

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

WIRELESS TRANSPORT LLC,

Plaintiff,

v.

EXTREME NETWORKS, INC.,

Defendant.

C.A. NO.

JURY TRIAL DEMANDED

ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT

1. This is an action for patent infringement in which Wireless Transport LLC makes the following allegations against Extreme Networks, Inc.

PARTIES

2. Plaintiff Wireless Transport LLC (“Plaintiff” or “Wireless Transport”) is a Delaware limited liability company with its principal place of business at 16192 Coastal Highway, Lewes, DE 19959.

3. On information and belief, Extreme Networks, Inc (“Defendant” or “Extreme Networks”) is a corporation organized and existing under the laws of the State of Delaware, which can be served through its registered agent Corporation Trust Company, Corporation Trust Center, 1209 Orange St, Wilmington, DE 19801.

JURISDICTION AND VENUE

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

5. Venue is proper in this district under 28 U.S.C. §§ 1391(c) and 1400(b). On information and belief, Defendant is incorporated in the State of Delaware, and, thus, resides in the State of Delaware for the purposes of 28 U.S.C. § 1400(b).

6. On information and belief, Defendant is subject to this Court's specific and general personal jurisdiction pursuant to due process and/or the Delaware Long Arm Statute, due at least to its substantial business in this forum, including: (i) at least a portion of the infringements alleged herein; and (ii) regularly doing or soliciting business, engaging in other persistent courses of conduct, and/or deriving substantial revenue from goods and services provided to individuals in Delaware and in this Judicial District.

COUNT I
INFRINGEMENT OF U.S. PATENT NO. 6,563,813

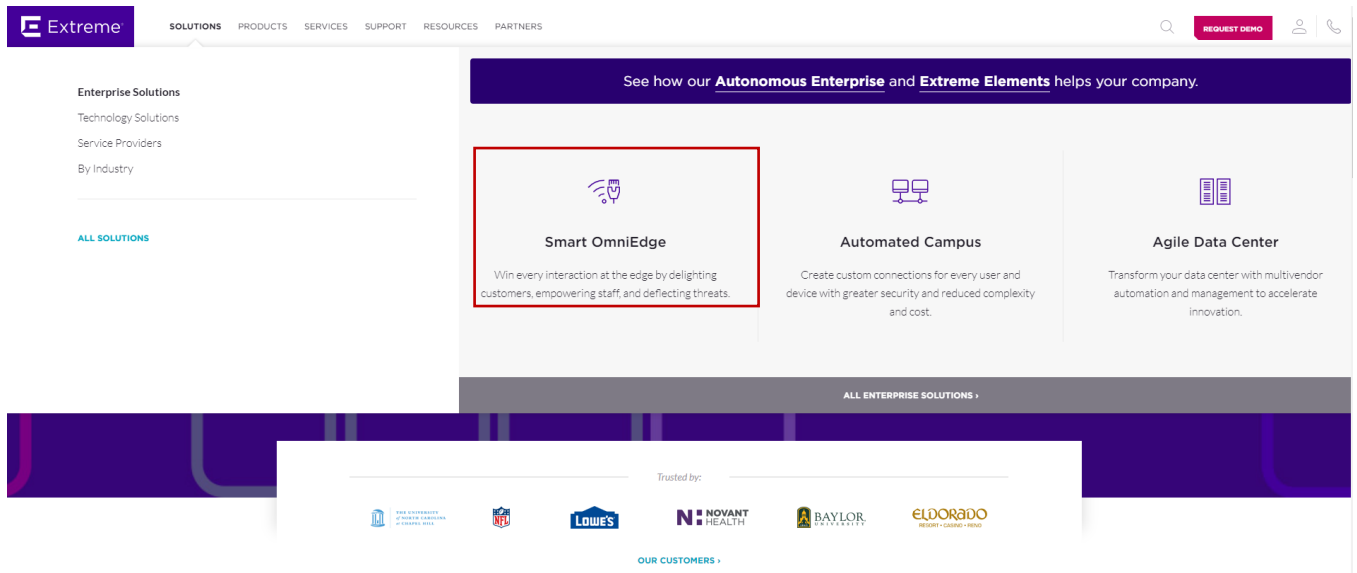
7. Plaintiff is the owner of United States Patent No. 6,563,813 ("the '813 patent") entitled "Wireless Transport Protocol." The '813 Patent issued on May 13, 2003. A true and correct copy of the '813 Patent is attached as Exhibit A.

