to solving the problem of efficiently managing multiple connections in a network communication system to optimize data packet transmission and improve the quality of service. It addresses issues related to the allocation of transmission rates among multiple connections, selective transmission of data packets, and ensuring that higher priority connections are allocated a more significant portion of the available transmission rate than lower priority connections.

17. The ‘353 Patent identifies shortcomings in the prior art. Specifically, the specification describes that conventional Transport Control Protocol (TCP) architectures, which were primarily designed for reliable, sequenced transmission of non-real-time data streams over high-bandwidth wireline channels, tend to exhibit sub-optimal performance when employed in environments with different or incompatible characteristics, such as wireless networks. Traditional TCP architectures face issues related to flow control, congestion control, and error recovery mechanisms, especially in scenarios involving multiple connections between a sender and a receiver, leading to inefficient use of resources and decreased overall throughput.

18. The inventions disclosed in the ‘353 Patent provide significant benefits and improvements to the function of the hardware in a computer network by ensuring that data transmission across multiple connections is managed efficiently and prioritized according to the significance of each connection. The methodology ensures that higher priority connections are allocated more bandwidth, reducing bursty data transmissions and ensuring that data is transmitted at a rate that the communication channel can support, thereby optimizing the utilization of network resources and enhancing the overall quality of service.

19. The invention taught by the ‘353 Patent solves discrete, technological problems associated with computer systems; specifically, it addresses the technical challenges related to managing and optimizing data packet transmission across multiple connections in a network communication system. It provides a systematic approach to allocate transmission rates, manage data packet transmission, and prioritize connections, ensuring efficient utilization of network resources and improved quality of service.

20. The technologies taught in the ‘353 Patent constitute an improvement in computer network technology by introducing a systematic and efficient methodology to manage multiple

connections in a network communication system. The teachings in the '353 Patent provide a mechanism to allocate transmission rates among connections, selectively transmit data packets, and prioritize connections based on associated weights, ensuring that higher priority connections are allocated a more significant portion of the available transmission rate, thereby optimizing data transmission and enhancing the quality of service in network communication systems.

21. The '353 Patent family has been cited by 1,469 United States and international patents and patent applications as relevant prior art. Specifically, 77 United States and international patents and patent applications have cited the '353 Patent itself as relevant prior art. The following companies and research institutions have cited the '353 Patent as relevant prior art:

- Broadcom Limited
- Cisco Systems, Inc.
- Commscope, Inc.
- Intel Corporation
- Interdigital, Inc.
- Lumen Technologies, Inc
- Microsoft Corporation
- NEC Corporation
- Netapp Inc.
- Nokia Corporation
- Oracle Corporation
- Panasonic Corporation
- Rensselaer Polytechnic Institute
- Samsung Electronics Co., Ltd.
- Telefonaktiebolaget Lm

U.S. PATENT NO. 8,521,901

22. U.S. Patent No. 8,521,901 entitled, *TCP Burst Avoidance*, was filed on December 22, 2008. The '901 Patent claims priority to Provisional Patent Application No. 61/017,275, filed on December 28, 2007. The '901 Patent is subject to a 35 U.S.C. § 154(b) term extension of 525 days. A true and correct copy of the '901 Patent is attached hereto as Exhibit 2.

23. The ‘901 Patent has been in full force and effect since its issuance. OptiMorphix, Inc. owns by assignment the entire right, title, and interest in and to the ‘901 Patent.

24. The ‘901 Patent generally relates to methods and systems for minimizing packet bursts. The ‘901 Patent teaches implementing a packet scheduler layer between the network layer and the transport layer of a device, which smooths the delivery of TCP packets by delaying their delivery, thus addressing the challenges posed by the rapid and bursty transmission of data packets in network communications.

25. The ‘901 Patent is directed to solving the problem of TCP packet bursts in high-speed data networks, which can result from the buffering of TCP acknowledgment packets. These bursts can cause packet loss and inefficient use network bandwidth.

26. The ‘901 Patent identifies the shortcomings of the prior art. Specifically, the specification describes that the prior art does not adequately address the issues of packet loss and inefficient bandwidth utilization resulting from the bursty nature of TCP packet transmission in data networks. The prior technologies do not effectively manage the sudden bursts of TCP acknowledgment packets, which can be caused by buffering, leading to suboptimal utilization of available bandwidth and undesirable packet loss.

27. The ‘901 Patent teaches the use of a packet scheduler layer, which is positioned between the network and transport layers of a device. This layer receives, smoothens (by delaying), and sends TCP packets to ensure that the delivery of these packets is managed in a manner that mitigates the issues of packet bursts. The packet scheduler layer manages both incoming and outgoing packets, ensuring that the transmission of these packets is smoothed out, thereby minimizing packet loss and ensuring more efficient use of available bandwidth. This approach provides benefits that differ from conventional methods by ensuring that TCP packet

transmission is managed in a way that minimizes packet loss and ensures efficient bandwidth utilization, thereby addressing the specific challenges posed by TCP packet bursts in high-speed data networks.

28. The invention taught by the '901 Patent solves discrete, technological problems associated with computer systems; specifically, it addresses the issues of packet loss and inefficient bandwidth utilization in high-speed data networks by managing the transmission of TCP packets in a manner that smoothens their delivery, thereby ensuring that the available bandwidth is utilized efficiently, and that packet loss is minimized.

29. The '901 Patent family has been cited by 21 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the '901 Patent family as relevant prior art:

- Lenovo Group Limited
- Telefonaktiebolaget Lm Ericsson
- Qualcomm, Inc.
- Nippon Telegraph & Telephone Corp.
- Hitachi, Ltd.
- Cisco Systems, Inc.
- Akamai Technologies, Inc.
- Huawei Technologies Co., Ltd.

U.S. PATENT NO. 7,616,559

30. U.S. Patent No. 7,616,559 entitled, *Multi-Link Network Architecture, Including Security, In Seamless Roaming Communications Systems And Methods*, was filed on September 2, 2004. The '559 Patent claims priority to Provisional Application No. 60/499,648, which was filed on September 3, 2003. The '559 Patent is subject to a 35 U.S.C. § 154(b) term extension of 638 days. A true and correct copy of the '559 Patent is attached hereto as Exhibit 3.

31. The ‘559 Patent has been in full force and effect since its issuance. OptiMorphix, Inc. owns by assignment the entire right, title, and interest in and to the ‘559 Patent.

32. The ‘559 Patent generally relates to a communications system that provides secure communications of information over multiple communication links. This system includes a client device, a server device, and at least one communication channels, elements, modes, and links for connecting the devices for communication of information between them. The system includes a link detector for determining the existence and usability of the communication links for communication of the information, a pathfinder for selecting one or more of the communication links for communication of at least some of the information, a link handover for switching to the selected one or more communication links for communication of the information or portion thereof, and an auto reconnector for re-connecting to detected and selected one or more communication links for communication of the information or portions of it in the event that any communication is hindered, terminated, or upset.

33. The ‘559 Patent is directed to solving the problem of ensuring secure and reliable communication over multiple communication links, especially in environments that include mobile or other roaming devices capable of communicating over multiple channels and with channel switching characteristics.

34. The ‘559 Patent identifies the shortcomings of the prior art. Specifically, the specification describes that when multiple links, both physical elements and the bands or channels within each such element, are employed for communications in data networks, substantial coordination of communicated information, as well as security of the information, is exponentially complicated. In wireless communications, concurrent or sequential operations can occur over cellular or wireless LAN technologies. Each of these wireless communications methods

experiences substantially greater complexity in timing, security, packet sequencing, data loss, and connectivity, over wired communications conditions.

35. The '559 Patent teaches the use of a system that includes a link detector for determining the existence and usability of the communication links for communication of the information, a pathfinder for selecting one or more of the communication links for communication of at least some of the information, a link handover for switching to the selected one or more communication links for communication of the information or portion thereof, and an auto reconnector for re-connecting to detected and selected one or more communication links for communication of the information or portions of it in the event that any communication is hindered, terminated, or upset.

36. The inventions disclosed in the '559 Patent provide significant benefits and improvements to the function of the hardware in a computer network by ensuring secure and reliable communication over multiple communication links. This is particularly beneficial in environments that include mobile or other roaming devices capable of communicating over multiple channels and with channel switching characteristics. The system's ability to detect usable communication links, select the most suitable ones, switch between them as needed, and reconnect in the event of communication disruption greatly enhances the reliability and efficiency of data transmission in a computer network.

37. The '559 Patent family has been cited by 17 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the '559 Patent family as relevant prior art:

- International Business Machines Corporation
- Samsung Electronics Co., Ltd
- Alphabet Inc.
- Research In Motion Limited

- BT Group plc

U.S. PATENT NO. 9,191,664

38. U.S. Patent No. 9,191,664 entitled, *Adaptive Bitrate Management for Streaming Media Over Packet Networks*, was filed on November 11, 2013. The '664 Patent claims priority to U.S. Provisional patent Application No. 60/948,917, which was filed on July 10, 2007. A true and correct copy of the '664 Patent is attached hereto as Exhibit 4.

39. The '664 Patent has been in full force and effect since its issuance. OptiMorphix, Inc. owns by assignment the entire right, title, and interest in and to the '664 Patent.

40. The '664 Patent is generally directed to adaptive bitrate management for streaming media over packet networks. Specifically, it aims to solve the problem of delivering multimedia content over capacity-limited, shared wireless links. Challenges like sudden bandwidth fluctuations, packet loss, reduction in effective capacity, and limited total bitrate budgets make consistent high-quality streaming difficult over wireless networks. Further, the '664 Patent teaches ways to quickly respond to changes in network conditions by adjusting the bitrate and the media encoding scheme to optimize the viewing and listening experience of the user. It addresses the issue of transferring a fixed bitrate over a connection that cannot provide the necessary throughput, which can lead to undesirable effects such as network buffer overflow, packet loss, and media player buffer underflow.

41. The prior art has several shortcomings that the '664 Patent identifies. Specifically, existing protocols for rate control in media streaming over packet networks were not fully equipped to handle the challenges posed by wireless networks. These challenges include sudden adjustments of nominal transmission rate, packet loss, reduction of effective bandwidth, and limited capacity.

42. To address these issues, the ‘664 Patent teaches in one embodiment an adaptive bitrate manager that monitors feedback information to estimate network conditions. The media is encoded according to the optimal bitrates and provided as encoded streams for transmission.

43. Several benefits and improvements to computer network functionality are provided by the inventions disclosed in the ‘664 Patent. Quickly responding to changes in available network bandwidth allows maintaining consistent streaming quality. Encoding audio and video based on network estimations optimizes the media performance within constrained wireless capacity. Avoiding underflows and overflows through bitrate adaptation enables stable streaming.

44. The ‘664 Patent solves technical problems rooted in streaming multimedia over wireless networks. Challenges like packet loss and volatile transmission rates present discrete technological issues. The ‘664 Patent teaches specific techniques for dynamic adaptation of media encoding in response to feedback-based network estimates. This constitutes an improvement to computer network technology by addressing these streaming challenges.

45. The ‘664 Patent family has been cited by 357 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the ‘664 Patent family as relevant prior art:

- Alphabet Inc.
- Oracle Corporation
- AT&T Inc.
- Telefonaktiebolaget LM Ericsson
- International Business Machines Corp.
- Microsoft Corporation
- Cisco Systems, Inc.
- DISH Network Corp.
- Broadcom Limited
- Amazon.com, Inc.
- Adobe Inc.
- Samsung Electronics Co., Ltd.
- Comcast Corporation
- Canon Inc.

- Technicolor S.A.
- Qualcomm, Inc.
- CommScope, Inc.
- Intel Corporation
- Meta Platforms, Inc.
- Hitachi, Ltd.
- Verizon Communications Inc.

U.S. PATENT NO. 7,987,285

46. U.S. Patent No. 7,987,285 entitled, *Adaptive Bitrate Management for Streaming Media Over Packet Networks*, was filed on July 9, 2008. The '285 Patent claims priority to U.S. Provisional Application No. 60/948,917, which was filed on July 10, 2007. The '285 patent is subject to a 35 U.S.C. § 154(b) term extension of 105 days. A true and correct copy of the '285 Patent is attached hereto as Exhibit 5.

47. The '285 Patent has been in full force and effect since its issuance. OptiMorphix, Inc. owns by assignment the entire right, title, and interest in and to the '285 Patent.

48. The '285 Patent relates to adaptive bitrate management for streaming media over packet networks. It teaches a method that includes receiving a receiver report from a terminal, estimating network conditions of a media network based on the receiver report, determining an optimal session bitrate based on the estimated network conditions, and providing media data to the terminal based on the optimal session bitrate.

49. The '285 Patent is directed to solving the problem of delivering bandwidth-intensive content like multimedia over capacity-limited, shared links, particularly in wireless networks. The challenge is to quickly respond to changes in network conditions by adjusting the bitrate and media encoding scheme to optimize the user's viewing and listening experience. This includes addressing issues like network buffer overflow, packet loss, playback stall, sudden

adjustment of nominal transmission rate, packet loss due to link transmission errors or network congestion, reduction of effective bandwidth, and limited capacity in wireless networks.

50. The ‘285 Patent identifies the shortcomings of the prior art. Specifically, existing rate control protocols and recommendations were insufficient for delivering multimedia sessions over wireless networks. Issues included sudden adjustments in nominal transmission rates, packet loss, reduction of effective bandwidth, limited capacity, infrequent and incomplete network state information, handling different media streams separately, and low bitrates available for wireless multimedia sessions. These challenges made it difficult to set up a consistent streaming media session.

51. The inventions disclosed in the ‘285 Patent provide significant benefits and improvements to the function by enabling more efficient and responsive control over the bitrate of streaming media sessions according to instantaneous network capacity. This leads to better user experience in streaming media over wireless packet networks, minimizing issues like buffer overflow, packet loss, and playback stall. The adaptive bitrate management system can work with existing media players and networks, providing a more robust and flexible solution for streaming media, especially in challenging wireless environments.

52. The inventions disclosed in the ‘285 Patent solve discrete, technological problems associated with computer systems, particularly in the context of streaming media over packet networks. These problems include managing bitrate in fluctuating network conditions, handling different types of media streams, optimizing the viewing and listening experience, and addressing specific challenges in wireless networks such as interference, fading, link transmission errors, network congestion, and limited capacity. The patent provides technical solutions through

adaptive bitrate management, network state estimation, control algorithms, and specific encoding and packetization methods.

53. The ‘285 Patent family has been cited by 357 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the ‘285 Patent family as relevant prior art:

- Alphabet Inc.
- Cisco Systems, Inc.
- Nokia Corporation
- Tencent Holdings Ltd.
- Hitachi Ltd.
- Oracle Corporation
- Microsoft Corporation
- DISH Network Corp.
- Broadcom Limited
- Amazon.com, Inc.
- Samsung Electronics Co., Ltd.
- Comcast Corporation
- Canon Inc.
- Qualcomm, Inc.
- CommScope, Inc.
- Intel Corporation
- Meta Platforms, Inc.
- Verizon Communications Inc.

U.S. PATENT NO. 7,991,904

54. U.S. Patent No. 7,991,904 entitled, *Adaptive Bitrate Management for Streaming Media Over Packet Networks*, was filed on March 31, 2009. The ‘904 Patent claims priority to U.S. Provisional Patent Application No. 60/948,917, which was filed on July 10, 2007. The ‘904 Patent is subject to a 35 U.S.C. § 154(b) term extension of 39 days. A true and correct copy of the ‘904 Patent is attached hereto as Exhibit 6.

55. The ‘904 Patent has been in full force and effect since its issuance. OptiMorphix, Inc. owns by assignment the entire right, title, and interest in and to the ‘904 patent.

56. The ‘904 Patent relates to adaptive bitrate management for streaming media over packet networks. The patent includes a comprehensive framework for adjusting the bitrate of streaming media sessions according to instantaneous network capacity, particularly in wireless packet networks.

57. The ‘904 Patent is directed to solving the problem of rate control for media streaming over packet networks, particularly in wireless environments. The challenge lies in delivering bandwidth-intensive content like multimedia over capacity-limited, shared links and quickly responding to changes in network conditions. The patent addresses issues such as network buffer overflow, packet loss, playback stall, and challenges in implementing bitrate management for pseudo-streaming.

58. The ‘904 Patent identifies the shortcomings of the prior art. Specifically, existing mechanisms for multimedia transport over packet networks, such as streaming protocols (e.g., RTP) and pseudo-streaming (e.g., TCP), had limitations. For example, TCP’s acknowledgment packets are unaware of the media time being transferred, making it difficult to implement a bitrate management algorithm for pseudo-streaming. The prior art also lacked efficient solutions for challenges encountered in delivering multimedia sessions over packet wireless networks, such as sudden adjustments in transmission rate, packet loss, reduction of effective bandwidth, and limited capacity.

59. The inventions disclosed in the ‘904 Patent provide significant benefits and improvements to the function of the hardware in a computer network by enabling adaptive bitrate management for streaming media. This allows for more efficient utilization of network resources, minimizes issues like buffer overflow and packet loss, and enhances the user experience by optimizing the viewing and listening experience. The patent’s approach to adaptive bitrate

management can be applied to various media transports and provides a comprehensive framework for delivering streaming media over wireless packet networks, particularly in fluctuating network conditions.

60. The '904 Patent family has been cited by 357 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the '904 Patent family as relevant prior art:

- Oracle Corporation
- Microsoft Corporation
- Comcast Corporation
- Alphabet Inc.
- International Business Machines Corp.
- Hitachi, Ltd.
- Electronics And Telecommunications Research Institute
- EchoStar Technologies LLC
- Amazon Technologies, Inc.
- Samsung Electronics Co., Ltd.
- Qualcomm, Inc.
- CommScope, Inc.
- Intel Corporation
- Meta Platforms, Inc.
- Verizon Communications Inc.
- Broadcom Limited

U.S. PATENT NO. 8,230,105

61. U.S. Patent No. 8,230,105 entitled, *Adaptive Bitrate Management for Streaming Media Over Packet Networks*, was filed on July 25, 2011. The '105 Patent is a continuation of U.S. Patent Application No. 12/170,347, which was filed July 9, 2008 and issued as U.S. Patent No. 7,987,285, and which claims the benefit of U.S. Provisional Application No. 60/948,917, which was filed July 10, 2007. A true and correct copy of the '105 Patent is attached hereto as Exhibit 7.

62. The '105 Patent has been in full force and effect since its issuance. OptiMorphix, Inc. owns by assignment the entire right, title, and interest in and to the '105 Patent.

63. The ‘105 Patent relates to a method for adaptive bitrate management in streaming media over packet networks. It discloses receiving a receiver report from a terminal, estimating network conditions based on the report, determining an optimal session bitrate according to the estimated network conditions, and providing media data to the terminal based on the optimal session bitrate. The patent emphasizes the need for rate control in delivering bandwidth-intensive content like multimedia over capacity-limited, shared links, and the challenges faced in wireless networks.

64. The ‘105 Patent is directed to solving the problem of delivering consistent and optimized streaming media sessions over packet networks, particularly in wireless networks. The challenges include sudden adjustments in nominal transmission rates, packet loss, reduction of effective bandwidth, limited capacity, and difficulties in setting up a consistent streaming media session.

65. The ‘105 Patent identifies the shortcomings of the prior art. Specifically, existing protocols and methods were inadequate in handling network buffer overflow, playback stall, interference, fading, and other challenges in wireless networks. The existing solutions were not efficient in responding to changes in network conditions, and the typical wireless media player support was limited and sporadic, leading to difficulties in providing a good streaming experience.

66. The ‘105 Patent teaches the use of adaptive bitrate management, which includes an adaptive bitrate controller and a variable bitrate encoder. This framework enables the delivery of self-adjusting streaming sessions to media players, such as standard 3GPP-compliant media players. It adjusts the bitrate according to instantaneous network capacity, optimizes performance by adjusting the streaming media bitrate, and implements joint session bitrate management for audio, video, and other streams simultaneously.

67. The inventions disclosed in the ‘105 Patent provide significant benefits and improvements to the function of the hardware in a computer network by enabling more efficient and adaptive control of streaming media sessions. By dynamically adjusting the bitrate according to network conditions, the invention minimizes issues like buffer overflow, packet loss, and playback stall. It enhances the user’s viewing and listening experience, particularly in wireless networks where traditional methods were inadequate.

68. The inventions taught by the ‘105 Patent solve discrete, technological problems associated with computer systems and networks, particularly in the context of streaming media over packet networks. These problems include network buffer management, bitrate optimization, handling of packet loss, and adjustments to sudden changes in network conditions. The invention addresses these technical challenges through a comprehensive framework that adapts to the network’s instantaneous capacity, ensuring a consistent and optimized streaming experience.

69. The ‘105 Patent family has been cited by 357 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the ‘105 Patent family as relevant prior art:

- Amazon.com, Inc.
- Hulu LLC
- Tencent Holdings Ltd.
- Cisco Systems, Inc.
- Oracle Corporation
- Microsoft Corporation
- Comcast Corporation
- Alphabet Inc.
- International Business Machines Corp.
- Hitachi, Ltd.
- Electronics And Telecommunications Research Institute
- EchoStar Technologies LLC
- Samsung Electronics Co., Ltd.
- Qualcomm, Inc.
- CommScope, Inc.

- Intel Corporation
- Meta Platforms, Inc.
- Verizon Communications Inc.
- Broadcom Limited

U.S. PATENT NO. 8,255,551

70. U.S. Patent No. 8,255,551 entitled, *Adaptive Bitrate Management for Streaming Media Over Packet Networks*, was filed on July 29, 2011. The '551 Patent is a continuation of U.S. Patent Application No. 12/416,085, which was filed March 31, 2009 and issued as U.S. Patent No. 7,991,904, and which is a continuation-in-part of U.S. Patent Application No. 12/170,347, which was filed July 9, 2008 and issued as U.S. Patent No. 7,987,285, which claims the benefit of U.S. Provisional Application No. 60/948,917 filed July 10, 2007. A true and correct copy of the '551 Patent is attached hereto as Exhibit 8.

71. The '551 Patent has been in full force and effect since its issuance. OptiMorphix, Inc. owns by assignment the entire right, title, and interest in and to the '551 Patent.

72. The '551 Patent pertains to adaptive bitrate management for streaming media over packet networks. It discloses a method that includes providing pseudo-streaming media data to a terminal, receiving a TCP acknowledgment, estimating network conditions based on the acknowledgment, determining an optimal session bitrate, and providing pseudo-streaming media data based on this optimal bitrate. The patent describes mechanisms for adjusting the bitrate of streaming media according to instantaneous network capacity, which is essential for delivering bandwidth-intensive content like multimedia over capacity-limited, shared links.

73. The '551 Patent is directed to solving the problem of rate control for media streaming over packet networks, particularly in wireless environments. The challenge lies in quickly responding to changes in network conditions by adjusting the bitrate and media encoding

scheme to optimize the user's viewing and listening experience. This includes addressing issues such as network buffer overflow, packet loss, playback stall, and the challenges encountered in delivering multimedia sessions over packet wireless networks.

74. The '551 Patent identifies the shortcomings of the prior art. Specifically, traditional methods of rate control in packet networks are inadequate for handling the complexities of multimedia streaming. The prior art also lacks efficient adaptive bitrate management for wireless mobile phones, with challenges such as infrequent and incomplete network state information, separate handling of different media streams, and low media bitrates.

75. The inventions disclosed in the '551 Patent provide significant benefits and improvements to the function of the hardware in a computer network by enabling precise control over the bitrate of streaming media. This leads to an optimized user experience by minimizing issues like buffer overflow, packet loss, and playback stall. The adaptive bitrate management framework allows for joint session bitrate management for audio, video, and other streams simultaneously, and can be applied to all media transports that provide transmission progress report mechanisms. It also offers solutions tailored to the challenges of wireless networks, enhancing the quality of multimedia streaming in mobile environments.

76. The '551 Patent addresses challenges and limitations specific to packet networks, particularly in the context of streaming media. For example, packet networks are often subject to rapid fluctuations in bandwidth and latency. These fluctuations can be caused by various factors such as interference, signal strength, user mobility, and network congestion. The '551 Patent's adaptive bitrate management system is designed to continuously monitor network conditions and adjust the streaming bitrate accordingly, ensuring a consistent user experience despite these fluctuations.

77. The ‘551 Patent addresses the inherent challenges and limitations of packet networks by providing a technological solution to handover challenges and Qualify of Service (QoS) management. Specifically, as mobile devices move between different wireless access points or network types, seamless handover is essential to maintain an uninterrupted streaming experience. The technologies taught in the ‘551 Patent are designed to handle these transitions smoothly, adapting to the new network conditions without disrupting the media playback. Further, ensuring QoS in wireless networks is complex due to the shared and unpredictable nature of the medium. The ‘551 Patent discloses technology to manage the QoS by dynamically adjusting the bitrate and encoding scheme based on real-time network conditions, ensuring that the desired level of service is maintained.

78. The ‘551 Patent family has been cited by 357 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the ‘551 Patent family as relevant prior art:

- Alphabet Inc.
- Oracle Corporation
- AT&T Inc.
- Telefonaktiebolaget LM Ericsson
- International Business Machines Corp.
- Microsoft Corporation
- Cisco Systems, Inc.
- DISH Network Corp.
- Broadcom Limited
- Amazon.com, Inc.
- Adobe Inc.
- Samsung Electronics Co., Ltd.
- Comcast Corporation
- Canon Inc.
- Technicolor S.A.
- Qualcomm, Inc.
- CommScope, Inc.
- Intel Corporation
- Meta Platforms, Inc.

- Hitachi, Ltd.
- Verizon Communications Inc.

U.S. PATENT NO. 10,412,388

79. U.S. Patent No. 10,412,388 entitled, *Framework for Quality-Aware Video Optimization*, was filed on January 8, 2018. The '388 Patent claims priority to U.S. Patent Application No. 12/751,951, which was filed on March 31, 2010, and which claims priority to U.S. Provisional Patent Application No. 61/165,224, which was filed on March 31, 2009. A true and correct copy of the '388 Patent is attached hereto as Exhibit 9.

80. The '388 Patent has been in full force and effect since its issuance. OptiMorphix, Inc. owns by assignment the entire right, title, and interest in and to the '388 Patent.

81. The '388 Patent generally relates to a method and system for quality-aware video optimization. It teaches receiving an encoded video frame, decompressing it, extracting a first quantization parameter (QP), and acquiring a delta QP based on the first QP. The method also includes acquiring a second QP based on the delta QP and the first QP, compressing the decompressed video frame based on the second QP, and providing the compressed video frame. The process allows for fine control of quality degradation in byte-reduced content and can be applied to transcoding scenarios where the input and output compression formats are different.

82. The '388 Patent identifies the shortcomings of the prior art. Specifically, existing single-pass rate control techniques had a problem in that the relationship between the compressed byte size of a video frame and its quantization parameter were only known after the frame is encoded. This made it challenging to achieve byte reduction and controllable quality degradation in a single pass.

83. The ‘388 Patent teaches the use of a quality-aware video optimization technique that modifies a video frame sequence to reduce the byte size while limiting perceptual quality degradation to a controllable level.

84. The inventions disclosed in the ‘388 Patent provide significant benefits and improvements to the function of hardware in a computer network by enabling efficient video optimization. The method allows for single-pass, on-the-fly quality-aware optimization, making it well-suited for various environments, including live video feeds and storage arrays.

85. The ‘388 patent family has been cited by 30 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the ‘388 Patent family as relevant prior art:

- Interdigital, Inc.
- Tencent Holdings Ltd
- Microsoft Corporation
- Qualcomm, Inc.
- Lattice Semiconductor
- Openwave Mobility, Inc.
- Samsung Electronics Co., Ltd.
- Beijing Dajia Interconnection Information Technology Co., Ltd.

U.S. PATENT NO. 9,894,361

86. U.S. Patent No. 9,894,361 entitled, *Framework for Quality-Aware Video Optimization*, was filed on March 31, 2010. The ‘361 Patent claims priority to U.S. Provisional Application No. 61/165,224, which was filed on March 31, 2009. The ‘361 Patent is subject to a 35 U.S.C. § 154(b) term extension of 1,038 days. A true and correct copy of the ‘361 Patent is attached hereto as Exhibit 10.

87. The ‘361 patent has been in full force and effect since its issuance. OptiMorphix, Inc. owns by assignment the entire right, title, and interest in and to the ‘361 Patent.

88. The ‘361 Patent relates to a method and system for quality-aware video optimization. Specifically, it teaches receiving an encoded video frame, decompressing it, extracting a first quantization parameter (QP), and acquiring a delta QP based on the first QP. The method further includes acquiring a second QP based on the delta QP and the first QP, compressing the decompressed video frame based on the second QP, and providing the compressed video frame. The process is designed to reduce the byte size of the video stream as much as possible while limiting perceptual quality degradation to a controllable level.

89. The ‘361 Patent is directed to solving the problem of optimizing video quality in a way that balances the reduction of byte size with the preservation of perceptual quality. This involves a nuanced understanding of how quantization parameters (QPs) affect both the perceptual quality and the bitrate of a video frame, and how to manipulate these QPs to achieve the desired balance.

90. The ‘361 Patent identifies the shortcomings of the prior art. Specifically, existing single-pass rate control techniques had a problem in that the relationship between the compressed byte size of a video frame and its quantization parameter was only known after the frame was encoded. This made it challenging to achieve byte reduction and controllable quality degradation in a single pass.

91. The ‘361 Patent teaches the use of a quality-aware video optimization technique that requires only a single pass over the previously encoded video frame sequence to optimize the video frame sequence. It introduces a novel function that defines ΔQP according to the value of QPInput, allowing fine control of quality degradation in the byte-reduced content. It also considers differences between input and output compression formats (codecs) and computes codec adjustment that accounts for these differences.

92. The inventions disclosed in the '361 Patent provide significant benefits and improvements to the function of hardware in a computer network by enabling efficient video optimization. By allowing for single-pass, on-the-fly, quality-aware optimization, the patent's methods can be applied in various environments, including optimizing live video feeds before they traverse a low-capacity network segment, or optimizing surveillance video before archiving, thus saving storage space and network bandwidth.

93. The '361 Patent family has been cited by 30 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the '361 Patent family as relevant prior art:

- Interdigital, Inc.
- Tencent Holdings Ltd
- Microsoft Corporation
- Qualcomm, Inc.
- Lattice Semiconductor
- Openwave Mobility, Inc.
- Samsung Electronics Co., Ltd.
- Beijing Dajia Interconnection Information Technology Co., Ltd.

U.S. PATENT NO. 10,123,015

94. U.S. Patent No. 10,123,015 entitled, *Macroblock-Level Adaptive Quantization in Quality-Aware Video Optimization*, was filed on April 10, 2017. The '015 patent claims priority to U.S. Application No. 13/492,619, which was filed on June 8, 2012, and which issued as U.S. Patent No. 9,621,896. The '015 Patent claims priority to U.S. Provisional Application No. 61/495,951, which was filed on June 10, 2011. A true and correct copy of the '015 Patent is attached hereto as Exhibit 11.

95. The '015 Patent has been in full force and effect since its issuance. OptiMorphix, Inc. owns by assignment the entire right, title, and interest in and to the '015 patent.

96. The ‘015 Patent teaches systems and methods for macroblock-level quality-aware video optimization. Unlike traditional methods that apply uniform compression settings across video frames, this approach focuses on adjusting compression at the macroblock level—small sections of a video frame. By analyzing each macroblock’s visual and compression characteristics, the system dynamically determines the appropriate quantization parameter (QP) to optimize the balance between file size and visual quality.

97. The technologies taught in the ‘015 Patent address the challenge of efficiently compressing video while preserving critical details, especially in regions with high visual complexity. Traditional methods fail to account for differences within a frame, leading to unnecessary quality degradation or inefficient compression. By tailoring QP settings to individual macroblocks, this system ensures better preservation of important visual elements, such as faces or text, while reducing the overall data size.

98. The ‘015 Patent provides significant benefits and improvements to the function of the hardware in a computer network by significantly reducing the necessary bitrate necessary to transmit video data with minimal perceptual quality loss. This is critical for computer networks to be able to deliver live-streamed video content and to deliver video content through low-bandwidth networks.

99. The ‘015 Patent has been cited by at least 29 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the ‘015 patent family as relevant prior art:

- Microsoft Technology Licensing, LLC
- Google LLC
- Apple Inc.
- Samsung Electronics Co., Ltd.
- Qualcomm Incorporated
- Netflix, Inc.

- Sharp Corporation
- Tencent Technology (Shenzhen) Co., Ltd.
- Huawei Technologies Co., Ltd.
- Magnum Semiconductor, Inc.
- Integrated Device Technology, Inc.

COUNT I
INFRINGEMENT OF U.S. PATENT NO. 7,136,353

100. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

101. NVIDIA designs, makes, uses, sells, and/or offers for sale in the United States products comprising technology for managing multiple connections for sending data packets between a sender and a receiver in a computer network.

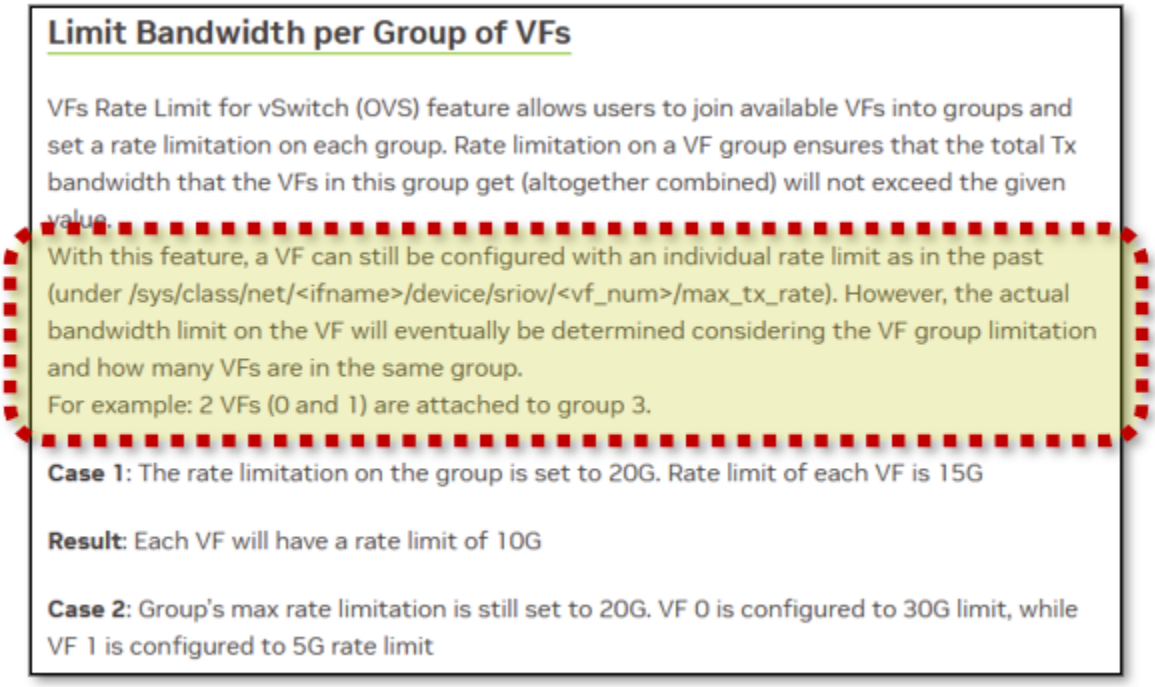
102. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses the following products: NVIDIA BlueField-3 SuperNICs (including model numbers: B3140H, B3140L, B3210L, and B3220L); ConnectX-8 SuperNIC Series; ConnectX-7 SuperNIC (including model numbers: 900-9X766-003N-SQ01, 900-9X766-003N-SR0, 900-9X766-003N-ST02, 900-9X7AH-0076-ST0, 900-9X7AH-0086-SQ0, 900-9X7AO-0003-ST0, 900-9X7AO-00C3-STZ, 900-9X7AH-004N-CT0, 900-9X721-003N-DT0, 900-9X721-003N-DT1, 900-9X760-0018-MB2, 900-9X760-0078-MB0, 900-9X7AH-0039-ST1, 900-9X7AH-0039-STZ, 900-9X7AH-004N-GT0, 900-9X7AH-0078-DTZ, 900-9X7AH-0078-ST0, 900-9X7AH-0079-DTZ, 900-9X7AH-0088-ST0, 900-9X7AX-003NMC0, 900-9X7AX-004NMC0); ConnectX-6 Dx SuperNIC (including model numbers: 900-9X6AP-0073-ST0, 900-9X663-0073-SQ0, 900-9X663-0083-SQ0, 900-9X6AG-0016-ST0, 900-9X6AG-0086-ST0, 900-9X6AG-0056-ST1, 900-9X6AG-0076-ST0, 900-9X6AK-0086-SQ0, 900-9X6AK-0086-SQ1, 900-9X6AG-0048-ST0, 900-9X6AG-0018-ST0, MCX621102AN-ADAT, MCX621102AC-ADAT, MCX623102AC-ADAT, MCX623102AN-ADAT, MCX621102AE-ADAT, MCX623102AC-GDAT, MCX623102AN-

GDAT, MCX623102AE-GDAT, MCX623102AS-GDAT, MCX623106PC-CDAT, MCX623105AC-CDAT, MCX623105AE-CDAT, MCX623106AE-CDAT, MCX623109AC-CDAT, MCX623109AN-CDAT, MCX623106GN-CDAT, MCX623106PC-CDAT, MCX623106PE-CDAT, MCX623106PN-CDAT, MCX623106TN-CDAT, MCX623105AE-VDAT, MCX623105AS-VDAT, 900-9X624-0073-SB0, 900-9X658-0016-SB0, 900-9X658-0046-SB0, 900-9X658-0056-MB0, 900-9X658-0076-MB0, 900-9X675-0076-MB0, 900-9X658-0086-SB0, 900-9X658-0056-SB1, 900-9X658-0046-SI0, 900-9X624-0063-SB0, 900-9X624-0085-SB0, 900-9X624-0075-SI0, 900-9X658-0026-SB0, 900-9X658-0038-SI0, 900-9X658-0066-SB0, 900-9X658-0076-SI0, 900-9X675-0046-MB0, 900-9X624-0083-SB0, 900-9X624-0003-SB0, 900-9X624-0055-SB0, 900-9X658-0048-SB0, 900-9X658-0016-MB0, 900-9X658-0018-SB0, 900-9X671-0046-SN0, 900-9X671-0016-SN0, 900-9X671-0018-SN0); ConnectX-6 Lx SuperNIC (including model numbers: 900-9X662-0053-ST1, 900-9X662-0083-ST0, 900-9X662-0073-ST0, 900-9X662-0063-ST0, 900-9X601-0025-ST0, 900-9X601-0015-SQ0, 900-9X601-0045-ST0, 900-9X625-0053-SB0, 900-9X625-0083-SB0, 900-9X625-0073-SB1, 900-9X659-0015-SB1, 900-9X659-0045-SB0, 900-9X625-0073-SB1, 900-9X625-0063-SB0, 900-9X625-0073-SI0, 900-9X659-0025-SB0); ConnectX-6 SuperNIC (including model numbers: 900-9X0BC-001H-ST1, 900-9X603-0016-DT0, 900-9X603-0056-DT0, 900-9X628-0016-ST0, 900-9X6AF-0016-ST1, 900-9X6AF-0018-MT2, 900-9X6AF-0018-SS0, 900-9X6AF-0056-MT1, 900-9X6AF-0058-MT1, 900-9X6AF-0058-SS0, 900-9X6AF-0058-ST1, 900-9X6B4-0018-DT1, 900-9X6B4-0018-DT2, 900-9X6B4-0056-DT0, 900-9X6B4-0056-DT1, 900-9X6B4-0058-DT0, 900-9X6B4-0058-DT1, 900-9X657-0008-SI0, 900-9X657-0018-MI0, 900-9X657-0058-SI2, 900-9X657-0058-SB0, 900-9X657-0018-SI0, 900-9X657-0016-SI0, 900-9X657-0018-SE0); ConnectX-5 Ex SuperNIC (including model numbers: 900-9X556-0055-MI0, 900-9X556-0016-

MI0, 900-9X556-0016-MB0, 900-9X556-0056-SI0, 900-9X556-0056-SB0, 900-9X569-0054-SN0, 900-9X569-0056-SN1, 900-9X569-0056-SN0,); and ConnectX-5 SuperNIC, (including model numbers: 900-9X523-0053-SI1, 900-9X523-0053-SB1, 900-9X556-0056-SI1, 900-9X556-0016-SB0, 900-9X513-0053-SN1, 900-9X513-0053-SN2, 900-9X513-0053-SN0, 900-9X568-0015-SN0, 900-9X568-0016-SN4, 900-9X568-0016-SN1, 900-9X568-0016-SN2, 900-9X568-0016-SN3, 900-9X568-0016-SN0, 900-9X568-0016-MN1) (collectively, the "NVIDIA '353 Product(s)").

103. One or more NVIDIA subsidiaries and/or affiliates use the NVIDIA '353 Products in regular business operations.

104. The NVIDIA '353 Products determine a host-level transmission rate between the sender and receiver by summing a current transmission rate associated with each of a plurality of connections. For example, the NVIDIA '353 Products enable determining a bandwidth limit based on the sum of individual VFs.



Limit Bandwidth per Group of VFs

VFs Rate Limit for vSwitch (OVS) feature allows users to join available VFs into groups and set a rate limitation on each group. Rate limitation on a VF group ensures that the total Tx bandwidth that the VFs in this group get (altogether combined) will not exceed the given value.

With this feature, a VF can still be configured with an individual rate limit as in the past (under /sys/class/net/<ifname>/device/sriov/<vf_num>/max_tx_rate). However, the actual bandwidth limit on the VF will eventually be determined considering the VF group limitation and how many VFs are in the same group.
For example: 2 VFs (0 and 1) are attached to group 3.

Case 1: The rate limitation on the group is set to 20G. Rate limit of each VF is 15G

Result: Each VF will have a rate limit of 10G

Case 2: Group's max rate limitation is still set to 20G. VF 0 is configured to 30G limit, while VF 1 is configured to 5G rate limit

Single Root IO Virtualization (SR-IOV), NVIDIA MLNX_OFED DOCUMENTATION V24.07-0.6.1.0 (last visited November 2024), *available at:* https://docs.nvidia.com/networking/display/mlnxofedv24070610/ (emphasis added).

105. The NVIDIA '353 Products identify a present transmission rate for individual connections between a host and client device.

106. The NVIDIA '353 Products conduct automated bandwidth discovery in which a bandwidth test is performed by sending a short burst of bidirectional traffic and measuring the received rate at each end.

107. The NVIDIA '353 Products compute a host-level transmission rate by totaling the current transmission rates over several connections.

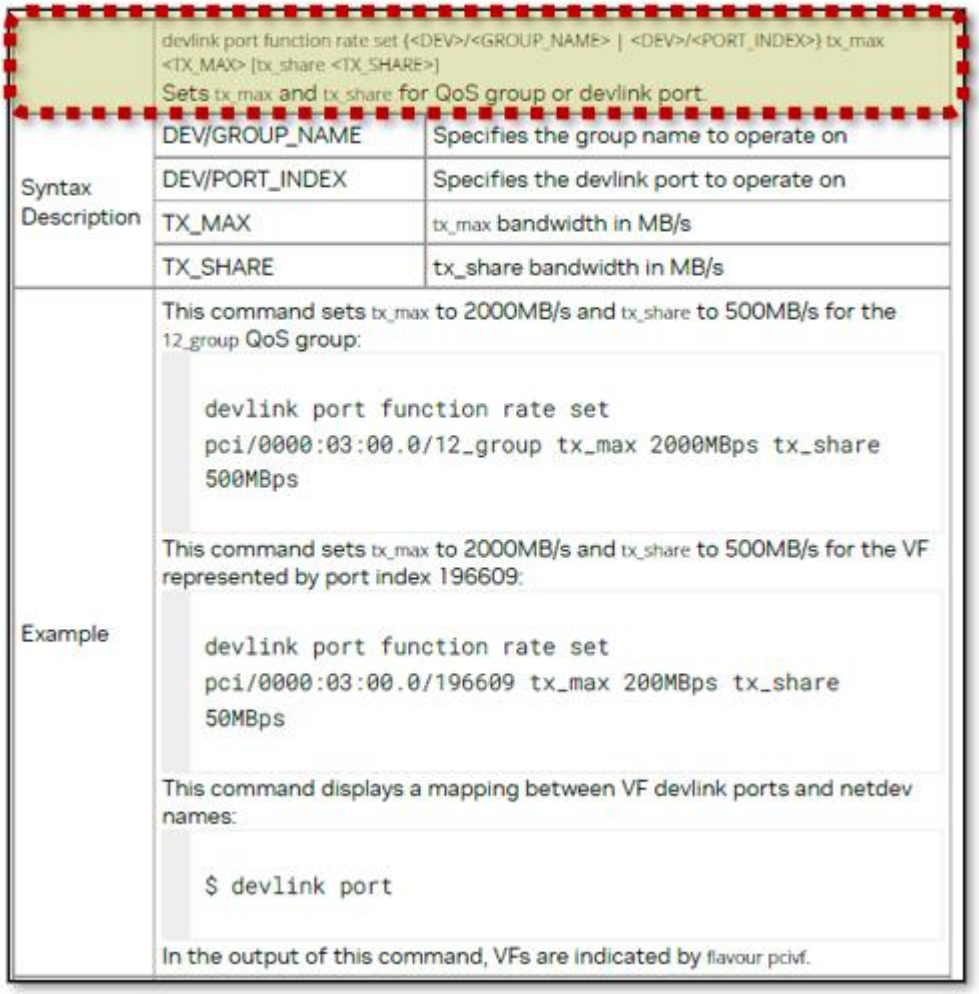
108. The NVIDIA '353 Products perform bandwidth aggregation across connections that utilizes all available links to deliver packets across different connections.

109. The NVIDIA '353 Products allocate the host-level transmission rate across multiple connections based on a ratio of a weight related to each connection and the total of the weights for set of multiple connections.

110. The NVIDIA ‘353 Products choose data packets for transmission in a way that each chosen data packet is linked with the connection exhibiting the greatest discrepancy between the allocated transmission rate and the actual transmission rate for the connection.

111. The NVIDIA ‘353 Products perform packet scheduling including through the use of a guaranteed minimum aggregate bandwidth during congestion based on scheduler weight (or percentage of bandwidth.

112. The NVIDIA ‘353 Products allocate the host-level transmission rate among the plurality of connections based on a ratio of a weight associated with each connection and a sum of the weights for the plurality of connections. For example, the tx_share parameter works in conjunction with tx_max to achieve weighted allocation. Each VF within a group is assigned a share (tx_share) by the NVIDIA ‘353 Products. The NVIDIA ‘353 Products determine a guaranteed minimum bandwidth from the total allocated bandwidth (tx_max) of the group.



devlink port function rate set {<DEV>/<GROUP_NAME> | <DEV>/<PORT_INDEX>} tx_max <TX_MAX> [tx_share <TX_SHARE>]

Sets tx_max and tx_share for QoS group or devlink port.