8. Defendant owns, uses, operates, advertises, controls, sells, and otherwise provides products and/or services that infringe the '813 patent. The '813 patent provides, among other things, "A communication system comprising: a wireless client; a wireless network; a land-line client; a land-line network; and a network backbone interfacing said land-line network and said wireless network to allow data packets to be exchanged between said wireless client and said land-line client, said communication system using a wireless transport layer protocol for data frame transmission over said land-line and wireless networks, each data frame including connection handling information specifying at least one data transport connection to be used to transmit data between said wireless client and said land-line client over said wireless and land-line networks; connection addressing information; a user data field including a data packet to be transmitted from one client to another client; and at least one sequencing field identifying the last packet received by the client that is transmitting a current data packet."

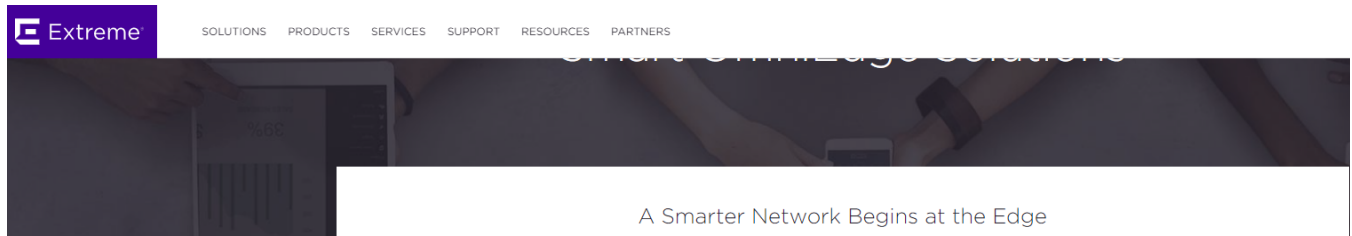
9. Defendant directly and/or through intermediaries, made, has made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or services that infringed one or more claims of the '813 patent, including at least Claim 6, in this district and elsewhere in the United States. For example, but without limitation, Smart OmniEdge solutions forms a communication system within the meaning of the '813 Patent. By making, using, importing, offering for sale, and/or selling such products and services, and all like

products and services, Defendant has injured Plaintiff and is thus liable for infringement of the ‘813 patent pursuant to 35 U.S.C. § 271.

10. Extreme Networks makes, uses, sells and/or offers for sale a communication system. For example, Extreme Networks provides a Smart OmniEdge solutions (“a communication system”) which includes ExtremeCloud Appliance products such as WLAN Access Points, Access Points, Ethernet Switches, and software (such as ExtremeAI, ExtremeLocation, AirDefense, Management Center, ExtremeControl and/or ExtremeAnalytics).



Source: <https://www.extremenetworks.com/>



Win the Battle at the Edge

The network edge is where digital transformation is won or lost. It's where your organization engages customers, where mobile transactions occur, where IoT devices connect, and where you make the first stand against cyber threats. Extreme's Smart OmniEdge network solution provides a unified wired/wireless infrastructure for cloud or premise deployment, augmented with AI-powered applications and managed through a single pane of glass. The result? A network that delivers a consistent customer-driven experience, contains costs, and enables competitive advantage through innovation and rapid new service delivery.

Extreme Emerges as a Leader in Gartner's Wired and Wireless LAN Magic Quadrant

DOWNLOAD THE REPORT TODAY

Source: <https://www.extremenetworks.com/solution/smart-omniedge/>



OmniEdge Take Your Network to the Next Level?

With Smart OmniEdge, enterprises can acquire and provision edge services quickly and easily, seamlessly deploying regardless of the consumption model (hardware, software or as-a-service). Users will enjoy a consistent experience over a unified infrastructure that supports campus and distributed wireless architectures without sacrificing convenient features.

Ultimately, Extreme Smart OmniEdge simplifies complexity to accelerate business transformation, comprising a secure, unified wired/wireless infrastructure, augmented with AI/ML powered applications and managed through a single pane of glass. Purpose built with a single operating model that scales to address the growth of IoT, Smart OmniEdge delivers a consistent customer-driven experience across campus and distributed environments, cloud and on-premise deployments.

What Technologies Does Smart OmniEdge Include?

Along with Extreme's new Smart OmniEdge solution, we are introducing a number of leading-edge technologies, designed specifically to enhance the edge network experience.