Syntax Description	DEV/GROUP_NAME	Specifies the group name to operate on
	DEV/PORT_INDEX	Specifies the devlink port to operate on
	TX_MAX	tx_max bandwidth in MB/s
	TX_SHARE	tx_share bandwidth in MB/s

Example

This command sets tx_max to 2000MB/s and tx_share to 500MB/s for the 12_group QoS group:

```
devlink port function rate set
pci/0000:03:00.0/12_group tx_max 2000MBps tx_share
500MBps
```

This command sets tx_max to 2000MB/s and tx_share to 500MB/s for the VF represented by port index 196609:

```
devlink port function rate set
pci/0000:03:00.0/196609 tx_max 200MBps tx_share
50MBps
```

This command displays a mapping between VF devlink ports and netdev names:

```
$ devlink port
```

In the output of this command, VFs are indicated by flavour pcivf.

NVIDIA BlueField BSP v4.8.0, NVIDIA DOCUMENTATION at 524 (November 2024) (emphasis added).

113. The NVIDIA '353 Products transmit data packets from the host across the related connections based on data packets associated with connections having a highest difference between the allocated transmission rate and an actual transmission rate are transmitted first. Further, each data packet being transmitted from the sender is transmitted in response to each expiration of a transmission timer having a period corresponding to the host-level transmission rate.

114. The NVIDIA '353 Products use intelligent packet scheduling based on differences between allocated transmission rates and actual rates for each connection. Specifically, the NVIDIA '353 Products enable packet pacing.

Push/Pop VLAN	Added support for Push/Pop VLAN, new FLOW TABLE ENTRY actions. These new actions are used by the driver to implement Q-in-Q functionality. For further information, please refer to the PRM section *Flow Table*
Packet Pacing	Added support for Packet Pacing in ConnectX-5 adapter cards. Packet Pacing (traffic shaping) is a rate-limited flow per Send QPs. A rate-limited flow is allowed to transmit a few packets before its transmission rate is evaluated, and the next packet is scheduled for transmission accordingly. Setting and changing the rate is done by modifying the QP.

MELLANOX CONNECTX-5 FIRMWARE RELEASE NOTES REV 16.24.4020 at 36 (2019) (emphasis added).

115. NVIDIA has directly infringed and continues to directly infringe the '353 Patent by, among other things, making, using, offering for sale, and/or selling technology for managing multiple connections for sending data packets between a sender and a receiver in a computer network, including but not limited to the NVIDIA '353 Products.

116. The NVIDIA '353 Products are available to businesses and individuals throughout the United States.

117. The NVIDIA '353 Products are provided to businesses and individuals located in this District.

118. By making, using, testing, offering for sale, and/or selling products and services comprising technology for managing multiple connections for sending data packets between a sender and a receiver in a computer network, including but not limited to the NVIDIA '353 Products, NVIDIA has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '353 Patent, including at least claim 13 pursuant to 35 U.S.C. § 271(a).

119. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '353 Patent.

120. As a result of NVIDIA's infringement of the '353 Patent, Plaintiff has suffered monetary damages, and seek recovery in an amount adequate to compensate for NVIDIA's infringement, but in no event less than a reasonable royalty for the use made of the invention by NVIDIA together with interest and costs as fixed by the Court.

COUNT II
INFRINGEMENT OF U.S. PATENT NO. 8,521,901

121. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

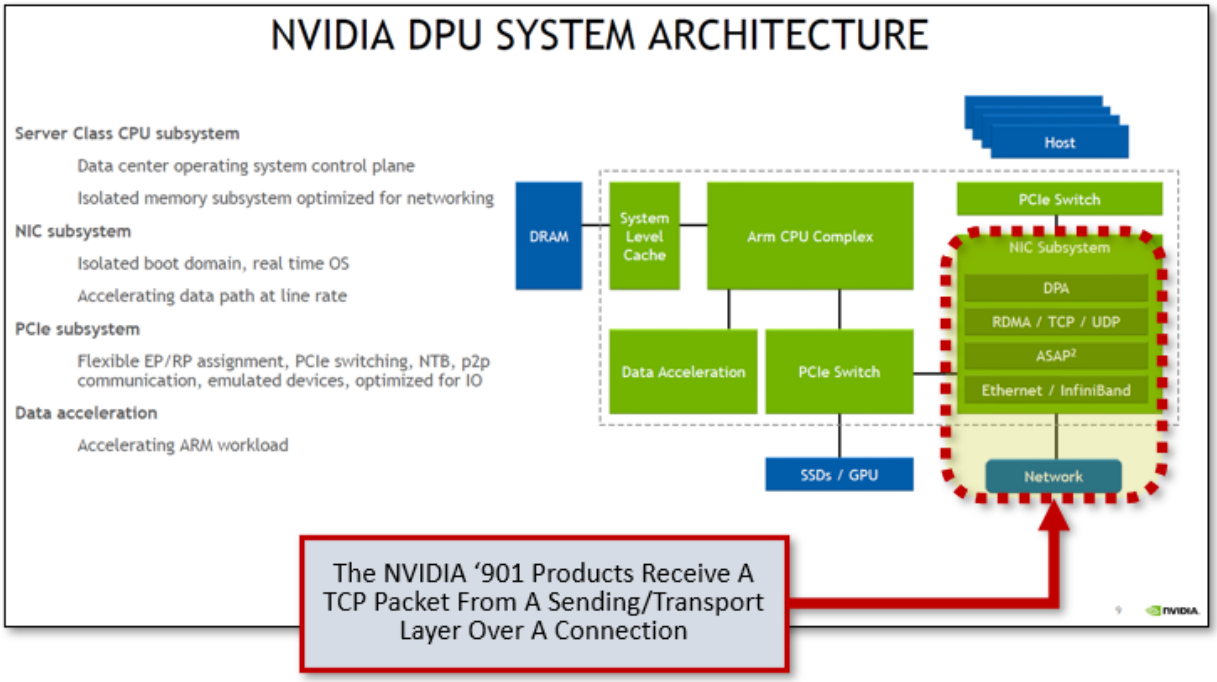
122. NVIDIA designs, makes, uses, sells, and/or offers for sale in the United States products comprising technology for a data packet scheduler that reduces packet bursts.

123. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses the following products: NVIDIA BlueField-3 Platform (including model numbers: 900-9D3B6-00CN-AB0, 900-9D3B6-00SN-AB0, 900-9D3B6-00CN-PA0, 900-9D3B6-00CV-AA0, 900-9D3B6-00SV-AA0, 900-9D3B6-00CC-EA0, 900-9D3B6-00SC-EA0, 900-9D3B4-00CC-EA0, 900-9D3B4-00SC-EA0, 900-9D3B4-00CV-EA0, 900-9D3B4-00SV-EA0, 900-9D3B4-00EN-EA0, 900-9D3B4-00PN-EA0, 900-9D3D4-00EN-HA0, 900-9D3D4-00NN-HA0, 900-9D3B6-00CC-AA0, 900-9D3B6-00SC-AA0) and ConnectX-7 SuperNIC (including model numbers: 900-9X766-003N-SQ01, 900-9X766-003N-SR0, 900-9X766-003N-ST02, 900-9X7AH-0076-ST0, 900-9X7AH-0086-SQ0, 900-9X7AO-0003-ST0, 900-9X7AO-00C3-STZ, 900-9X7AH-004N-CT0, 900-9X721-003N-DT0, 900-9X721-003N-DT1, 900-9X760-0018-MB2, 900-9X760-0078-MB0, 900-9X7AH-0039-ST1, 900-9X7AH-0039-STZ, 900-9X7AH-004N-GT0, 900-9X7AH-0078-DTZ, 900-9X7AH-0078-ST0, 900-9X7AH-0079-DTZ, 900-9X7AH-0088-ST0, 900-9X7AX-003NMC0, 900-9X7AX-004NMC0) (collectively, the "NVIDIA '901 Product(s)").

124. One or more NVIDIA subsidiaries and/or affiliates use the NVIDIA '901 Products in regular business operations.

125. The NVIDIA '901 Products receive a transmission control protocol (TCP) packet from a sending layer on the first device. The sending layer is one of the network interface layer or the transport layer and the TCP packet is sent over a connection between the first device and a second device.

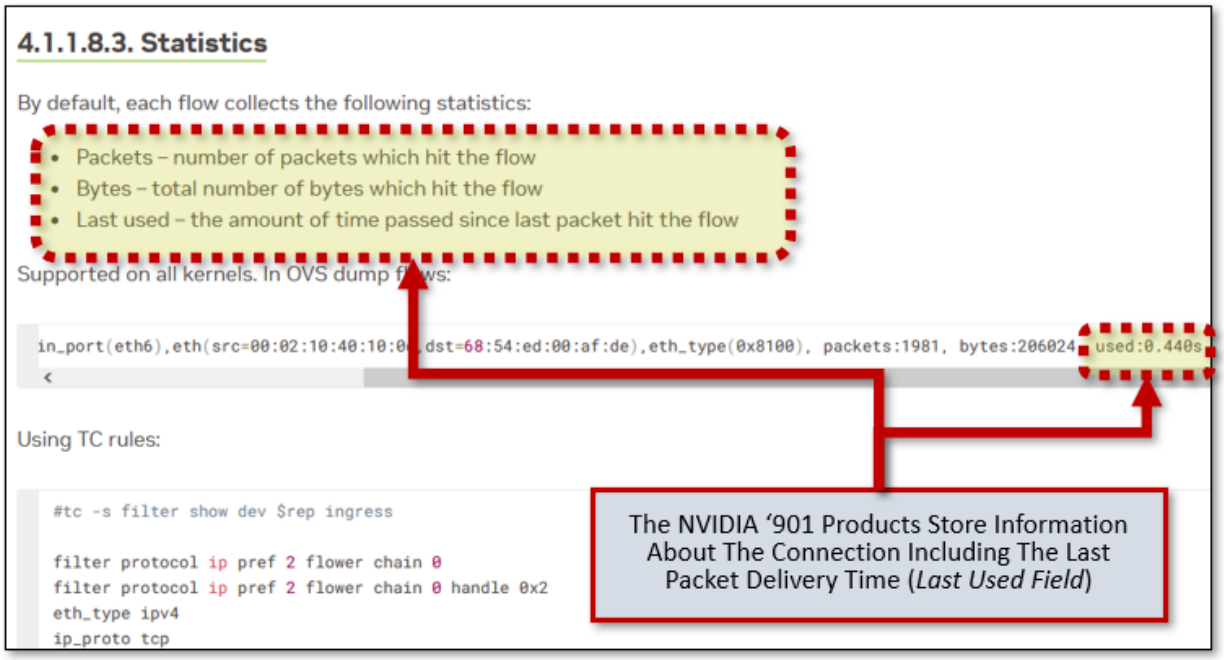
126. The NVIDIA '901 Products receive TCP packets from a sending layer (either the network interface layer or the transport layer) on another device (e.g., a host server or another BlueField device).



Idan Burstein, *NVIDIA Data Center Processing Unit (DPU) Architecture*, HOTCHIPS CONFERENCE PRESENTATION at 9 (2021) (annotation added).

127. NVIDIA '901 Products contain functionality for receiving and sending TCP packets and comprise functionality for optimizing the flow of data between devices over various network paths.

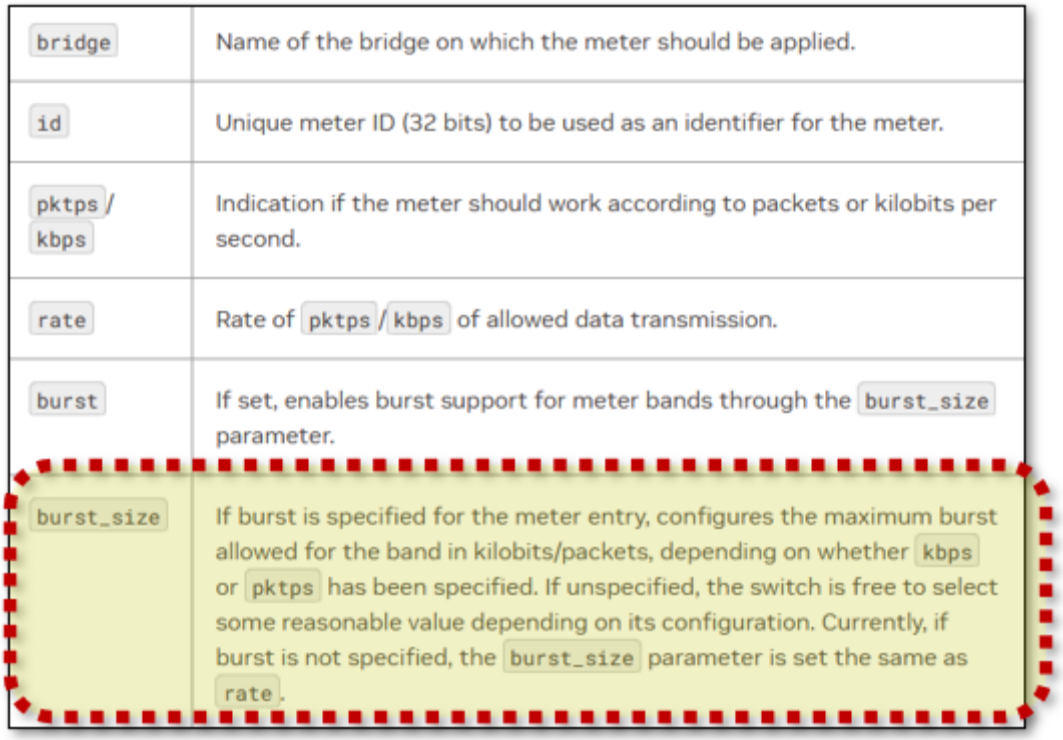
128. The NVIDIA '901 Products store, at the first device, information about the connection between the first device and the second device, the information including a last packet delivery time for the connection. The NVIDIA '901 Products maintain stateful information about network connections. The NVIDIA '901 Products store metadata such as connection identifiers, sequence numbers, and timing information. Specifically, the NVIDIA '901 Products keep a record of the last packet delivery time for a TCP connection to monitor latency.



NVIDIA BlueField DPUs / SuperNICs & DOCA – DOCA Documentation v2.2.0, NVIDIA DOCUMENT HUB (last visited November 2024), *available at:* https://docs.nvidia.com/doca/archive/doca-v2.2.0/ (annotation added).

129. The NVIDIA '901 Products determine whether a TCP packet is part of a bursty transmission on the connection by ascertaining that a burst count of the connection is greater than a burst-count threshold. Specifically, The NVIDIA '901 Products perform rate limiting and related QoS features. By monitoring the packet arrival rate for a connection and comparing it against a burst-count threshold, NVIDIA '901 Products can determine if a transmission is bursty. The "burst

count" includes the parameter value specified by the number of packets arriving within a defined time window.



`bridge`	Name of the bridge on which the meter should be applied.
`id`	Unique meter ID (32 bits) to be used as an identifier for the meter.
`pktps` / `kbps`	Indication if the meter should work according to packets or kilobits per second.
`rate`	Rate of `pktps` / `kbps` of allowed data transmission.
`burst`	If set, enables burst support for meter bands through the `burst_size` parameter.
`burst_size`	If burst is specified for the meter entry, configures the maximum burst allowed for the band in kilobits/packets, depending on whether `kbps` or `pktps` has been specified. If unspecified, the switch is free to select some reasonable value depending on its configuration. Currently, if burst is not specified, the `burst_size` parameter is set the same as `rate`.

NVIDIA BlueField DPUs / SuperNICs & DOCA – DOCA Documentation v2.2.0, NVIDIA DOCUMENT HUB (last visited November 2024), *available at:* https://docs.nvidia.com/doca/archive/doca-v2.2.0/ (emphasis added).

130. NVIDIA '901 Products calculate a delay time for a connection using the last packet delivery time after determining that the TCP packet is part of a bursty transmission. Specifically, the NVIDIA '901 Products measure latency and jitter for each connection/link. This measurement is then used to determine the burstiness of a TCP packet transmission.

131. The NVIDIA '901 Products contain functionality for delivering the TCP packet to a receiving layer based on the calculated delay time, wherein the receiving layer is either the network interface layer or the transport layer that is not the sending layer. Specifically, the NVIDIA '901 Products manage packet transmission times and delays as part of the NVIDIA '901 Product's traffic optimization and prioritization functionality.

132. The NVIDIA '901 Products enable sending the TCP packet to the receiving layer.

133. NVIDIA has directly infringed and continues to directly infringe the '901 Patent by, among other things, making, using, offering for sale, and/or selling technology for a data packet scheduler that reduces packet bursts, including but not limited to the NVIDIA '901 Products.

134. The NVIDIA '901 Products are available to businesses and individuals throughout the United States.

135. The NVIDIA '901 Products are provided to businesses and individuals located in this District.

136. By making, using, testing, offering for sale, and/or selling products and services comprising technology for a data packet scheduler that reduced packet bursts, including but not limited to the NVIDIA '901 Products, NVIDIA has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '901 Patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

137. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '901 Patent.

138. As a result of NVIDIA's infringement of the '901 Patent, Plaintiff has suffered monetary damages, and seek recovery in an amount adequate to compensate for NVIDIA's infringement, but in no event less than a reasonable royalty for the use made of the invention by NVIDIA together with interest and costs as fixed by the Court.

COUNT III
INFRINGEMENT OF U.S. PATENT NO. 7,616,559

139. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

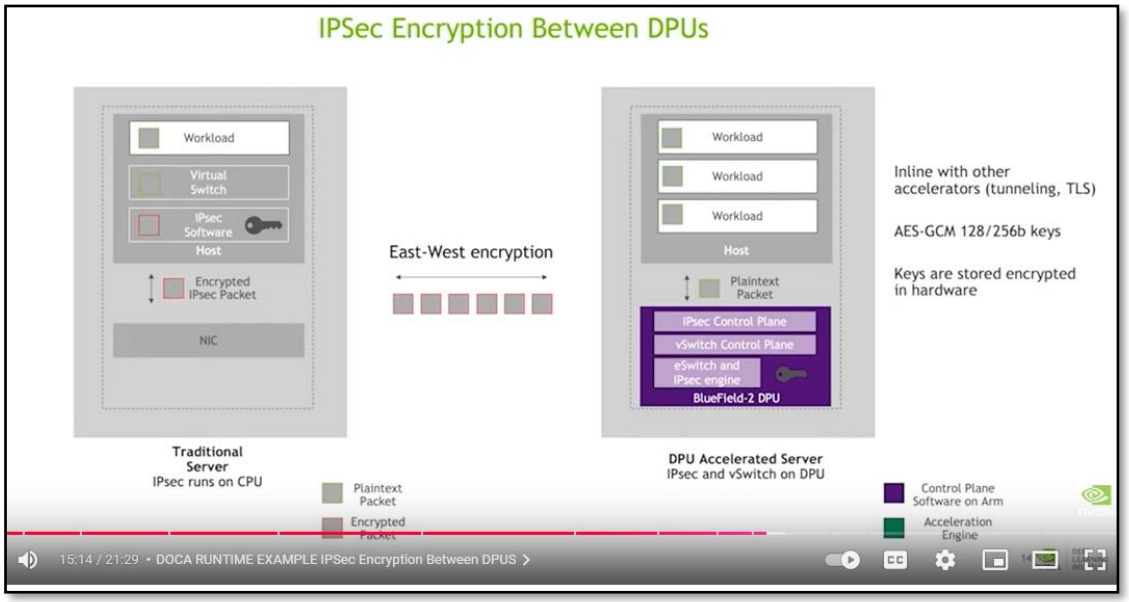
140. NVIDIA designs, makes, uses, sells, and/or offers for sale in the United States products that communicate information over multiple communications links.

141. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses the following products: NVIDIA BlueField-3 Networking Platform (including model numbers: B3240, B3220, B3210E, B3140H, B3140L, B3210L, B3220L, B3210) (collectively, the "NVIDIA '559 Product(s)").

142. One or more NVIDIA subsidiaries and/or affiliates use the NVIDIA '559 Products in regular business operations.

143. The NVIDIA '559 Products identify an initial communication path with a specific security protocol for the transmission of data between a client system and a server system.

144. The NVIDIA '559 Products detect a first communications link having a first security feature for communicating data between a client device and a server device. For example, the NVIDIA '559 Products detect an IPsec or MACsec link over a physical or virtual interface. Constitute a first security for the first communications link as the IPSec and MACsec protocols offer specific encryption functionality.

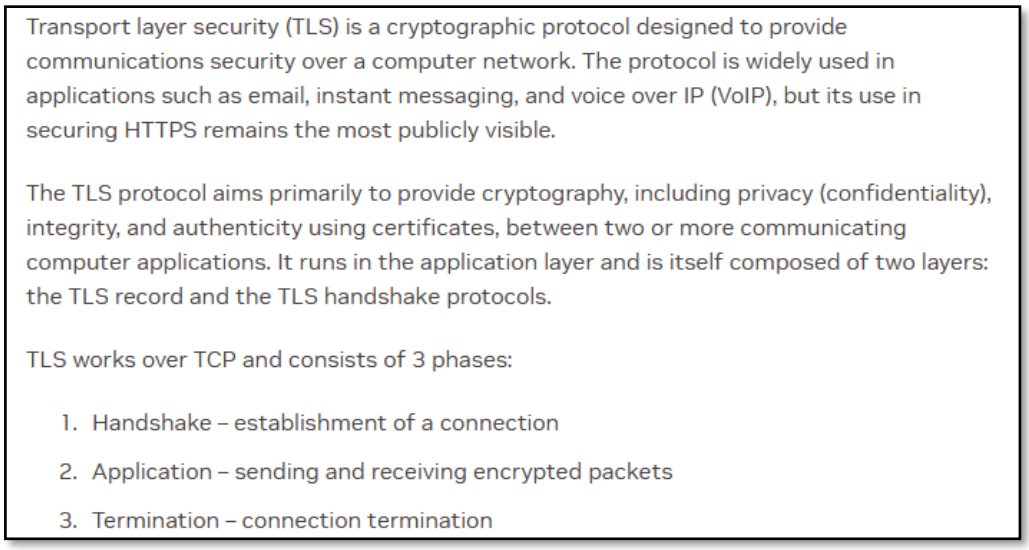


Introduction to NVIDIA DOCA Module #1: DOCA Demystified at 15:14, NVIDIA DEVELOPER YOUTUBE CHANNEL (January 21, 2022), *available at:* https://www.youtube.com/watch?v=iaFN0F53L6w (showing the use of IPSec for a first connection).

145. The NVIDIA '559 Products utilize algorithms to ensure the first security level's parameters, such as encryption and authentication protocols are met. By identifying the presence of this first communications link, the NVIDIA '559 Products can prioritize a communications link for use based on predefined security requirements or other criteria.

146. The NVIDIA '559 Products contain functionality for identifying an alternate communication pathway that possesses a different level of security for exchanging data between a client and a server.

147. The NVIDIA '559 Products detect a second communications link having a second security feature. The second communications link enables data to be sent between a client and server. Specifically, the second communications link can be a TLS link as described below.



Transport layer security (TLS) is a cryptographic protocol designed to provide communications security over a computer network. The protocol is widely used in applications such as email, instant messaging, and voice over IP (VoIP), but its use in securing HTTPS remains the most publicly visible.

The TLS protocol aims primarily to provide cryptography, including privacy (confidentiality), integrity, and authenticity using certificates, between two or more communicating computer applications. It runs in the application layer and is itself composed of two layers: the TLS record and the TLS handshake protocols.

TLS works over TCP and consists of 3 phases:

1. Handshake – establishment of a connection
2. Application – sending and receiving encrypted packets
3. Termination – connection termination

NVIDIA Networking BlueField DPUs / SuperNICs & DOCA Documentation, NVIDIA DOCUMENT HUB (last visited November 2024), *available at:* https://docs.nvidia.com/doca/archive/2-5-2/nvidia+tls+offload+guide/ (describing the NVIDIA products establish a second communications link having a second security (e.g., TLS)).

148. The NVIDIA '559 Products monitor network channels and enable security protocols to evaluate the parameters of the second communications link. The security features used by the NVIDIA '559 Products include encryption standards and/or authentication technology. The second communications link serves to ensure continuous data transfer by the NVIDIA '559 Products if the first communications link is unavailable.

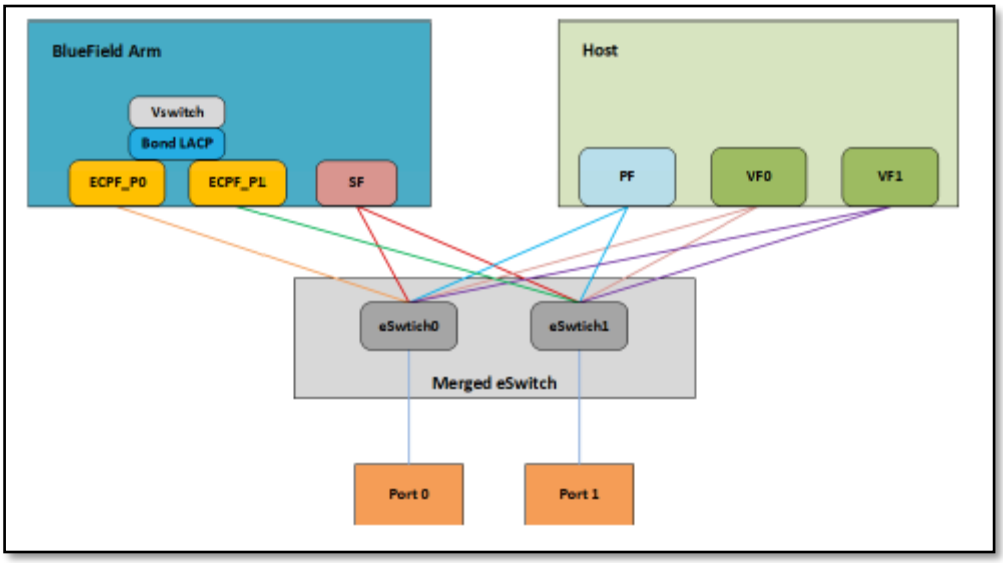
149. The NVIDIA '559 Products determine if the initial communication path is inaccessible, opting for the alternate communication pathway with its distinct security level, to facilitate data transmission between a client and server.

150. The NVIDIA '559 Products select the first communications link, having first security, for communicating between a client device and a server. After the detection of both the first and second communications links, the NVIDIA '559 Products prioritize the link with the higher security features (e.g., first link) for data transmission. This prioritization by the NVIDIA '559 Products is based on pre-established security criteria and network conditions. If the first link

meets the requirements, it is selected by the NVIDIA '559 Products to provide enhanced security and reliability.

151. The NVIDIA '559 Products maintain a connection with one of either the initial or alternate communication pathways, to ensure uninterrupted data exchange between the client system and the server system.

152. If the first communications link is not available, the NVIDIA '559 Products select the second communications link having second security, for communicating between the client device and the server device. For example. NVIDIA '559 Products perform failover mechanisms to maintain connectivity. If the primary secure link is unavailable, the NVIDIA '559 Products can automatically switch to an alternative link to ensure ongoing communication.



NVIDIA DOCA SWITCHING SUPPORT USER GUIDE, V2.2.0, NVIDIA DOCUMENTATION at 51 (October 2023) (showing how "Link Aggregation" switches between a first and second security link based on the health of the link).

153. This action is prompted when the preferred first link, typically with higher security, is unavailable or fails to meet a criteria. The NVIDIA '559 Products switch to the second link,

ensuring continuous communication. While generally considered less secure, the second link serves as a contingency, allowing uninterrupted information flow between a client and server.

154. If the data transmission is interrupted over the alternate communication pathway, the NVIDIA '559 Products contain functionality for restoring the connection to the initial communication link to continue exchanging information between the client and the server.

155. The NVIDIA '559 Products enable linking to one of either the first communications link and the second communications link, to maintain communicative connectivity during communications between the client and server. The NVIDIA '559 Products establish a dynamic link management process, maintaining an active connection by continuously evaluating both communication links.

156. The NVIDIA '559 Products contain functionality where if communication disruption occurs over the primary communication link, the alternate communication link is reestablished to facilitate the exchange of information between the client and server.

157. The NVIDIA '559 Products enable reconnecting to the first communications link for communicating information between the client and server if communications are hindered over the second communications link. This step is a part of a resilient communication strategy that actively monitors both links and switches back to the first link when issues are detected with the second communications link.

158. The NVIDIA '559 Products enable reconnecting to the second communications link for communicating information between the client device and the server device, if communications are hindered over the first communications link. If issues are detected on the primary link, the NVIDIA '559 Products automatically switch to the secondary link, maintaining the communication while also adhering to the security protocols.

159. NVIDIA has directly infringed and continues to directly infringe the '559 Patent by, among other things, making, using, offering for sale, and/or selling technology comprising a method of communicating information over multiple communications links, including but not limited to the NVIDIA '559 Products.

160. The NVIDIA '559 Products are available to businesses and individuals throughout the United States.

161. The NVIDIA '559 Products are provided to businesses and individuals located in this District.

162. By making, using, testing, offering for sale, and/or selling products and services comprising a method of communicating information over multiple communications links, including but not limited to the NVIDIA '559 Products, NVIDIA has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '559 Patent, including at least claim 5 pursuant to 35 U.S.C. § 271(a).

163. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '559 Patent.

164. As a result of NVIDIA's infringement of the '559 Patent, Plaintiff has suffered monetary damages, and seeks recovery in an amount adequate to compensate for NVIDIA's infringement, but in no event less than a reasonable royalty for the use made of the invention by NVIDIA together with interest and costs as fixed by the Court.

COUNT IV
INFRINGEMENT OF U.S. PATENT NO. 9,191,664

165. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

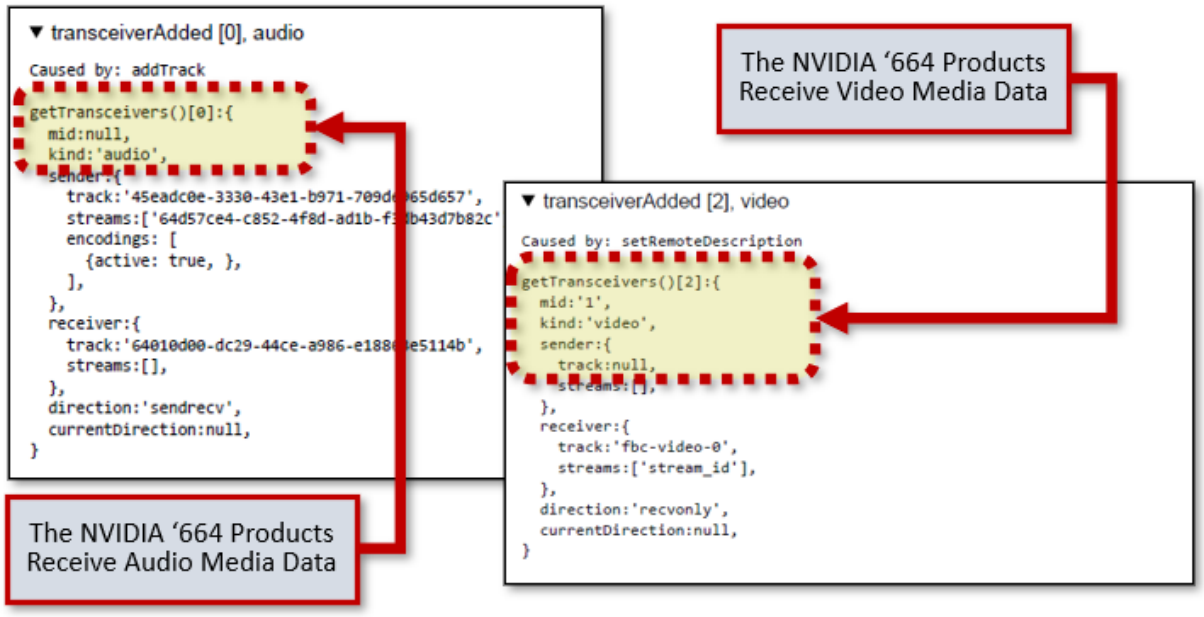
166. NVIDIA designs, makes, uses, sells, and/or offers for sale in the United States products for adaptive bitrate management.

167. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses the following products: NVIDIA GeForce NOW Platform, NVIDIA CloudXR Suite, NVIDIA NVENC 6th Generation Encoder, NVIDIA NVENC 7th Generation Encoder, and NVIDIA NVENC 8th Generation Encoder (collectively, the "NVIDIA '664 Product(s)").

168. One or more NVIDIA subsidiaries and/or affiliates use the NVIDIA '664 Products in regular business operations.

169. The NVIDIA '664 Products accept and/or gather media data, which comprises both elements of audio and video information.

170. The NVIDIA '664 Products perform the step of receiving media data that includes both audio media data and video media data. Specifically, the NVIDIA '664 Products show the receiving of media data that is comprised of audio (kind: 'audio') and video (kind: 'video') data.

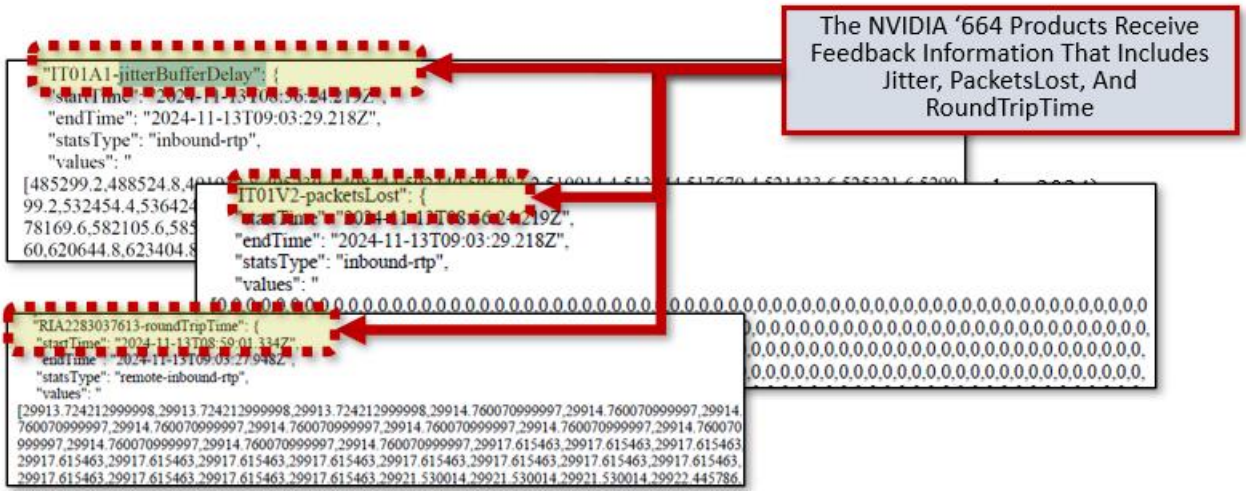


NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

171. In this stage of the method, the NVIDIA '664 Products or collect media data, which might come from various sources like a live broadcast, stored files, or a streaming service. The data is then parsed or separated into audio and video components for further processing,

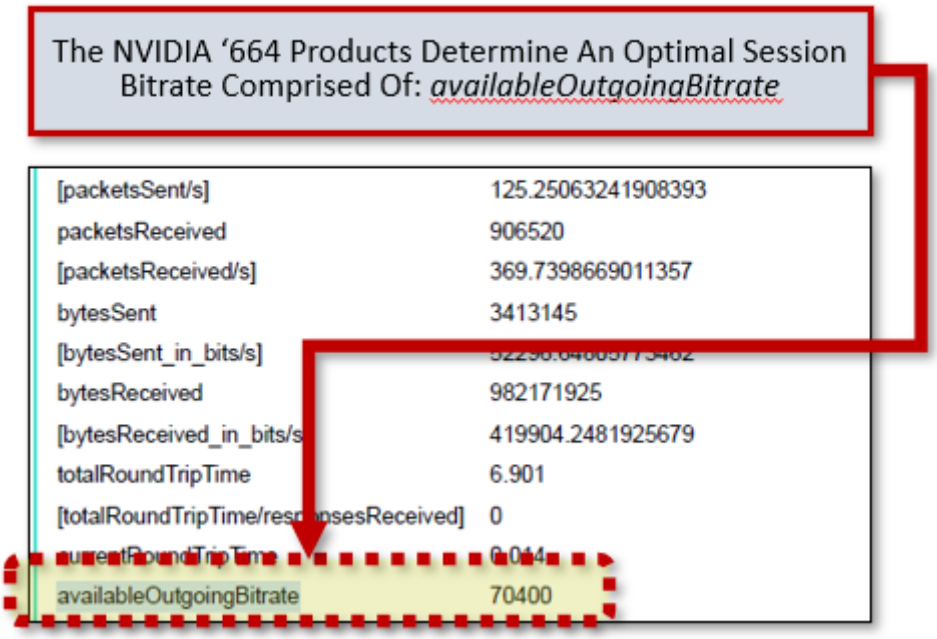
172. The NVIDIA '664 Products receive feedback information from a terminal.

173. The NVIDIA '664 Products receive feedback information from a terminal including Jitter, PacketLost, and RoundTripTime data. The receipt of this feedback information by the NVIDIA '664 Products is shown below.



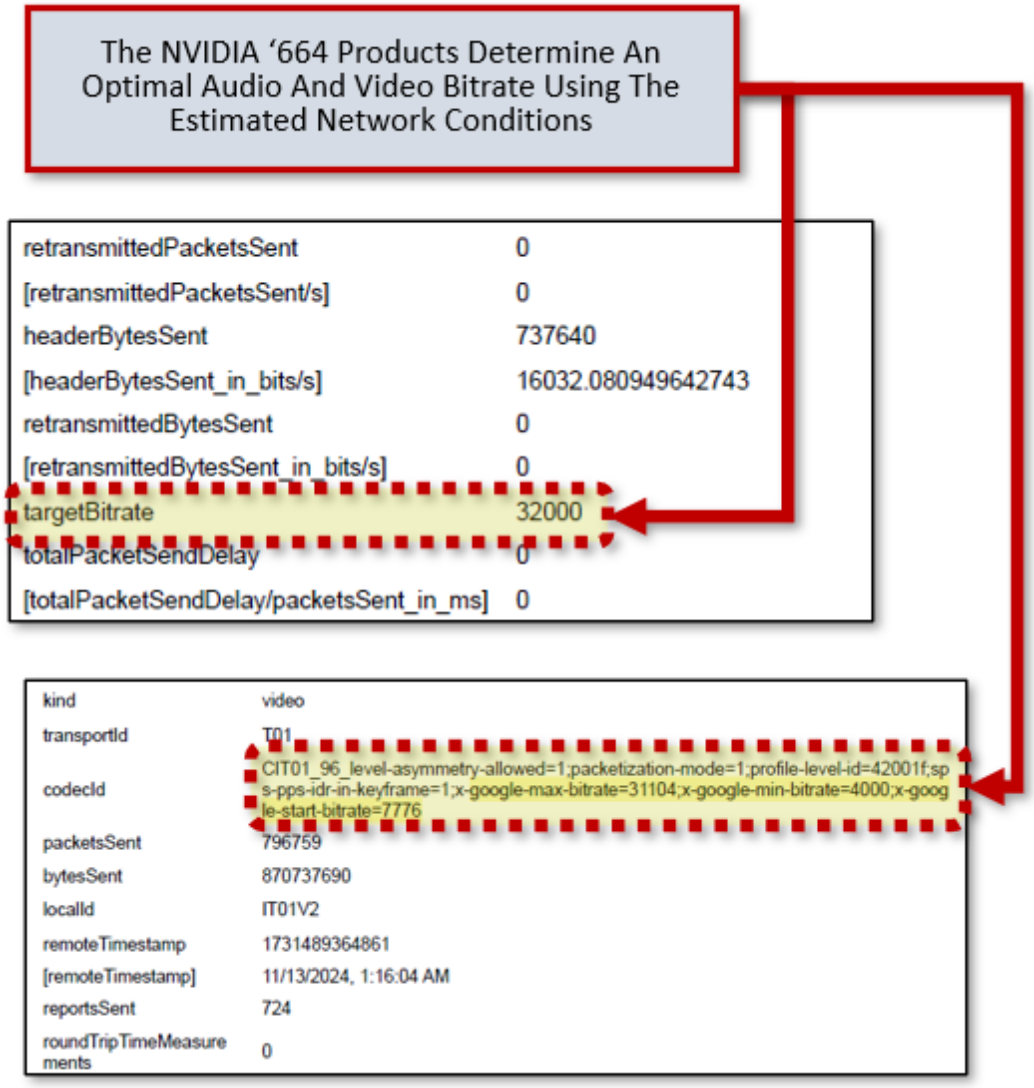
NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

174. The NVIDIA '664 Products estimate network conditions of the media network using this feedback information (Jitter, PacketLost, and, RoundTripTime). Specifically, the NVIDIA '664 Products generate an availableOutgoingBitrate value based on the network conditions.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

175. The NVIDIA '664 Products determine an optimal audio bitrate and an optimal video bitrate using the estimated network conditions. The NVIDIA '664 Products generate a target bitrate for audio and video data.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

176. The NVIDIA '664 Products encode the audio media data using the optimal audio bitrate.

177. The NVIDIA '664 Products encode the video media data using the optimal video bitrate.

178. The NVIDIA '664 Products provide the encoded audio media data and the encoded video media data for transmission to the terminal.

179. NVIDIA has directly infringed and continues to directly infringe the '664 Patent by, among other things, making, using, offering for sale, and/or selling technology comprising a method of adaptive bitrate management, including but not limited to the NVIDIA '664 Products.

180. The NVIDIA '664 Products are available to businesses and individuals throughout the United States.

181. The NVIDIA '664 Products are provided to businesses and individuals located in this District.

182. By making, using, testing, offering for sale, and/or selling products and services comprising a method of adaptive bitrate management, including but not limited to the NVIDIA '664 Products, NVIDIA has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '664 Patent, including at least claim 9 pursuant to 35 U.S.C. § 271(a).

183. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '664 Patent.

184. As a result of NVIDIA's infringement of the '664 Patent, Plaintiff has suffered monetary damages, and seeks recovery in an amount adequate to compensate for NVIDIA's infringement, but in no event less than a reasonable royalty for the use made of the invention by NVIDIA together with interest and costs as fixed by the Court.

COUNT V
INFRINGEMENT OF U.S. PATENT NO. 7,987,285

185. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

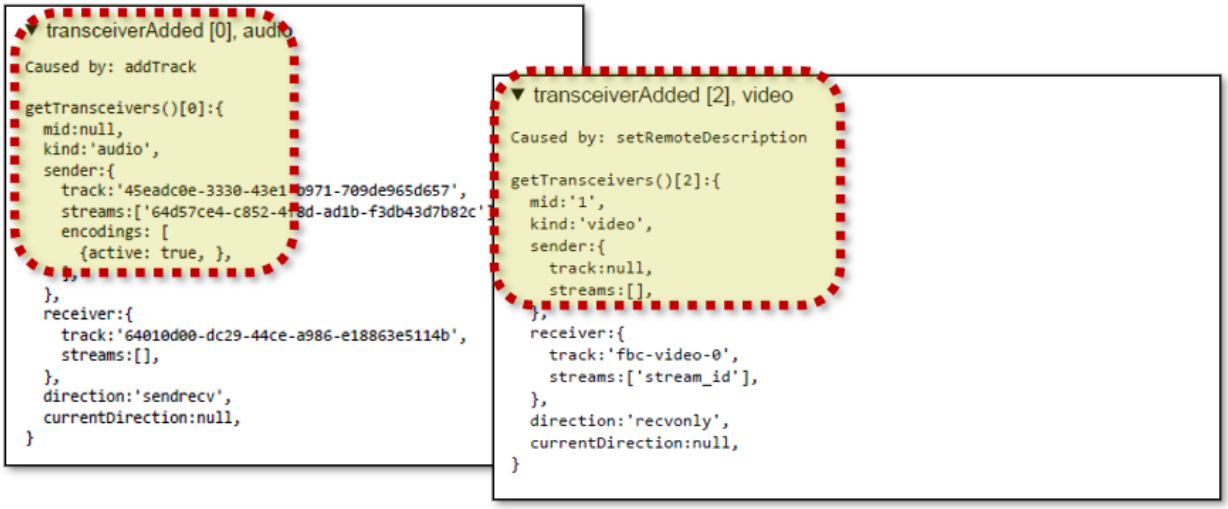
186. NVIDIA designs, makes, uses, sells, and/or offers for sale in the United States products comprising technology for adaptive bitrate management for streaming media over packet networks.

187. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses the following products: NVIDIA GeForce NOW Platform, NVIDIA CloudXR Suite, NVIDIA NVENC 6th Generation Encoder, NVIDIA NVENC 7th Generation Encoder, and NVIDIA NVENC 8th Generation Encoder (collectively, the "NVIDIA '285 Product(s)").

188. One or more NVIDIA subsidiaries and/or affiliates use the NVIDIA '285 Products in regular business operations.

189. The NVIDIA '285 Products receive a receiver report from a terminal.

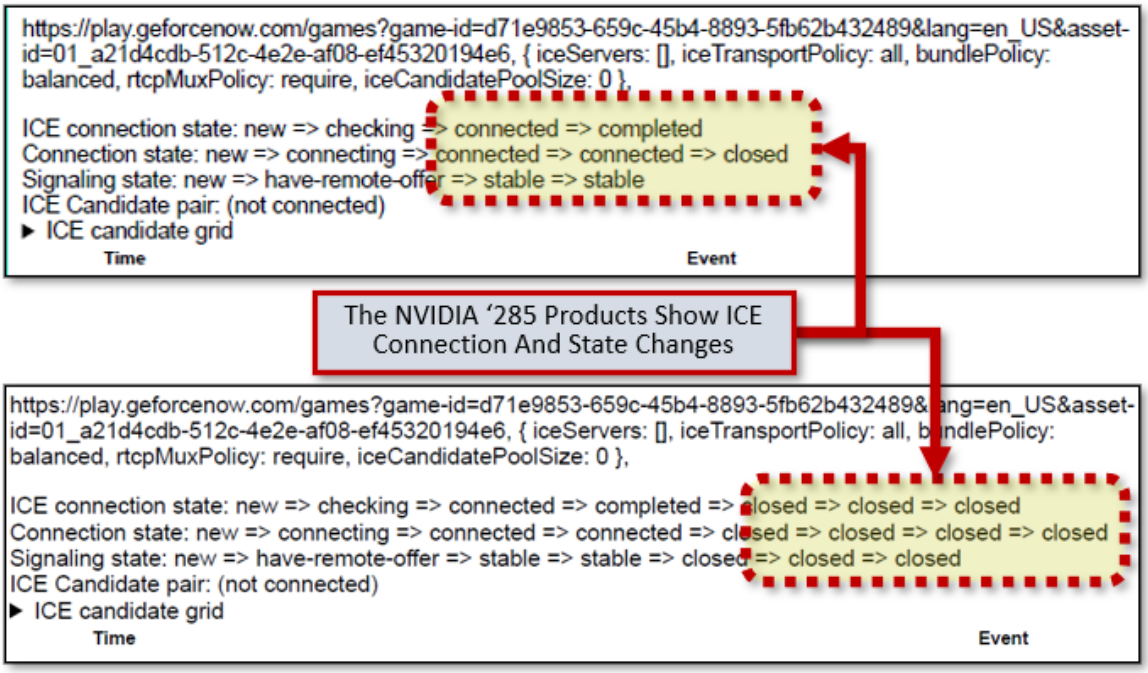
190. The NVIDIA '285 Products utilize this receiver report to estimate network conditions. Specifically, the transceivers for both audio and video streams are added during a video conferencing session, showing a "receiver" with attributes such as 'track' and 'streams.' The presence of a "receiver" object in the transceivers is consistent with WebRTC's capability to receive RTCP receiver reports.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (emphasis added).

191. The NVIDIA '285 Products show multiple state changes in the Interactive Connectivity Establishment (ICE) process, progressing from "new" to "connected" and later to "closed." Each transition signals the progression of the WebRTC session, aligning with the

expected flow of RTCP reports that track and control media stream quality during active connections.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

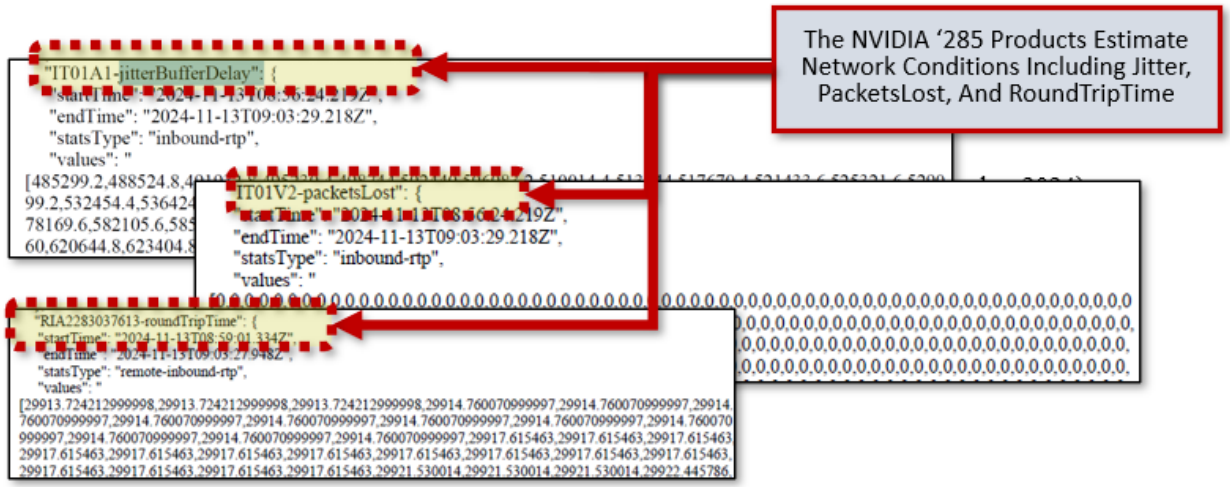
192. The NVIDIA '285 Products obtain a best-suited session bitrate.

193. The NVIDIA '285 Products initiate a session by leveraging an adaptive bitrate algorithm (e.g., Dynamic Adaptive Streaming over HTTP (DASH)), to fetch the optimal session bitrate. This involves network probing to converge to an optimal bitrate that maximizes Quality of Experience (QoE) while minimizing re-buffering events and latency.

194. The NVIDIA '285 Products determine stability criterion using one or more of the network conditions. To determine the stability criterion, the NVIDIA '285 Products compare the received bitrate with a current bitrate session.

195. The NVIDIA '285 Products estimate network conditions using receiver reports during a video conferencing session. Receiver reports used by the NVIDIA '285 Products provide feedback on media quality, specifically for metrics such as packet loss, delay, and jitter, which the

NVIDIA '285 Products use to gauge network conditions and adjust media transmission as necessary. For example, the NVIDIA '285 Products generate and utilize data such as jitter, packetsLost, and roundTripTime. The below documentation shows how the NVIDIA '285 Products track the roundTripTime, Jitter, and PacketsLost.

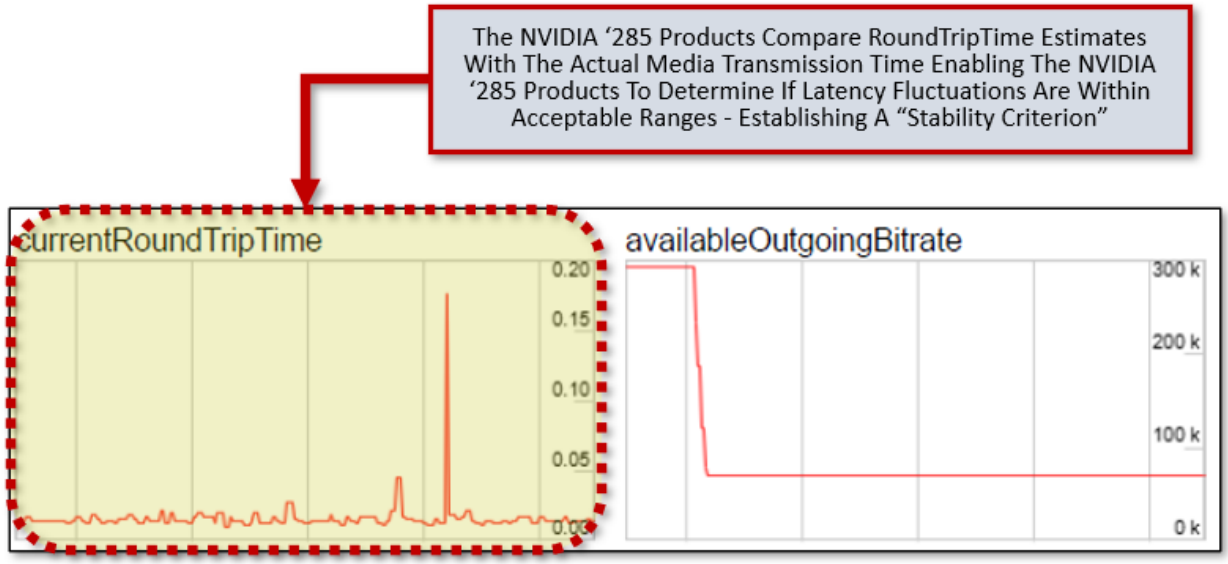


NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

196. The NVIDIA '285 Products utilize the stability criterion to determine the stability of the media network.

197. The NVIDIA '285 Products utilize the media-network-stability determination to provide the optimal session bitrate.

198. The NVIDIA '285 Products determine an optimal session bitrate by estimating network conditions and applying stability criteria. This process includes comparing media time in transit with round-trip time, evaluating received bitrate against current session bitrate, assessing media network stability, and adjusting the session bitrate accordingly. For example, the NVIDIA '285 Products use round-trip time (RTT) as a measure for network latency. RTT values are logged across the session, showing fluctuations that inform the NVIDIA '285 Products about network delays.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

199. When The NVIDIA '285 Products maintain a current bitrate when the stability of the media network is considered normal.

200. The NVIDIA '285 Products use the rtcpMuxPolicy: "require," meaning RTP and RTCP data are multiplexed over the same channel, allowing receiver reports to continuously monitor packet loss, delay, and jitter on the active transport connection. This enables the NVIDIA '285 Products to estimate network conditions based on consistent, real-time RTCP feedback. Further, the NVIDIA '285 Products use rtcp-fb parameters to estimate network jitter and loss rates. The NVIDIA '285 Products apply this feedback to dynamically adjust encoding parameters and media quality based on network conditions.

```
"rtcConfiguration": "{ iceServers: [], iceTransportPolicy: all, bundlePolicy: balanced, rtcpMuxPolicy: require, iceCandidatePoolSize: 0 }",
 "stats": {
  "AP-kind": {
   "startTime": "2024-11-13T08:56:24.219Z",
   "endTime": "2024-11-13T09:06:23.226Z",
   "statsType": "media-playout",
   "values": "
[\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"au
dio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\"
,\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"audio\",\"au
```


NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (emphasis added).

201. The NVIDIA '285 Products apply network feedback from receiver reports to adjust the session's bitrate. For example, targetBitrate values adjust alongside changes in RTT and packet loss, showing the optimal session bitrate determined by the NVIDIA '285 Products is set in response to network conditions.


```
"OT01A2283037613-targetBitrate": {
 "startTime": "2024-11-13T08:56:24.219Z",
 "endTime": "2024-11-13T09:03:29.218Z",
 "statsType": "outbound-rtp",
 "values": "
```


The NVIDIA '285 Products Make Bitrate Adjustments Based On Stability Criteria That Is Then Reflected In Changes To The targetBitrate Value

NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

202. The NVIDIA '285 Products output an adjusted bitrate based on network stability. Specifically, "availableOutgoingBitrate" is based on network condition estimations. The NVIDIA '285 Products use roundtrip time, packet loss, and current bitrate data to determine an optimal session bitrate that reflects network conditions.

NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (emphasis added).

203. The NVIDIA '285 Products deliver compressed audio and video information for transmission to an end device. The NVIDIA '285 Products deliver this media data to the terminal according to the optimal session bitrate.

204. The NVIDIA '285 Products encapsulate the encoded audio and video streams into a container format such as MPEG-4 Part 14 (.mp4) or Matroska (.mkv). This container is then chunked and packetized for delivery.

205. NVIDIA has directly infringed and continues to directly infringe the '285 Patent by, among other things, making, using, offering for sale, and/or selling technology for adaptive bitrate management for streaming media over packet networks, including but not limited to the NVIDIA '285 Products.

206. The NVIDIA '285 Products are available to businesses and individuals throughout the United States.

207. The NVIDIA '285 Products are provided to businesses and individuals located in this District.

208. By making, using, testing, offering for sale, and/or selling products and services comprising technology for adaptive bitrate management for streaming media over packet networks, including but not limited to the NVIDIA '285 Products, NVIDIA has injured Plaintiff

and is liable to Plaintiff for directly infringing one or more claims of the '285 Patent, including at least claim 2 pursuant to 35 U.S.C. § 271(a).

209. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '285 Patent.

210. As a result of NVIDIA's infringement of the '285 Patent, Plaintiff has suffered monetary damages, and seek recovery in an amount adequate to compensate for NVIDIA's infringement, but in no event less than a reasonable royalty for the use made of the invention by NVIDIA together with interest and costs as fixed by the Court.

COUNT VI
INFRINGEMENT OF U.S. PATENT NO. 7,991,904

211. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

212. NVIDIA designs, makes, uses, sells, and/or offers for sale in the United States products comprising technology for adaptive bitrate management for streaming media over packet networks.

213. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses the following products: NVIDIA GeForce NOW Platform, NVIDIA CloudXR Suite, NVIDIA NVENC 6th Generation Encoder, NVIDIA NVENC 7th Generation Encoder, and NVIDIA NVENC 8th Generation Encoder (collectively, the "NVIDIA '904 Product(s)").

214. One or more NVIDIA subsidiaries and/or affiliates use the NVIDIA '904 Products in regular business operations.

215. The NVIDIA '904 Products acquire the best-suited session bitrate guided by the feedback from a TCP acknowledgement.

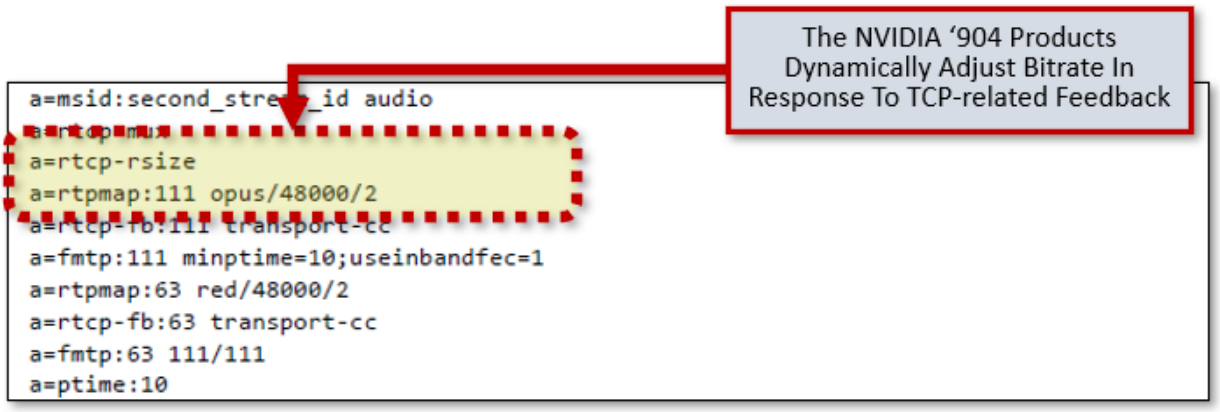
216. The NVIDIA ‘904 Products divide the acquired session bitrate between audio and video channels to yield ideal bitrates for both, where the division is partially based on giving a higher weight to either the audio or video stream.

217. The NVIDIA ‘904 Products utilize specified codecs to compress audio and video streams in accordance with the determined optimal audio and video bitrates.

218. The NVIDIA ‘904 Products combine the compressed audio and video streams through a multiplexing operation.

219. The NVIDIA ‘904 Products prepare the multiplexed audio and video streams for forwarding to an end terminal.

220. The NVIDIA ‘904 Products employ a closed-loop control mechanism, where TCP acknowledgements are parsed to obtain Round-Trip Time (RTT) and packet loss metrics. These metrics are fed into a rate adaptation algorithm to ascertain an optimal session bitrate that maximizes throughput while minimizing latency. Specifically, the NVIDIA ‘904 Products make a software defined parameter (SDP) offer that includes an explicit transport control protocol feedback mechanism. This appears repeatedly in the session description for both audio and video streams which show the NVIDIA ‘904 Products use a TCP acknowledgment for bitrate optimization. The NVIDIA ‘904 Products use rtcp-fb for transport-cc (transport congestion control) on audio and video streams. This feedback mechanism allows for the NVIDIA ‘904 Product to adjust session bitrates dynamically based on RTCP feedback, which includes acknowledgments of packet delivery status.

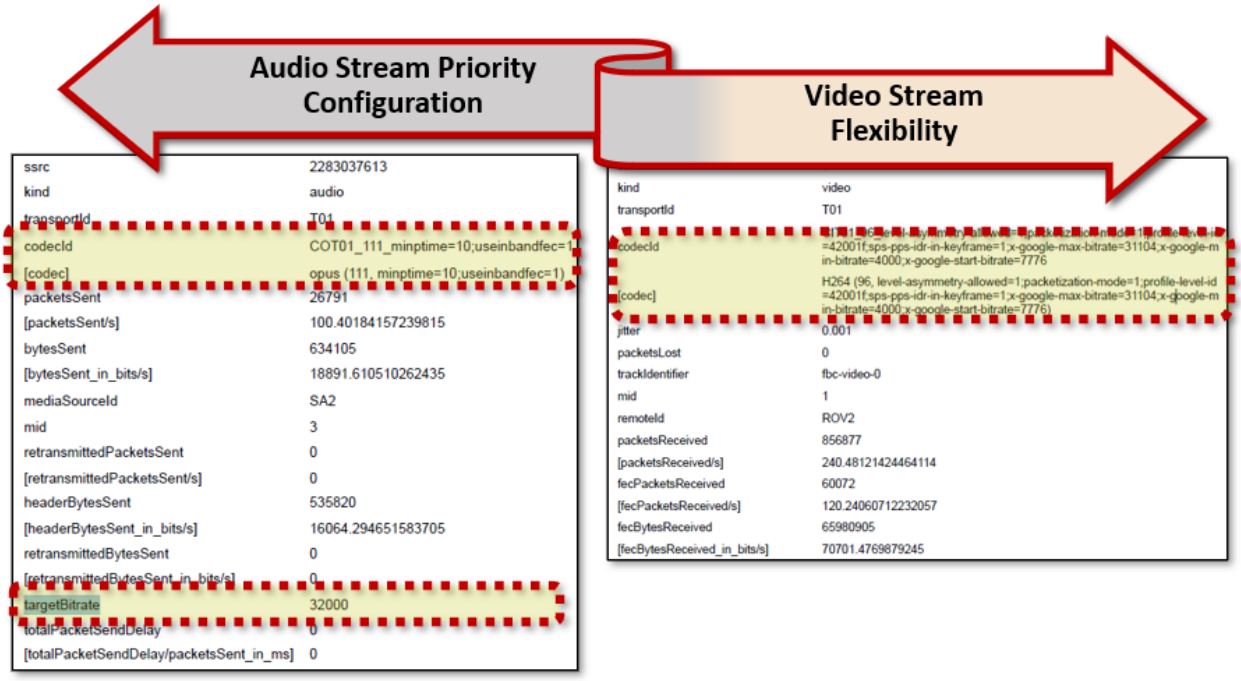


NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

221. The NVIDIA '904 Products apply a bitrate allocation mechanism subject to the constraint of the optimal session bitrate. The allocation is adaptive to contextual elements to privilege either the audio or video stream.

222. The NVIDIA '904 Products allocate a session bitrate dynamically between audio and video media, prioritizing one over the other when necessary. Specifically, the audio stream maintains a consistent bitrate allocation and higher quality of service parameters than the video stream. The video stream has a variable bitrate allocation and adaptive quality.

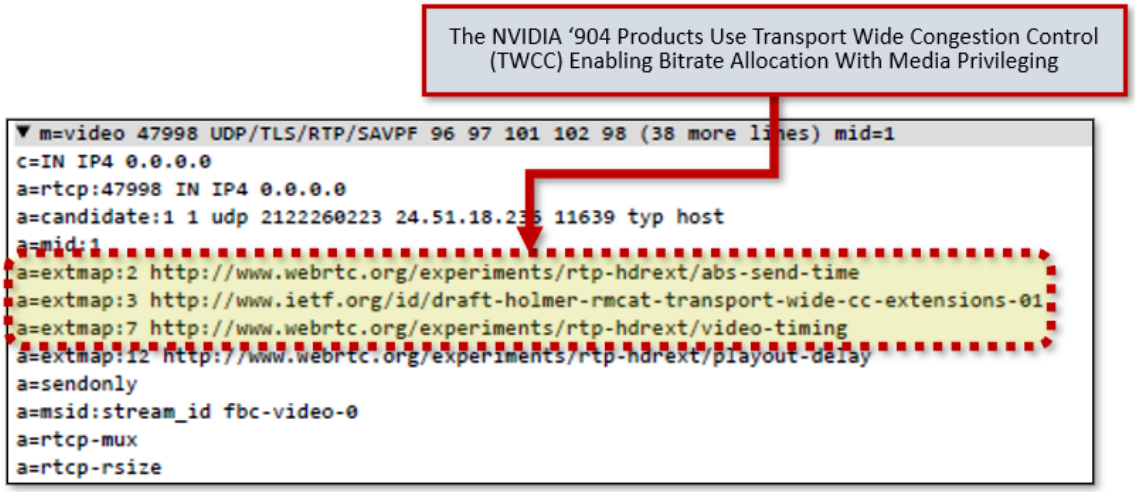
223. The audio settings of the NVIDIA '904 Products (opus/48000/2 for audio with transport congestion control feedback) support lower latency audio transmission, which is essential when audio is prioritized. Video encoding, on the other hand, includes frame rate and resolution constraints, enabling downscaling or bitrate reduction when video quality is secondary to audio quality. This selective allocation of bitrate for audio (*e.g.*, using minptime=10; useinbandfec=1 for error resilience in audio) shows the NVIDIA '904 Products are adjusting allocation between audio and video data.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

224. The NVIDIA '904 Products perform changing bandwidth allocation patterns between video and audio data. The stable, lower bitrate allocation for audio versus the more variable video bitrate show the NVIDIA '904 Products prioritize either the audio media or the video media over the other.

225. The codecs used by the NVIDIA '904 Products are optimized for the allocated optimal bitrates. The NVIDIA'904 Products perform Transport Wide Congestion Control (TWCC) functionality which allows for bitrate allocation with audio or video privileging.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

226. The NVIDIA '904 Products utilize Time Division Multiplexing (TDM) and/or Statistical Time Division Multiplexing (STDM) to interleave the encoded audio and video streams. Data packets are annotated by the NVIDIA '904 Products with appropriate headers and timestamps to facilitate downstream de-multiplexing.

227. The NVIDIA '904 Products encapsulate the multiplexed audio and video streams into a transport stream.

228. NVIDIA has directly infringed and continues to directly infringe the '904 Patent by, among other things, making, using, offering for sale, and/or selling technology for adaptive bitrate management for streaming media over packet networks, including but not limited to the NVIDIA '904 Products.

229. The NVIDIA '904 Products are available to businesses and individuals throughout the United States.

230. The NVIDIA '904 Products are provided to businesses and individuals located in this District.

231. By making, using, testing, offering for sale, and/or selling products and services comprising technology for adaptive bitrate management for streaming media over packet networks, including but not limited to the NVIDIA '904 Products, NVIDIA has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '904 Patent, including at least claim 11 pursuant to 35 U.S.C. § 271(a).

232. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '904 Patent.

233. As a result of NVIDIA's infringement of the '904 Patent, Plaintiff has suffered monetary damages, and seek recovery in an amount adequate to compensate for NVIDIA's infringement, but in no event less than a reasonable royalty for the use made of the invention by NVIDIA together with interest and costs as fixed by the Court.

COUNT VII
INFRINGEMENT OF U.S. PATENT NO. 8,230,105

234. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

235. NVIDIA designs, makes, uses, sells, and/or offers for sale in the United States products comprising streaming technology that optimizes audio-video bitrate allocation.

236. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses the following products: NVIDIA GeForce NOW Platform, NVIDIA CloudXR Suite, NVIDIA NVENC 6th Generation Encoder, NVIDIA NVENC 7th Generation Encoder, and NVIDIA NVENC 8th Generation Encoder (collectively, the "NVIDIA '105 Product(s)").

237. One or more NVIDIA subsidiaries and/or affiliates use the NVIDIA '105 Products in regular business operations.

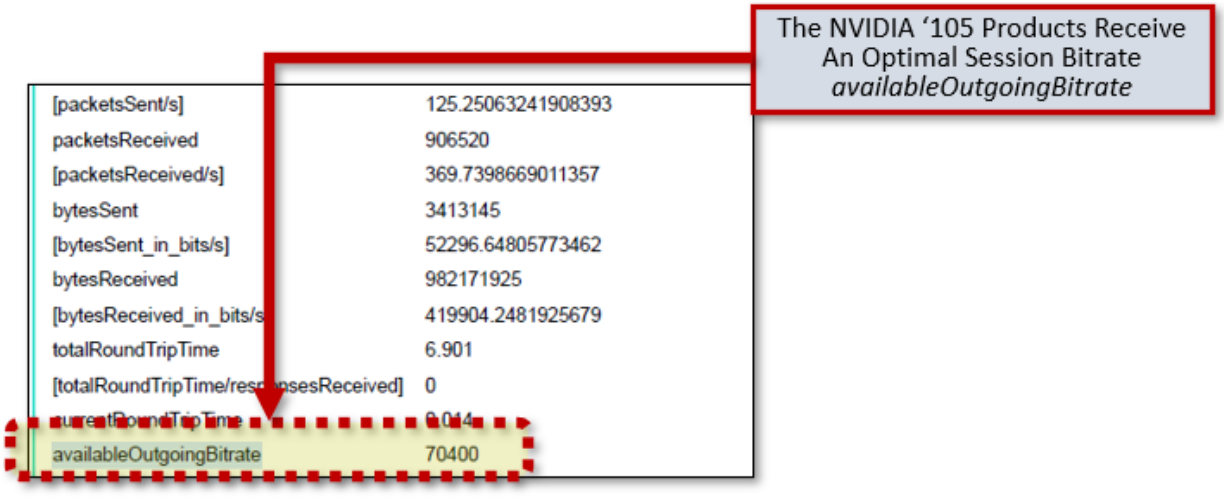
238. The NVIDIA '105 Products obtain an optimal session bitrate for media streaming.

239. The NVIDIA ‘105 Products receive an optimal session bitrate. Specifically, this determination is based on one or more factors including network conditions, available bandwidth, and device capabilities.

240. The NVIDIA ‘105 Products divide this optimal session bitrate between audio and video data to yield the best-suited bitrates for each.

241. The NVIDIA ‘105 Products allocate the optimal session bitrate between audio and video media data to produce an optimal audio bitrate and an optimal video bitrate, wherein allocating the optimal session bitrate between audio and video media data is based on a metric selected from a group including a predetermined allocation, a user preference, an optimal performance data, privileging one type of data over the other, and an amount of audio and video media data to be provided.

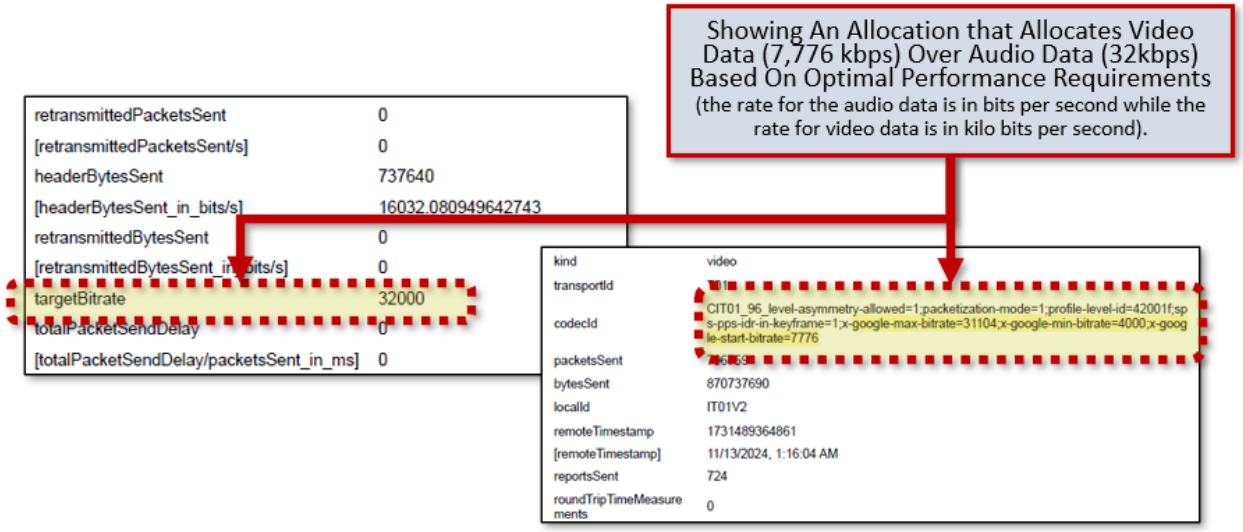
242. The NVIDIA ‘105 Products receive an optimal session bitrate. Specifically, the NVIDIA ‘105 Products track incoming and outgoing bitrates with specific allocations. The total session bitrate is automatically optimized based on network conditions.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

243. In accordance with MPEG-DASH standard, the NVIDIA '105 Products are responsible for calculating or receiving an optimal session bitrate based on network conditions and/or the client's capabilities.

244. The NVIDIA '105 Products allocate session bitrates between audio and video streams. This allocation is based on the network conditions which as seen above are used to adjust the optimal session bitrate. The below excerpt shows that the NVIDIA '105 Products' session bitrate is allocated between audio and video and the video stream has significantly more data being allocated to it than the audio stream.

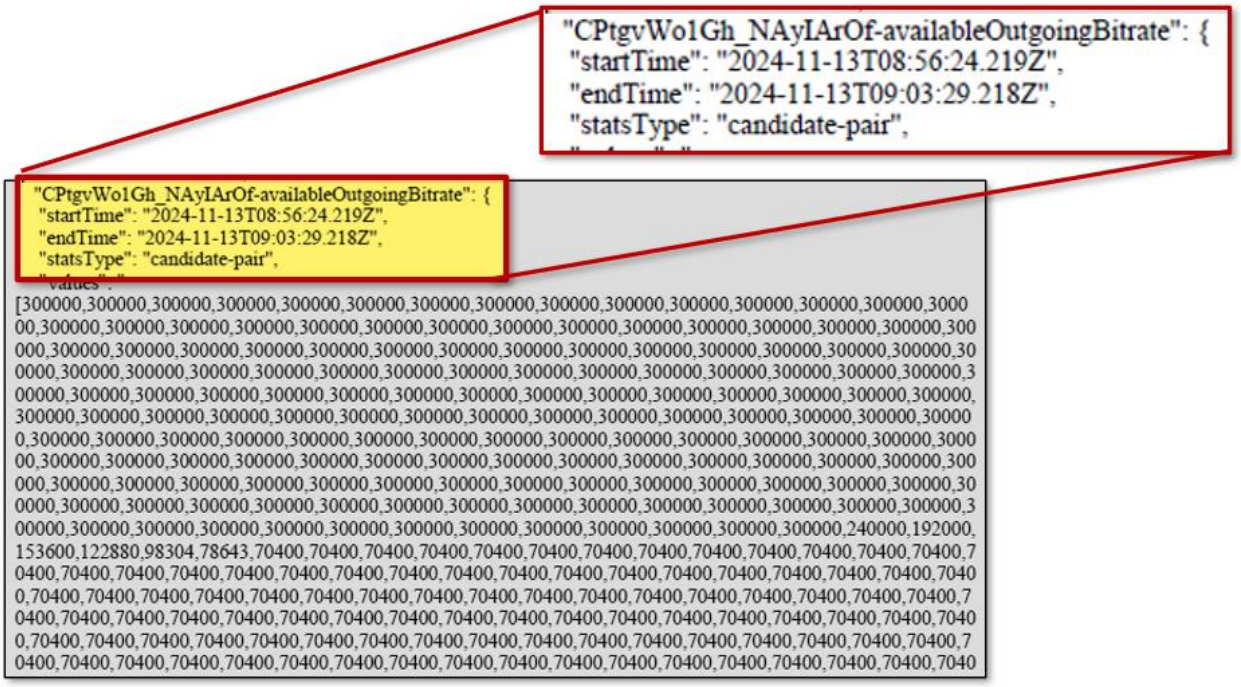


NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

245. The NVIDIA '105 Products allocate this optimal session bitrate between audio and video data to yield the best-suited bitrates for each.

246. The NVIDIA '105 Products receive an optimal session bitrate that is tracked by the NVIDIA '105 Products and is adjusted based on network conditions. For example, the below excerpt from, NVIDIA '105 Product documentation shows that the "availableOutgoingBitrate" is

adjusted based on network conditions. The below shows that the value for "availableOutgoingBitrate" is updated numerous times in a session.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

247. The NVIDIA '105 Products base the bitrate allocation on criteria chosen from a set that includes pre-defined ratios, user settings, performance metrics, prioritizing one media type over the other, and the volume of audio and video data to be delivered.

248. The bitrate allocation used by the NVIDIA '105 Products is based on a metric selected from a group including a predetermined allocation, a user preference, an optimal performance data, privileging one type of data over the other, and an amount of audio and video media data to be provided.

249. The NVIDIA '105 Products compress the audio and video content as per the determined optimal audio and video bitrates.

250. The NVIDIA ‘105 Products encode audio and video media data according to the optimal audio bitrate and the optimal video bitrate.

251. The NVIDIA ‘105 Products make available the compressed audio and video streams for forwarding to an end device.

252. The NVIDIA ‘105 Products encode audio and video media data according to the optimal audio bitrate and the optimal video bitrate. This is achieved through utilizing encoding algorithms that are tailored to the bitrates allocated for each type of media. By compressing the media data according to these specific bitrates, the system ensures that the audio and video streams are packaged in a way that maximizes quality while adhering to the bandwidth limitations.

253. NVIDIA has directly infringed and continues to directly infringe the ‘105 Patent by, among other things, making, using, offering for sale, and/or selling streaming technology that optimizes audio-video bitrate allocation, including but not limited to the NVIDIA ‘105 Products.

254. The NVIDIA ‘105 Products are available to businesses and individuals throughout the United States.

255. The NVIDIA ‘105 Products are provided to businesses and individuals located in this District.

256. By making, using, testing, offering for sale, and/or selling products and services comprising streaming technology that optimizes audio-video bitrate allocation, including but not limited to the NVIDIA ‘105 Products, NVIDIA has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the ‘105 Patent, including at least claim 16 pursuant to 35 U.S.C. § 271(a).

257. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the ‘105 Patent.

258. As a result of NVIDIA's infringement of the '105 Patent, Plaintiff has suffered monetary damages, and seek recovery in an amount adequate to compensate for NVIDIA's infringement, but in no event less than a reasonable royalty for the use made of the invention by NVIDIA together with interest and costs as fixed by the Court.

COUNT VIII
INFRINGEMENT OF U.S. PATENT NO. 8,255,551

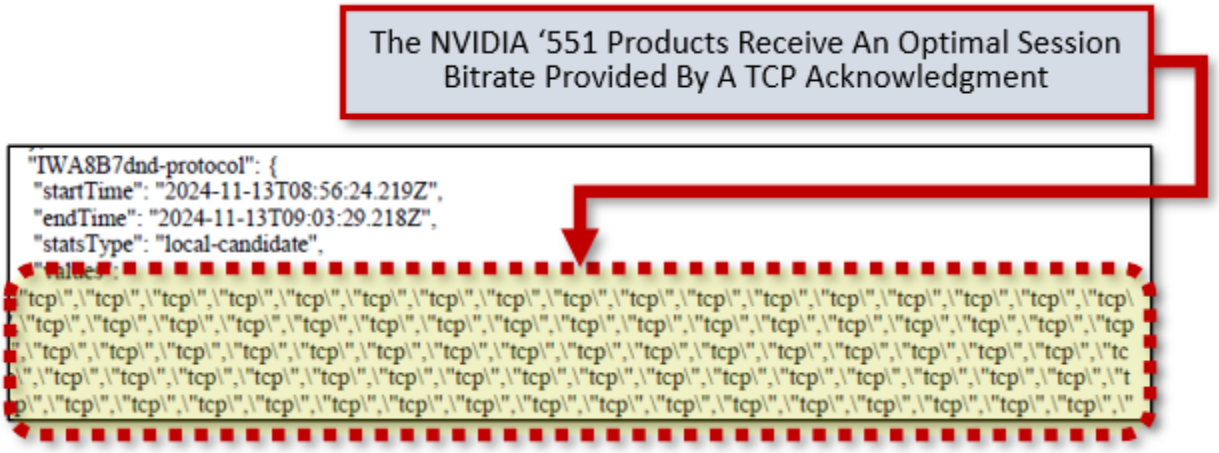
259. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

260. NVIDIA designs, makes, uses, sells, and/or offers for sale in the United States products comprising a technology for dynamically adapting audio and video bitrates based on TCP acknowledgments.

261. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses the following products: NVIDIA GeForce NOW Platform, NVIDIA CloudXR Suite, NVIDIA NVENC 6th Generation Encoder, NVIDIA NVENC 7th Generation Encoder, and NVIDIA NVENC 8th Generation Encoder (collectively, the "NVIDIA '551 Product(s)").

262. One or more NVIDIA subsidiaries and/or affiliates use the NVIDIA '551 Products in regular business operations.

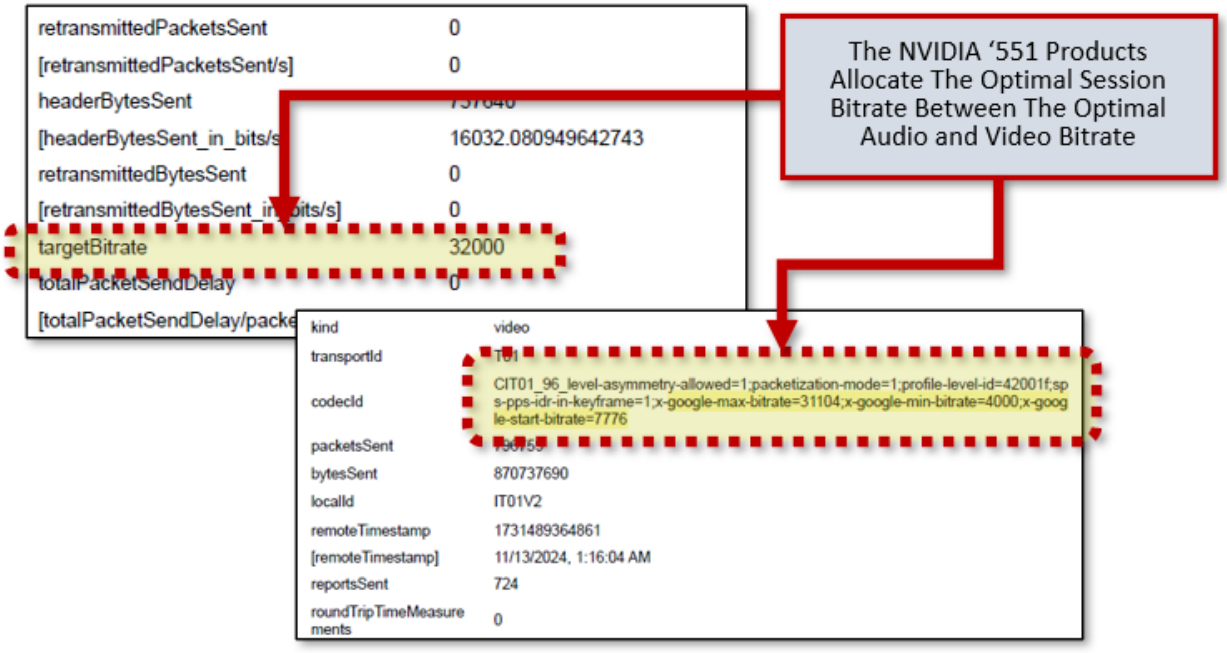
263. The NVIDIA '551 Products receive an optimal session bitrate through data received from TCP acknowledgments. Specifically, the NVIDIA '551 Products receive TCP acknowledgments.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

264. The NVIDIA '551 Products distribute the ideal session bitrate between audio and video streams, prioritizing either audio or video to achieve their respective optimal bitrates.

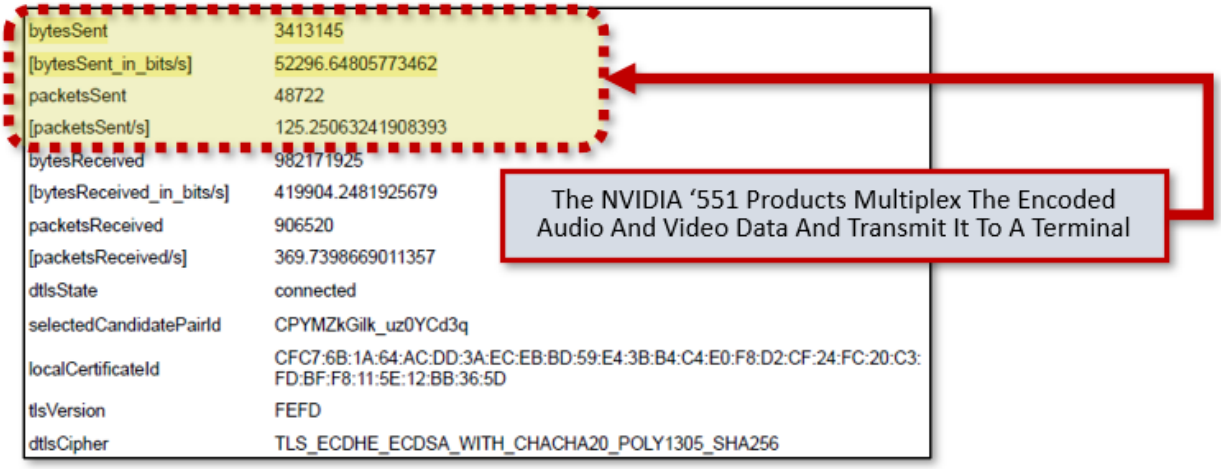
265. The NVIDIA '551 Products allocate the optimal session bitrate between audio and video media to produce an optimal audio bitrate and an optimal video bitrate.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

266. The NVIDIA '551 Products process both audio and video streams using their determined optimal bitrates for encoding.

267. The NVIDIA '551 Products combine the encoded audio and video streams into a single data stream. The NVIDIA '551 Products deliver the combined audio and video data stream for transmission to a terminal device. The NVIDIA '551 Products multiplex the encoded audio and video media data; and provide the multiplexed audio and video data for transmittal to a terminal.



NVIDIA GEFORCE NOW PLATFORM, *available at:* https://play.geforcenow.com (November 2024) (annotation added).

268. NVIDIA has directly infringed and continues to directly infringe the '551 Patent by, among other things, making, using, offering for sale, and/or selling technology for dynamically adapting audio and video bitrates based on TCP acknowledgments, including but not limited to the NVIDIA '551 Products.

269. The NVIDIA '551 Products are available to businesses and individuals throughout the United States.

270. The NVIDIA '551 Products are provided to businesses and individuals located in this District.

271. By making, using, testing, offering for sale, and/or selling products and services comprising technology for dynamically adapting audio and video bitrates based on TCP acknowledgments, including but not limited to the NVIDIA '551 Products, NVIDIA has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '551 Patent, including at least claim 12 pursuant to 35 U.S.C. § 271(a).

272. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '551 Patent.

273. As a result of NVIDIA's infringement of the '551 Patent, Plaintiff has suffered monetary damages, and seek recovery in an amount adequate to compensate for NVIDIA's infringement, but in no event less than a reasonable royalty for the use made of the invention by NVIDIA together with interest and costs as fixed by the Court.

COUNT IX
INFRINGEMENT OF U.S. PATENT NO. 10,412,388

274. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

275. NVIDIA designs, makes, uses, sells, and/or offers for sale in the United States products comprising technology for video compression using adaptive re-quantization using extracted and derived quantization parameters.

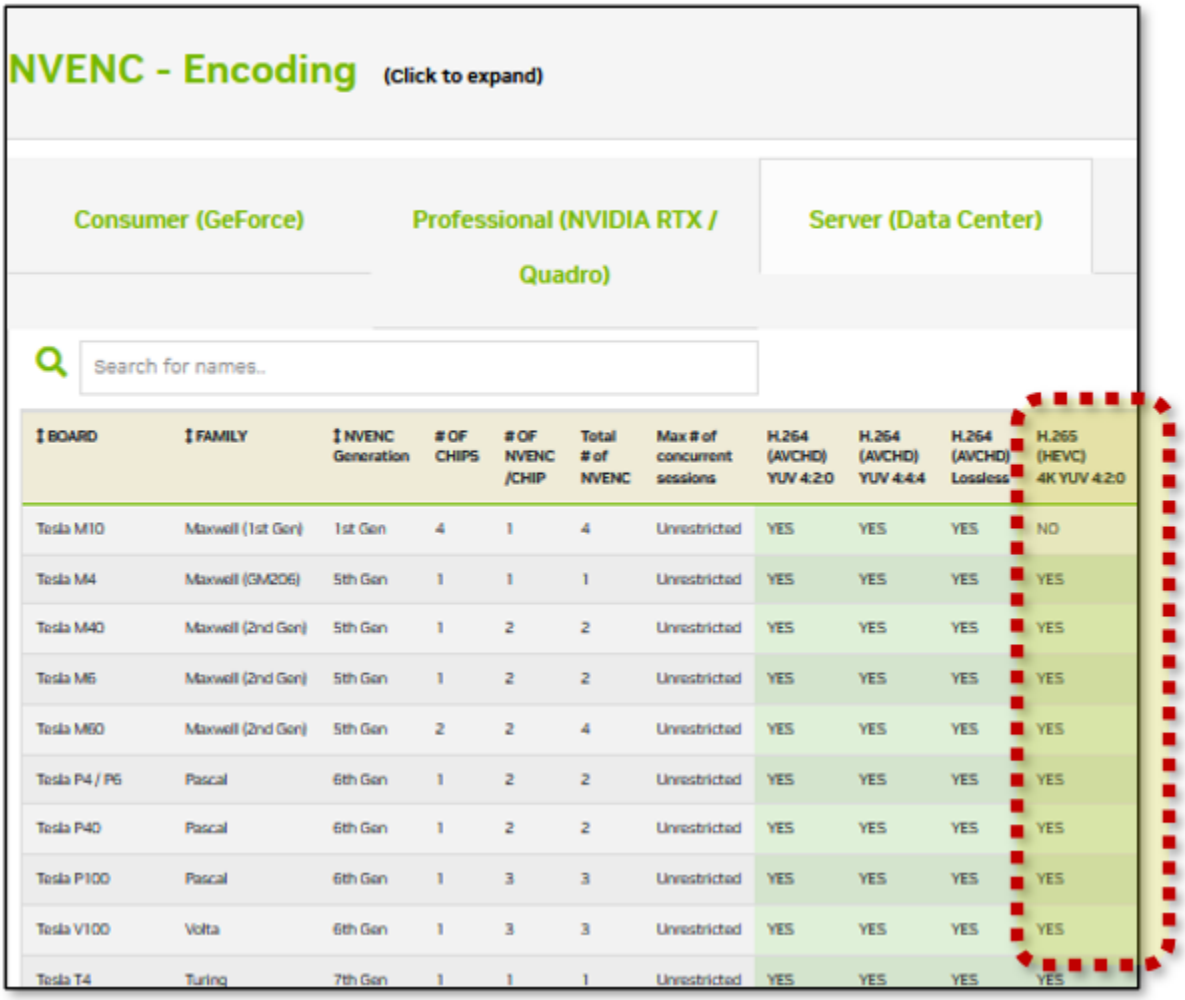
276. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses NVIDIA Products containing H.265 encoding technology, including: GeForce GTX 1650 GDDR6, GeForce GTX 1650 SUPER, GeForce GTX 1660 Ti Max-Q, GeForce GTX 1660 Ti / 1660, GeForce GTX 1660 SUPER, GeForce RTX 2060 / 2070, GeForce RTX 2060 SUPER, GeForce RTX 2060 (TU104), GeForce RTX 2070 Max-Q, GeForce RTX 2070 SUPER, GeForce RTX 2080, GeForce RTX 2080 Max-Q, GeForce RTX 2080 SUPER, GeForce RTX 2080 Ti, Titan

RTX, GeForce RTX 2050, GeForce RTX 3050, GeForce RTX 3050 Laptop, GeForce RTX 3080 Ti Laptop, GeForce RTX 3080 Laptop, GeForce RTX 3070 Ti Laptop, GeForce RTX 3070 Laptop, GeForce RTX 3060 Ti Laptop, GeForce RTX 3060 Laptop, GeForce RTX 3060, GeForce RTX 3070, GeForce RTX 3080, GeForce RTX 3090, GeForce MX570, GeForce RTX 3050 Ti Laptop, GeForce RTX 3060 Ti, GeForce RTX 3070 Ti, GeForce RTX 3080 Ti, GeForce RTX 3090 Ti, GeForce RTX 4050 Laptop, GeForce RTX 4060 Laptop, GeForce RTX 4060, GeForce RTX 4060TI, GeForce RTX 4070 Laptop, GeForce RTX 4070, GeForce RTX 4070 Super, GeForce RTX 4070 Ti, GeForce RTX 4070 Ti Super, GeForce RTX 4080 Laptop, GeForce RTX 4080 16GB, GeForce RTX 4080 Super, GeForce RTX 4090 Laptop, GeForce RTX 4090, Quadro GP100, Quadro P400, Quadro P600 / P620/ P1000, Quadro P2000 / P2200, Quadro P3200 / P4200 / P5200, Quadro P4000, Quadro P5000, Quadro P6000, Quadro GV100, NVIDIA T400 / T400 4GB, NVIDIA T550 Laptop GPU, NVIDIA T600, NVIDIA T1000 / T1000 8GB, NVIDIA T600 Laptop GPU, NVIDIA T1200 Laptop GPU, Quadro T2000 Max-Q, Quadro T2000, Quadro RTX 3000 Max-Q, Quadro RTX 3000, Quadro RTX 4000 Max-Q, Quadro RTX 4000 / RTX 5000, Quadro RTX 6000 / RTX 8000, NVIDIA RTX A500 Laptop GPU, NVIDIA RTX A1000 Laptop GPU, NVIDIA RTX A2000 and A2000 8GB Laptop GPUs, NVIDIA RTX A3000 and A3000 12GB Laptop GPUs, NVIDIA RTX A400, NVIDIA RTX A1000, NVIDIA RTX A4000, NVIDIA RTX A4500, NVIDIA RTX A5000, NVIDIA RTX A5500, NVIDIA RTX A6000, NVIDIA RTX A4000 Laptop GPU, NVIDIA RTX A4500 Laptop GPU, NVIDIA RTX A5000 Laptop GPU, NVIDIA RTX A5500 Laptop GPU, NVIDIA RTX A2000 / A2000 12GB, NVIDIA RTX A1000 6GB Laptop GPU, NVIDIA RTX 500 Ada Generation Laptop GPU, NVIDIA RTX 1000 Ada Generation Laptop GPU, NVIDIA RTX 2000 Ada Generation Laptop GPU, NVIDIA RTX 3000 Ada Generation Laptop GPU, NVIDIA RTX 3500 Ada Generation Laptop GPU, NVIDIA RTX

4000 Ada Generation Laptop GPU, NVIDIA RTX 5000 Ada Generation Laptop GPU, NVIDIA RTX 2000 Ada Generation, NVIDIA RTX 4000 SFF Ada Generation, NVIDIA RTX 4000 Ada Generation, NVIDIA RTX 4500 Ada Generation, NVIDIA RTX 5000 Ada Generation, NVIDIA RTX 6000 Ada Generation, Tesla M4, Tesla M40, Tesla M6, Tesla M60, Tesla P4 / P6, Tesla P40, Tesla P100, Tesla V100, Tesla T4, NVIDIA A40, NVIDIA A16, NVIDIA A10, NVIDIA A2, NVIDIA L40, NVIDIA L40S, NVIDIA L4, DGX Station, DGX-1, and DGX-2) (collectively, the "NVIDIA '388 Product(s)").

277. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses NVIDIA '388 products that comply with the H.265 video encoding standard.

278. The NVIDIA '388 Products perform video processing compliant with the High Efficiency Video Coding (HEVC) standard, which is also often referred to as the H.265 standard. Specifically, the NVIDIA '388 products perform HEVC encoding.



NVENC - Encoding (Click to expand)

Consumer (GeForce) | Professional (NVIDIA RTX / Quadro) | Server (Data Center)

Search for names..

BOARD	FAMILY	NVENC Generation	# OF CHIPS	# OF NVENC /CHIP	Total # of NVENC	Max # of concurrent sessions	H.264 (AVCHD) YUV 4:2:0	H.264 (AVCHD) YUV 4:4:4	H.264 (AVCHD) Lossless	H.265 (HEVC) 4K YUV 4:2:0
Tesla M10	Maxwell (1st Gen)	1st Gen	4	1	4	Unrestricted	YES	YES	YES	NO
Tesla M4	Maxwell (GM206)	5th Gen	1	1	1	Unrestricted	YES	YES	YES	YES
Tesla M40	Maxwell (2nd Gen)	5th Gen	1	2	2	Unrestricted	YES	YES	YES	YES
Tesla M6	Maxwell (2nd Gen)	5th Gen	1	2	2	Unrestricted	YES	YES	YES	YES
Tesla M60	Maxwell (2nd Gen)	5th Gen	2	2	4	Unrestricted	YES	YES	YES	YES
Tesla P4 / P6	Pascal	6th Gen	1	2	2	Unrestricted	YES	YES	YES	YES
Tesla P40	Pascal	6th Gen	1	2	2	Unrestricted	YES	YES	YES	YES
Tesla P100	Pascal	6th Gen	1	3	3	Unrestricted	YES	YES	YES	YES
Tesla V100	Volta	6th Gen	1	3	3	Unrestricted	YES	YES	YES	YES
Tesla T4	Turing	7th Gen	1	1	1	Unrestricted	YES	YES	YES	YES

NVIDIA Encode And Decode GPU Support Matrix, NVIDIA DEVELOPER WEBSITE (last visited November 2024), *available at:* https://developer.nvidia.com/video-encode-and-decode-gpu-support-matrix-new (showing NVIDIA products that perform the infringing HEVC encoding).

279. One or more NVIDIA subsidiaries and/or affiliates use the NVIDIA '388 Products in regular business operations.

280. The NVIDIA '388 Products identify an initial quantization parameter employed to compress a previously decoded frame.

281. The NVIDIA '388 Products, as part of the encoding process use an initial quantization parameter (QP) for encoding each frame or coding unit (CU). In conforming to the

HEVC standard, the NVIDIA '388 Products must set an initial QP value that serves as the baseline for encoding the decoded frame.

282. The NVIDIA '388 Products calculate a delta quantization parameter as influenced by the initial quantization parameter, where the function is designed to yield this delta parameter at least in part to achieve a bitrate reduction while sustaining a given quality threshold.

283. The NVIDIA '388 Products calculate a delta QP based on the initial quantization parameter. This function aims to minimize bitrate while retaining the required video quality.

284. The NVIDIA '388 Products ascertain a subsequent quantization parameter for the purpose of compressing the decoded frame, based on both the initial and delta quantization parameters.

285. The NVIDIA '388 Products determine a second quantization parameter using the initial QP and the delta QP. The NVIDIA '388 Products calculate the second quantization parameter as QP1 + Delta QP. This second quantization parameter is the one used for encoding either the entire frame or specific coding units within the frame.

286. The NVIDIA '388 Products compress the decoded frame utilizing the second quantization parameter.

287. The NVIDIA '388 Products encode the video frames using the newly derived second quantization parameter.

288. By complying with the HEVC standard, the NVIDIA '388 Products necessarily infringe the '388 Patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '388 Patent, including but not limited to claim 1. High Efficiency Video Coding, Series H: Audiovisual And Multimedia Systems: Infrastructure Of Audiovisual Services – Coding Of Moving Video Rec. ITU-T H.265 (August 2021). The following sections of the

HEVC Standard are relevant to NVIDIA's infringement of the '388 patent: "7.3.2.2.3 Sequence parameter set screen content coding extension syntax;" "7.3.8.4 Coding quadtree syntax;" "7.3.8.14 Delta QP syntax;" "7.4.3.3.1 General picture parameter set RBSP semantics;" "7.4.7.1 General slice segment header semantics;" "7.4.9.14 Delta QP semantics;" "8.6.1 Derivation process for quantization parameters;" and "9.3.3.10 Binarization process for cu_qp_delta_abs."

289. All implementations of the HEVC standard necessarily infringe the '388 patent as every implementation of the standard requires compliant devices to carry out the following: Each frame or coding unit (CU) is encoded using a pre-defined initial Quantization Parameter (QP) which serves as a baseline for various optimizations. The standard mandates that a first QP (QP1) be identified before any encoding can occur. The NVIDIA '388 Products are, therefore, required to have mechanisms to set this initial QP1 for the to-be-encoded (or re-encoded) frame. Further, the HEVC standard sets out a structured way to adjust this initial QP based on a delta value. The objective of introducing a delta QP is generally to adapt to the complexity variations within a video sequence and to optimize rate-distortion performance. The HEVC encoding standard sets forth calculating a new QP (QP2) after determining the delta QP. This is done by adding the initial QP (QP1) and the delta QP. This step is essential for maintaining granular control over the rate-distortion tradeoff during encoding. Finally, the final encoding of the frame or CU takes place using QP2. The HEVC standard specifies that this is a requisite step for the encoding process to be considered compliant. The NVIDIA '388 Products must, therefore, encode frames using this newly computed QP2 to meet the standard's rate and quality stipulations.

290. NVIDIA has directly infringed and continues to directly infringe the '388 Patent by, among other things, making, using, offering for sale, and/or selling technology for video

compression using adaptive re-quantization using extracted and derived quantization parameters, including but not limited to the NVIDIA '388 Products.

291. The NVIDIA '388 Products are available to businesses and individuals throughout the United States.

292. The NVIDIA '388 Products are provided to businesses and individuals located in this District.

293. By making, using, testing, offering for sale, and/or selling products and services comprising technology for video compression using adaptive re-quantization using extracted and derived quantization parameters, including but not limited to the NVIDIA '388 Products, NVIDIA has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '388 Patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

294. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '388 Patent.

295. As a result of NVIDIA's infringement of the '388 Patent, Plaintiff has suffered monetary damages, and seek recovery in an amount adequate to compensate for NVIDIA's infringement, but in no event less than a reasonable royalty for the use made of the invention by NVIDIA together with interest and costs as fixed by the Court.

COUNT X
INFRINGEMENT OF U.S. PATENT NO. 9,894,361

296. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

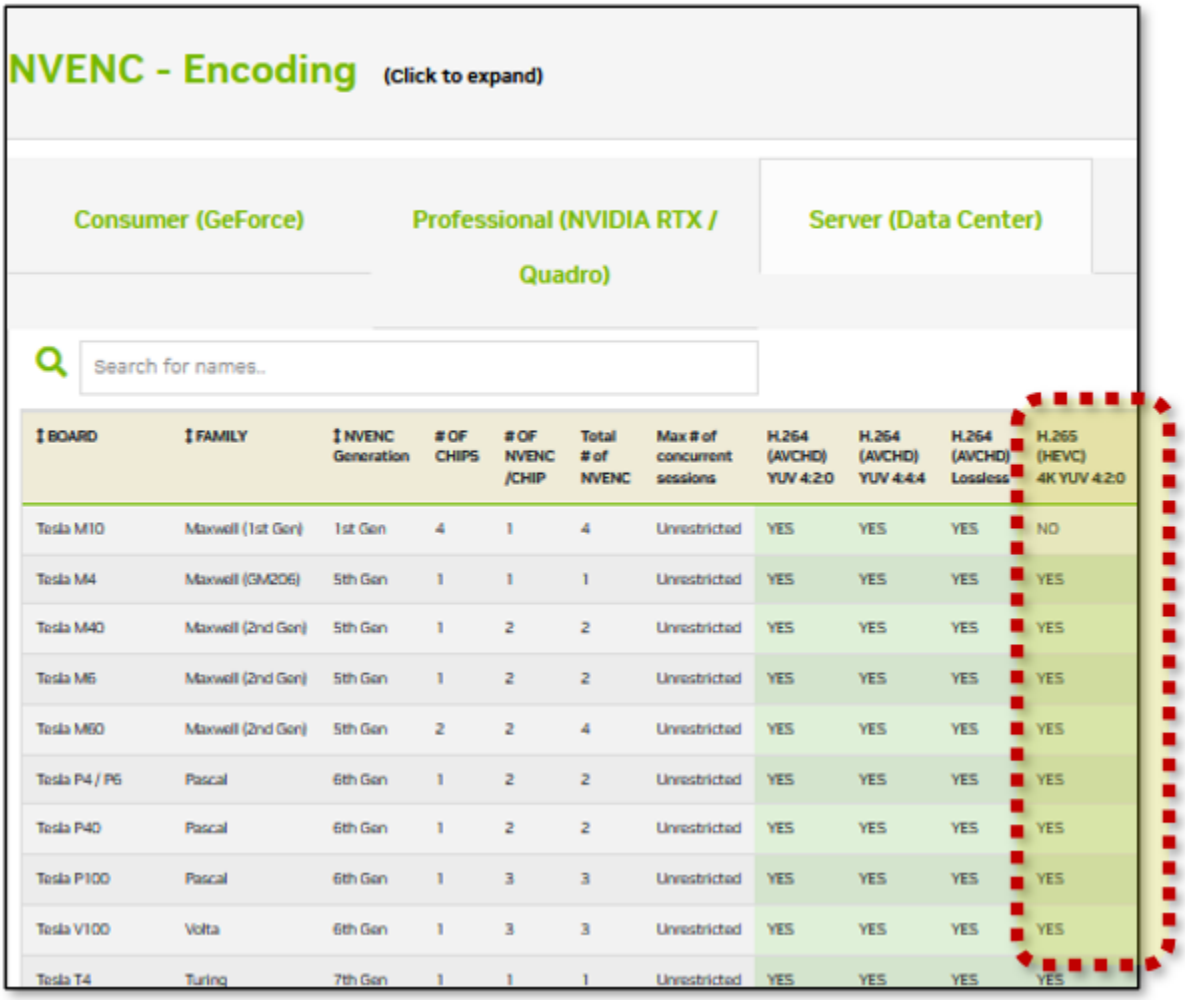
297. NVIDIA designs, makes, uses, sells, and/or offers for sale in the United States products containing technology for quality-aware video optimization.

298. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses NVIDIA Products containing H.265 encoding technology, including: GeForce GTX 1650 GDDR6, GeForce GTX 1650 SUPER, GeForce GTX 1660 Ti Max-Q, GeForce GTX 1660 Ti / 1660, GeForce GTX 1660 SUPER, GeForce RTX 2060 / 2070, GeForce RTX 2060 SUPER, GeForce RTX 2060 (TU104), GeForce RTX 2070 Max-Q, GeForce RTX 2070 SUPER, GeForce RTX 2080, GeForce RTX 2080 Max-Q, GeForce RTX 2080 SUPER, GeForce RTX 2080 Ti, Titan RTX, GeForce RTX 2050, GeForce RTX 3050, GeForce RTX 3050 Laptop, GeForce RTX 3080 Ti Laptop, GeForce RTX 3080 Laptop, GeForce RTX 3070 Ti Laptop, GeForce RTX 3070 Laptop, GeForce RTX 3060 Ti Laptop, GeForce RTX 3060 Laptop, GeForce RTX 3060, GeForce RTX 3070, GeForce RTX 3080, GeForce RTX 3090, GeForce MX570, GeForce RTX 3050 Ti Laptop, GeForce RTX 3060 Ti, GeForce RTX 3070 Ti, GeForce RTX 3080 Ti, GeForce RTX 3090 Ti, GeForce RTX 4050 Laptop, GeForce RTX 4060 Laptop, GeForce RTX 4060, GeForce RTX 4060TI, GeForce RTX 4070 Laptop, GeForce RTX 4070, GeForce RTX 4070 Super, GeForce RTX 4070 Ti, GeForce RTX 4070 Ti Super, GeForce RTX 4080 Laptop, GeForce RTX 4080 16GB, GeForce RTX 4080 Super, GeForce RTX 4090 Laptop, GeForce RTX 4090, Quadro GP100, Quadro P400, Quadro P600 / P620/ P1000, Quadro P2000 / P2200, Quadro P3200 / P4200 / P5200, Quadro P4000, Quadro P5000, Quadro P6000, Quadro GV100, NVIDIA T400 / T400 4GB, NVIDIA T550 Laptop GPU, NVIDIA T600, NVIDIA T1000 / T1000 8GB, NVIDIA T600 Laptop GPU, NVIDIA T1200 Laptop GPU, Quadro T2000 Max-Q, Quadro T2000, Quadro RTX 3000 Max-Q, Quadro RTX 3000, Quadro RTX 4000 Max-Q, Quadro RTX 4000 / RTX 5000, Quadro RTX 6000 / RTX 8000, NVIDIA RTX A500 Laptop GPU, NVIDIA RTX A1000 Laptop GPU, NVIDIA RTX A2000 and A2000 8GB Laptop GPUs, NVIDIA RTX A3000 and A3000 12GB Laptop GPUs, NVIDIA RTX A400, NVIDIA RTX A1000, NVIDIA RTX A4000, NVIDIA

RTX A4500, NVIDIA RTX A5000, NVIDIA RTX A5500, NVIDIA RTX A6000, NVIDIA RTX A4000 Laptop GPU, NVIDIA RTX A4500 Laptop GPU, NVIDIA RTX A5000 Laptop GPU, NVIDIA RTX A5500 Laptop GPU, NVIDIA RTX A2000 / A2000 12GB, NVIDIA RTX A1000 6GB Laptop GPU, NVIDIA RTX 500 Ada Generation Laptop GPU, NVIDIA RTX 1000 Ada Generation Laptop GPU, NVIDIA RTX 2000 Ada Generation Laptop GPU, NVIDIA RTX 3000 Ada Generation Laptop GPU, NVIDIA RTX 3500 Ada Generation Laptop GPU, NVIDIA RTX 4000 Ada Generation Laptop GPU, NVIDIA RTX 5000 Ada Generation Laptop GPU, NVIDIA RTX 2000 Ada Generation, NVIDIA RTX 4000 SFF Ada Generation, NVIDIA RTX 4000 Ada Generation, NVIDIA RTX 4500 Ada Generation, NVIDIA RTX 5000 Ada Generation, NVIDIA RTX 6000 Ada Generation, Tesla M4, Tesla M40, Tesla M6, Tesla M60, Tesla P4 / P6, Tesla P40, Tesla P100, Tesla V100, Tesla T4, NVIDIA A40, NVIDIA A16, NVIDIA A10, NVIDIA A2, NVIDIA L40, NVIDIA L40S, NVIDIA L4, DGX Station, DGX-1, and DGX-2) (collectively, the "NVIDIA '361 Product(s)").

299. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses NVIDIA '361 products that comply with the H.265 video encoding standard.

300. The NVIDIA '361 Products perform video processing compliant with the High Efficiency Video Coding (HEVC) standard, which is also often referred to as the H.265 standard. Specifically, the NVIDIA '361 Products perform HEVC encoding.



NVENC - Encoding (Click to expand)

Consumer (GeForce) | Professional (NVIDIA RTX / Quadro) | Server (Data Center)

Search for names..

BOARD	FAMILY	NVENC Generation	# OF CHIPS	# OF NVENC /CHIP	Total # of NVENC	Max # of concurrent sessions	H.264 (AVCHD) YUV 4:2:0	H.264 (AVCHD) YUV 4:4:4	H.264 (AVCHD) Lossless	H.265 (HEVC) 4K YUV 4:2:0
Tesla M10	Maxwell (1st Gen)	1st Gen	4	1	4	Unrestricted	YES	YES	YES	NO
Tesla M4	Maxwell (GM206)	5th Gen	1	1	1	Unrestricted	YES	YES	YES	YES
Tesla M40	Maxwell (2nd Gen)	5th Gen	1	2	2	Unrestricted	YES	YES	YES	YES
Tesla M6	Maxwell (2nd Gen)	5th Gen	1	2	2	Unrestricted	YES	YES	YES	YES
Tesla M60	Maxwell (2nd Gen)	5th Gen	2	2	4	Unrestricted	YES	YES	YES	YES
Tesla P4 / P6	Pascal	6th Gen	1	2	2	Unrestricted	YES	YES	YES	YES
Tesla P40	Pascal	6th Gen	1	2	2	Unrestricted	YES	YES	YES	YES
Tesla P100	Pascal	6th Gen	1	3	3	Unrestricted	YES	YES	YES	YES
Tesla V100	Volta	6th Gen	1	3	3	Unrestricted	YES	YES	YES	YES
Tesla T4	Turing	7th Gen	1	1	1	Unrestricted	YES	YES	YES	YES

NVIDIA Encode And Decode GPU Support Matrix, NVIDIA DEVELOPER WEBSITE (last visited November 2024), *available at:* https://developer.nvidia.com/video-encode-and-decode-gpu-support-matrix-new (showing NVIDIA products that perform the infringing HEVC encoding).

301. One or more NVIDIA subsidiaries and/or affiliates use the NVIDIA '361 Products in regular business operations.

302. The NVIDIA '361 Products unpack a compressed video frame from a series containing multiple video frames.

303. The NVIDIA '361 Products take an encoded video frame as input. This frame is one in a series that consists of multiple frames. The encoded frame is then passed through a decoding pipeline by the NVIDIA '361 Products. The NVIDIA '361 Products use inverse

quantization and inverse DCT (Discrete Cosine Transform) functions, to revert the video data to a decompressed state suitable for further manipulation.

304. The NVIDIA ‘361 Products obtain an initial Quantization Parameter (QP) from the unpacked video frame, where this initial QP is indicative of the quantization configurations initially applied to compress the video frame.

305. The NVIDIA ‘361 Products extract a first Quantization Parameter (QP) from the video frame metadata or from the bitstream itself. This first QP reflects the quantization settings initially applied during the original encoding. This first QP is read from the slice header or similar control structures and used to modulate the quantization matrices in the decoding process.

306. The NVIDIA ‘361 Products calculate a delta QP influenced by the initial QP.

307. Upon acquiring the first QP, a delta QP is calculated by the NVIDIA ‘361 Products. This delta QP value is computed through a set of heuristic functions to optimize for certain objectives like bitrate reduction, video quality, or computational efficiency. The delta QP acquired by the NVIDIA ‘361 Products is a function of the first QP and other parameters, such as frame type (I-frame, P-frame, etc.).

308. The NVIDIA ‘361 Products derive an inflation factor through comparing the total byte size of video frames after and before decompression, where both the newly received compressed frame and those previously decompressed belong to the same series of multiple video frames.

309. The NVIDIA ‘361 Products compute an inflation adjustment factor based on the total byte size of previously decompressed frames and those frames post-compression. This comparison aids in estimating the compression efficiency.

310. The NVIDIA ‘361 Products acquire a subsequent QP influenced by both the delta QP and the inflation factor, wherein this subsequent QP is indicative of the quantization configurations to be applied for recompressing the unpacked frame.

311. The second QP is then acquired by the NVIDIA ‘361 Products by combining the calculated delta QP and the inflation adjustment. This second quantization parameter acquired by the NVIDIA ‘361 Products aims to balance the trade-offs between quality and bitrate, taking into account the information gleaned from previous frames as indicated by the inflation adjustment.

312. The NVIDIA ‘361 Products compress the unpacked video frame utilizing the subsequent QP.

313. The decompressed video frame is re-encoded based on the second QP by the NVIDIA ‘361 Products. The frame is then serialized into a bitstream and packaged with appropriate headers and metadata for transmission or storage.

314. NVIDIA has directly infringed and continues to directly infringe the ‘361 patent by, among other things, making, using, offering for sale, and/or selling technology for quality-aware video optimization, including but not limited to the NVIDIA ‘361 Products.

315. The NVIDIA ‘361 Products are available to businesses and individuals throughout the United States.

316. The NVIDIA ‘361 Products are provided to businesses and individuals located in this District.

317. By making, using, testing, offering for sale, and/or selling products and services comprising technology for quality-aware video optimization, including but not limited to the NVIDIA ‘361 Products, NVIDIA has injured Plaintiff and is liable to Plaintiff for directly

infringing one or more claims of the '361 Patent, including at least claim 10 pursuant to 35 U.S.C. § 271(a).

318. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '361 Patent.

319. As a result of NVIDIA's infringement of the '361 Patent, Plaintiff has suffered monetary damages, and seek recovery in an amount adequate to compensate for NVIDIA's infringement, but in no event less than a reasonable royalty for the use made of the invention by NVIDIA together with interest and costs as fixed by the Court.

COUNT XI
INFRINGEMENT OF U.S. PATENT NO. 10,123,015

320. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

321. NVIDIA designs, makes, uses, sells, and/or offers for sale in the United States products comprising technology for optimizing encoded video streams by tailoring quality settings for macroblocks.

322. NVIDIA designs, makes, sells, offers to sell, imports, and/or uses the following products: GeForce GTX 1650 GDDR6, GeForce GTX 1650 SUPER, GeForce GTX 1660 Ti Max-Q, GeForce GTX 1660 Ti / 1660, GeForce GTX 1660 SUPER, GeForce RTX 2060 / 2070, GeForce RTX 2060 SUPER, GeForce RTX 2060 (TU104), GeForce RTX 2070 Max-Q, GeForce RTX 2070 SUPER, GeForce RTX 2080, GeForce RTX 2080 Max-Q, GeForce RTX 2080 SUPER, GeForce RTX 2080 Ti, Titan RTX, GeForce RTX 2050, GeForce RTX 3050, GeForce RTX 3050 Laptop, GeForce RTX 3080 Ti Laptop, GeForce RTX 3080 Laptop, GeForce RTX 3070 Ti Laptop, GeForce RTX 3070 Laptop, GeForce RTX 3060 Ti Laptop, GeForce RTX 3060 Laptop, GeForce RTX 3060, GeForce RTX 3070, GeForce RTX 3080, GeForce RTX 3090, GeForce

MX570, GeForce RTX 3050 Ti Laptop, GeForce RTX 3060 Ti, GeForce RTX 3070 Ti, GeForce RTX 3080 Ti, GeForce RTX 3090 Ti, GeForce RTX 4050 Laptop, GeForce RTX 4060 Laptop, GeForce RTX 4060, GeForce RTX 4060TI, GeForce RTX 4070 Laptop, GeForce RTX 4070, GeForce RTX 4070 Super, GeForce RTX 4070 Ti, GeForce RTX 4070 Ti Super, GeForce RTX 4080 Laptop, GeForce RTX 4080 16GB, GeForce RTX 4080 Super, GeForce RTX 4090 Laptop, GeForce RTX 4090, Quadro GP100, Quadro P400, Quadro P600 / P620/ P1000, Quadro P2000 / P2200, Quadro P3200 / P4200 / P5200, Quadro P4000, Quadro P5000, Quadro P6000, Quadro GV100, NVIDIA T400 / T400 4GB, NVIDIA T550 Laptop GPU, NVIDIA T600, NVIDIA T1000 / T1000 8GB, NVIDIA T600 Laptop GPU, NVIDIA T1200 Laptop GPU, Quadro T2000 Max-Q, Quadro T2000, Quadro RTX 3000 Max-Q, Quadro RTX 3000, Quadro RTX 4000 Max-Q, Quadro RTX 4000 / RTX 5000, Quadro RTX 6000 / RTX 8000, NVIDIA RTX A500 Laptop GPU, NVIDIA RTX A1000 Laptop GPU, NVIDIA RTX A2000 and A2000 8GB Laptop GPUs, NVIDIA RTX A3000 and A3000 12GB Laptop GPUs, NVIDIA RTX A400, NVIDIA RTX A1000, NVIDIA RTX A4000, NVIDIA RTX A4500, NVIDIA RTX A5000, NVIDIA RTX A5500, NVIDIA RTX A6000, NVIDIA RTX A4000 Laptop GPU, NVIDIA RTX A4500 Laptop GPU, NVIDIA RTX A5000 Laptop GPU, NVIDIA RTX A5500 Laptop GPU, NVIDIA RTX A2000 / A2000 12GB, NVIDIA RTX A1000 6GB Laptop GPU, NVIDIA RTX 500 Ada Generation Laptop GPU, NVIDIA RTX 1000 Ada Generation Laptop GPU, NVIDIA RTX 2000 Ada Generation Laptop GPU, NVIDIA RTX 3000 Ada Generation Laptop GPU, NVIDIA RTX 3500 Ada Generation Laptop GPU, NVIDIA RTX 4000 Ada Generation Laptop GPU, NVIDIA RTX 5000 Ada Generation Laptop GPU, NVIDIA RTX 2000 Ada Generation, NVIDIA RTX 4000 SFF Ada Generation, NVIDIA RTX 4000 Ada Generation, NVIDIA RTX 4500 Ada Generation, NVIDIA RTX 5000 Ada Generation, NVIDIA RTX 6000 Ada Generation, Tesla M4,

Tesla M40, Tesla M6, Tesla M60, Tesla P4 / P6, Tesla P40, Tesla P100, Tesla V100, Tesla T4, NVIDIA A40, NVIDIA A16, NVIDIA A10, NVIDIA A2, NVIDIA L40, NVIDIA L40S, NVIDIA L4, DGX Station, DGX-1, and DGX-2) (collectively, the "NVIDIA '015 Product(s)").

323. One or more NVIDIA subsidiaries and/or affiliates use the NVIDIA '015 Products in regular business operations.

324. The NVIDIA '015 Products optimize encoded video streams comprised of video frames. Each video frame is comprised of a plurality of macroblocks.

325. The NVIDIA '015 Products receive information for a macroblock of a video frame of the encoded video stream.

326. The NVIDIA '015 Products extract a first quantization parameter (QP) corresponding to the quantization settings originally used for compressing the macroblock.

327. The NVIDIA '015 Products determine, using the received information, motion vector information for at least one motion vector associated with the macroblock that indicates a location of a prediction block within the video frame or another video frame which was subtracted from the macroblock prior to encoding.

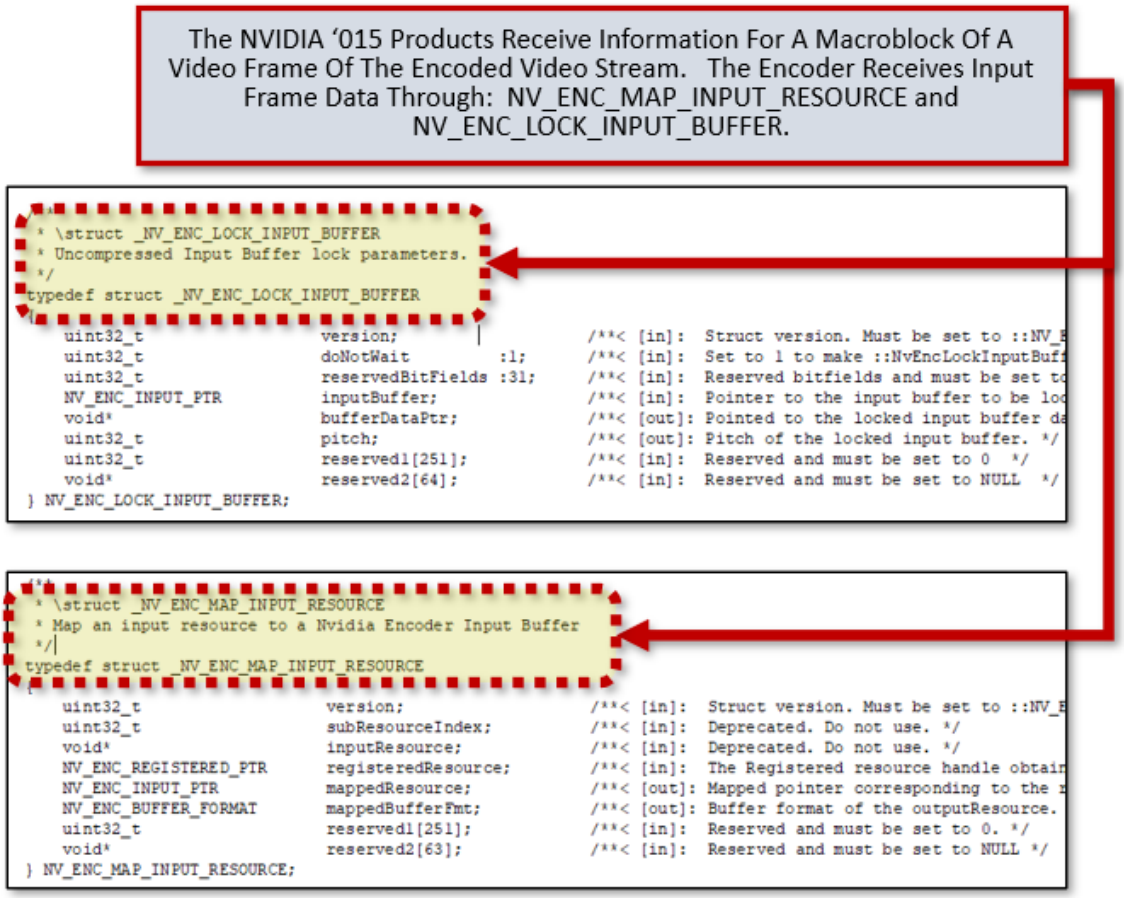
328. The NVIDIA '015 Products compute a second quantization parameter (QP) for re-encoding the macroblock. The second QP is based at least in part on the first QP and the motion vector information.

329. The NVIDIA '015 Products re-encode the macroblock based on the second QP.

330. The NVIDIA '015 Products transmit the re-encoded macroblock to a user device.

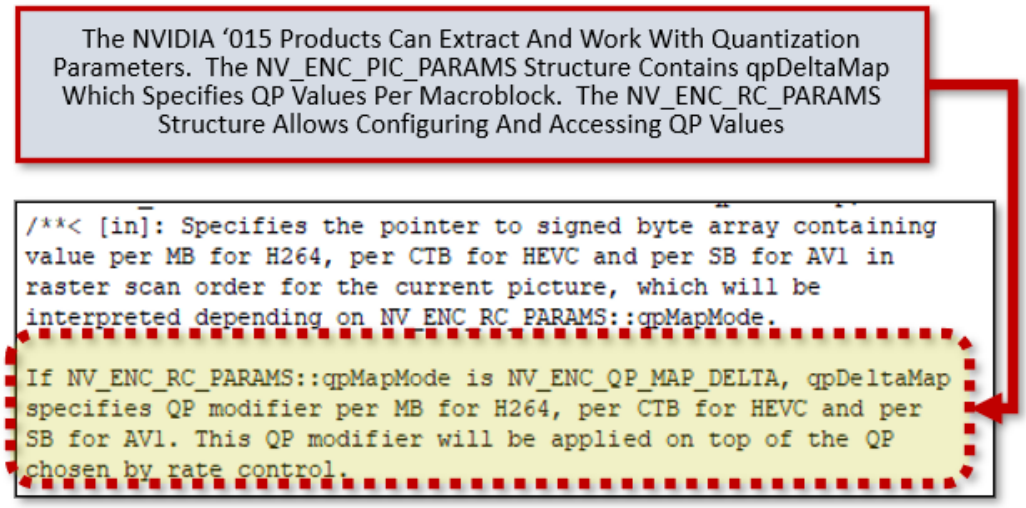
331. NVIDIA'015 Products receive information for a macroblock of a video frame of the encoded video stream. Specifically, the NVIDIA '015 Products receive information for macroblocks of a video frame. The NVIDIA '015 Products process macroblock-level information

during encoding including motion vectors and quantization parameters. According to the below excerpt from NVIDIA documentation the NVIDIA '015 Products receive macroblock-level motion vectors.



nvEncodeAPI.h, NVIDIA VIDEO CODEC SDK 12.2 (March 18, 2024) (annotation added).

332. The NVIDIA'015 Products extract a first quantization parameter corresponding to quantization settings originally used for compressing the macroblock. Specifically, the NVIDIA '015 Products support constant quantization parameter (QP) mode (NV_ENC_PARAMS_RC_CONSTQP). In constant QP mode, the NVIDIA'015 Products apply a fixed quantization parameter to encoding that uses quantization information from prior stages.



nvEncodeAPI.h, NVIDIA VIDEO CODEC SDK 12.2 (March 18, 2024) (annotation added).

333. The NVIDIA'015 Products determine motion vector information for at least one motion vector associated with a macroblock. Specifically, the motion vector associated with the macroblock indicates a location of at least one prediction block within the video frame or another video frame which was subtracted from the macroblock prior to encoding. The NVIDIA '015 Products perform "motion estimation only mode" which determines motion vectors for each macroblock. The process is used for both prediction block determination and frame interpolation by the NVIDIA '015 Products.

> NVENC can be used as a hardware accelerator to perform motion search and generate motion vectors and mode information. The resulting motion vectors or mode decisions can be used, for example, in motion compensated filtering or for supporting other codecs not fully supported by NVENC or simply as motion vector hints for a custom encoder. The procedure to use the feature is explained below.
>
> For use-cases involving computer vision, AI and frame interpolation, Turing and later GPUs contain another hardware accelerator for computing optical flow vectors between frames, which provide better visual matching than the motion vectors.

NVIDIA VIDEO CODEC SDK – ENCODER PROGRAMMING GUIDE at 23 (March 2024) (emphasis added).

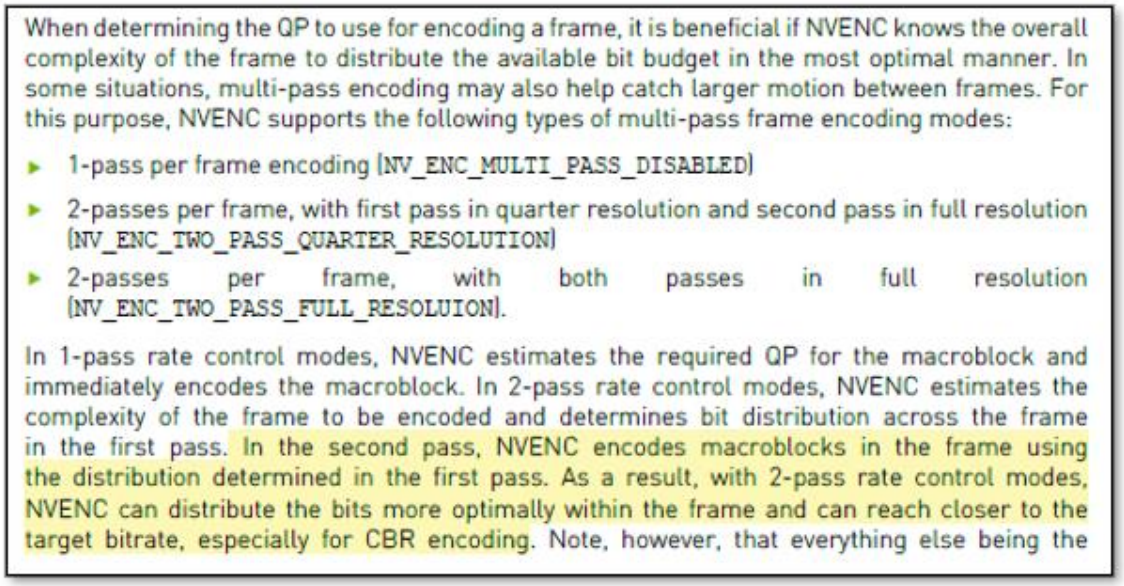
334. The NVIDIA'015 Products compute a second quantization parameter for re-encoding the macroblock, the second quantization parameter based at least in part on the first

quantization parameter and the motion vector information. Specifically, the NVIDIA '015 Products compute different quantization parameters for different encoding passes via adaptive quantization (AQ). Adaptive quantization adjusts the initial QP creating a second quantization parameter based on the complexity analysis. Further, the NVIDIA '015 Products perform multi-pass encoding. Using multi-pass encoding the NVIDIA '015 Products compute optimal QP values by evaluating frame complexity during the first pass and then use this information to adjust bit allocation during the second pass.

```
/**
 * Multi Pass encoding
 */
typedef enum _NV_ENC_MULTI_PASS
{
    NV_ENC_MULTI_PASS_DISABLED              = 0x0,       /**< Single Pass */
    NV_ENC_TWO_PASS_QUARTER_RESOLUTION      = 0x1,       /**< Two Pass encoding is enabled where first Pass is quarter resolution */
    NV_ENC_TWO_PASS_FULL_RESOLUTION         = 0x2,       /**< Two Pass encoding is enabled where first Pass is full resolution */
} NV_ENC_MULTI_PASS;
```

nvEncodeAPI.h, NVIDIA VIDEO CODEC SDK 12.2 (March 18, 2024) (annotation added) (showing multi-pass encoding enabled by the NVIDIA '015 Products).

335. The NVIDIA '015 Products perform multi-pass encoding wherein in the second pass, the NVIDIA '015 Products use the data gathered during the first pass, including the motion vector information, to make more informed decisions about bit allocation and quantization. Macroblocks that were identified as having high motion (based on their motion vectors) can be targeted with a lower QP during the second pass to improve the quality of those areas. In this second pass, the NVIDIA '015 Products recalculate the second quantization parameter for each macroblock, reducing QP values in areas with high motion (to reduce visible artifacts) and increasing QP values in areas with little or no motion.



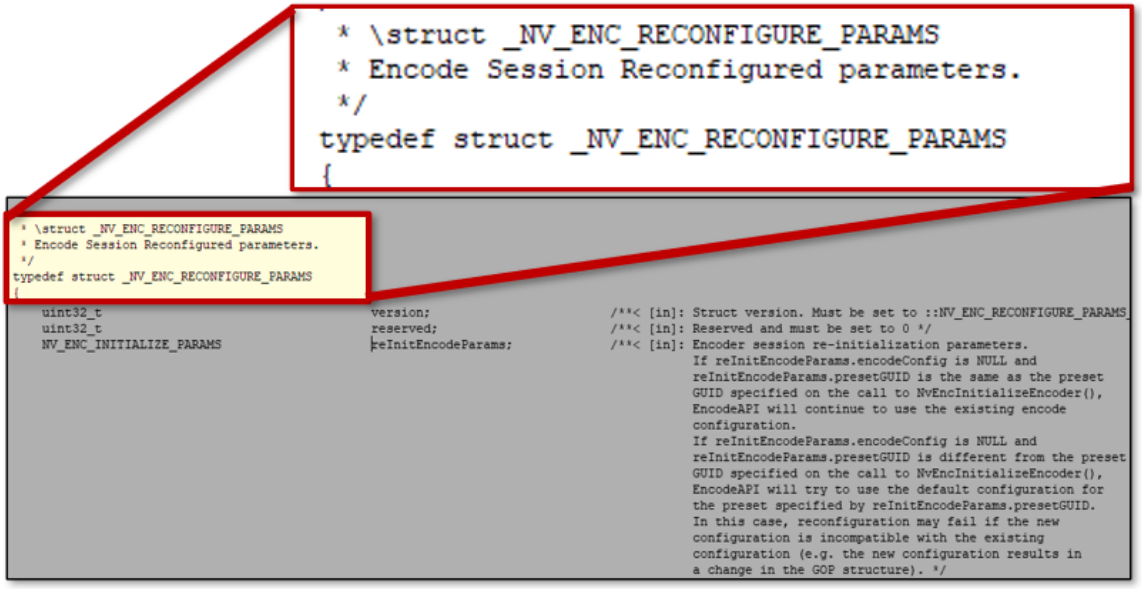
When determining the QP to use for encoding a frame, it is beneficial if NVENC knows the overall complexity of the frame to distribute the available bit budget in the most optimal manner. In some situations, multi-pass encoding may also help catch larger motion between frames. For this purpose, NVENC supports the following types of multi-pass frame encoding modes:

- 1-pass per frame encoding (NV_ENC_MULTI_PASS_DISABLED)
- 2-passes per frame, with first pass in quarter resolution and second pass in full resolution (NV_ENC_TWO_PASS_QUARTER_RESOLUTION)
- 2-passes per frame, with both passes in full resolution (NV_ENC_TWO_PASS_FULL_RESOLUION).

In 1-pass rate control modes, NVENC estimates the required QP for the macroblock and immediately encodes the macroblock. In 2-pass rate control modes, NVENC estimates the complexity of the frame to be encoded and determines bit distribution across the frame in the first pass. In the second pass, NVENC encodes macroblocks in the frame using the distribution determined in the first pass. As a result, with 2-pass rate control modes, NVENC can distribute the bits more optimally within the frame and can reach closer to the target bitrate, especially for CBR encoding. Note, however, that everything else being the

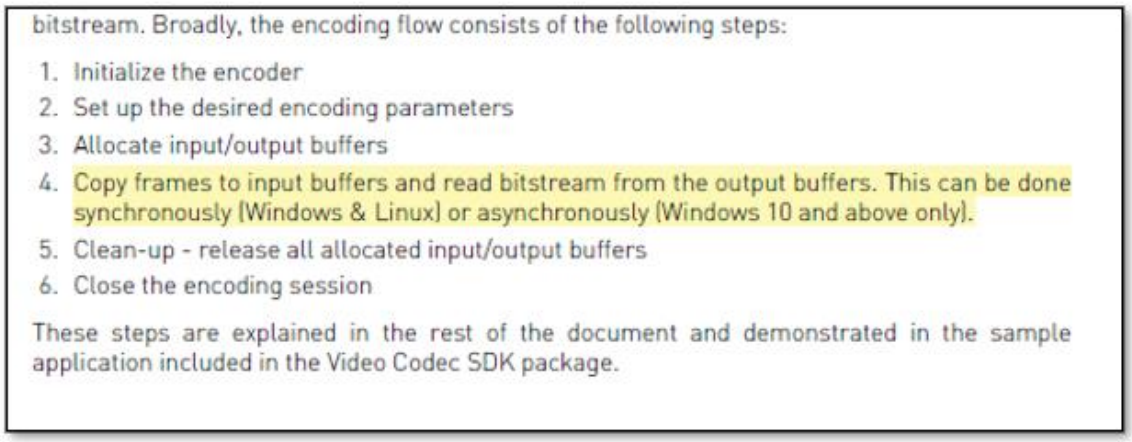
NVIDIA VIDEO CODEC SDK – ENCODER PROGRAMMING GUIDE at 10 (March 2024) (emphasis added).

336. The NVIDIA'015 Products re-encode a macroblock based on the second quantization parameter. Specifically, the NVIDIA '015 Products perform iterative encoding where the same frame can be encoded multiple times with different QP values. Further, the NV_ENC_RECONFIGURE_PARAMS structure in the NVIDIA '015 Products dynamically changes the encoding parameters including QP settings.



nvEncodeAPI.h, NVIDIA VIDEO CODEC SDK 12.2 (March 18, 2024) (emphasis added) (showing the NV_ENC_RECONFIGURE_PARAMS structure in the NVIDIA '015 Products).

337. The NVIDIA'015 Products transmit the re-encoded macroblock to a user device using the output buffer.



NVIDIA VIDEO CODEC SDK – ENCODER PROGRAMMING GUIDE at 2 (March 2024) (emphasis added).

338. NVIDIA has directly infringed and continues to directly infringe the '015 Patent by, among other things, making, using, offering for sale, and/or selling technology for optimizing encoded video streams by tailoring quality settings for macroblocks, including but not limited to the NVIDIA '015 Products.

339. The NVIDIA ‘015 Products are available to businesses and individuals throughout the United States.

340. The NVIDIA ‘015 Products are provided to businesses and individuals located in this District.

341. By making, using, testing, offering for sale, and/or selling products and services comprising technology for optimizing encoded video streams by tailoring quality settings for macroblocks, including but not limited to the NVIDIA ‘015 Products, NVIDIA has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the ‘015 Patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

342. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the ‘015 Patent.

343. As a result of NVIDIA’s infringement of the ‘015 Patent, Plaintiff has suffered monetary damages, and seek recovery in an amount adequate to compensate for NVIDIA’s infringement, but in no event less than a reasonable royalty for the use made of the invention by NVIDIA together with interest and costs as fixed by the Court.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff OptiMorphix, Inc. respectfully requests that this Court enter:

A. A judgment in favor of Plaintiff that NVIDIA has infringed, either literally and/or under the doctrine of equivalents, ‘353, ‘901, ‘559, ‘664, ‘285, ‘904, ‘105, ‘551, ‘388, ‘361, and ‘015 Patents;

B. An award of damages resulting from NVIDIA’s acts of infringement in accordance with 35 U.S.C. § 284;

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

D. Any and all other relief to which Plaintiff may show themselves to be entitled.

JURY TRIAL DEMANDED

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

Dated: November 21, 2024

OF COUNSEL:

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