- **ExtremeAI:** A powerful artificial intelligence and machine learning solution, ExtremeAI augments the edge experience and provides customers technological advances in WiFi RF management that save time, effort and money while improving the end user experience.
- **ExtremeCloud Appliance:** Designed for customers who love the simplicity of cloud, ExtremeCloud Appliance allows customers to take advantage of their own on-premise version of Extreme Smart OmniEdge. ExtremeCloud Appliance delivers cloud-like simplicity, management and tightly integrated services, complemented with simplified licensing. ExtremeCloud and the new ExtremeCloud Appliance are like one application, delivering a uniform user experience regardless of how it's acquired and consumed. ExtremeCloud Appliance is also available as a VM for customers with their own private cloud services. The Extreme Smart OmniEdge approach provides customers maximum flexibility to deploy ExtremeCloud and ExtremeCloud Appliance in the cloud of their choice.

Source: <https://www.extremenetworks.com/extreme-networks-blog/introducing-extreme-smart-omniedge-the-unrivaled-customer-driven-network-edge-solution/>

Extreme

SOLUTIONSPRODUCTSSERVICESSUPPORTRESOURCESPARTNERS

Extreme Smart OmniEdge transforms and modernizes the network edge	Transform the Experience	Augment with AI/ML	Enhance Business Agility
	Derive Business Insights	Personalize Engagement	Protect your Reputation

Smart OmniEdge Solution

Pervasive Intelligence

Pervasive APIs and machine learning connect business insights with the contextual information needed to personalize engagement and enable network programmability.

Business Adaptive

Zero "lock-in" technology with consistent management, hardware (wired & WLAN), and services across public, private and hybrid cloud.

Intrinsic Security

A cohesive security ecosystem with integrated and automated threat detection, intelligence and mitigation from device on-boarding to session completion.

Source: <https://www.extremenetworks.com/solution/smart-omniedge/>

Smart OmniEdge™

A New Era in Edge Networking

Extreme's Smart OmniEdge provides enterprises a new framework for how edge networks should be designed, deployed and consumed. It allows enterprises to shift their focus from managing the network to growing their business. At the core of our strategy is delivering a superior customer-driven experience that is consistent across different architectures, locations and consumption models. Smart OmniEdge eliminates the complexity of edge networks with a secure, unified wired/wireless infrastructure which is augmented with AI/ ML powered applications and managed through a single pane of glass. Purpose built with a single operating model that scales to address the growth of IoT, Smart OmniEdge delivers a consistent customer-driven experience across campus and distributed environments, cloud and on-premise deployments. Smart OmniEdge provides operational efficiency via AI/ ML and automation, new customer experiences via pervasive intelligence, diversified business models with its adaptive hybrid-cloud capabilities and strong network security.

Agile and Adaptive

Today's enterprises each have different needs – they require choice. Choice of campus, distributed and hybrid architectures, choice of cloud and/or premise deployments, all with the simplicity of annualized subscription licensing to best fit their operating needs. And as their business grows, their networks need to evolve and change quickly, in lock step with the business, to stay competitive and meet their digital transformation goals. Extreme's Smart OmniEdge provides the agility enterprises have been asking for. Extreme delivers on these new enterprise requirements with ExtremeCloud and ExtremeCloud Appliance, using a common user interface and workflows with unified wired and wireless solutions, as a service or an appliance – or both.

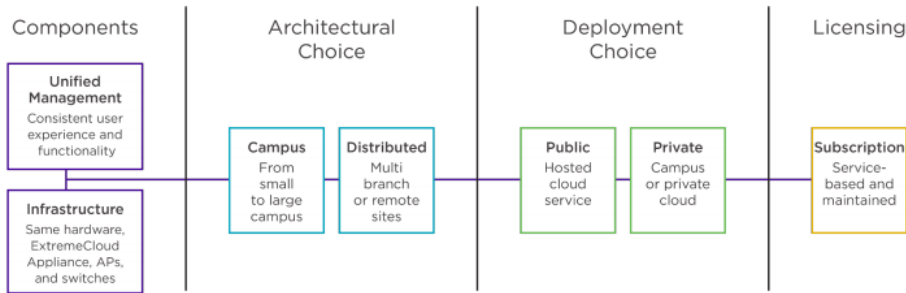


Figure 1: Smart OmniEdge Agile and Adaptive

Source: https://cloud.kapostcontent.net/pub/aa85e332-3cf6-4502-a9e5-393c480a57ed/extremecloud-appliance-data-sheet?kui=CuPMY6j6ZecRs2unh_ZLXw, page 2

Extreme Application Support

The following Extreme applications are supported by, or can integrate with ExtremeCloud Appliance:


Extreme Application	Description	Type
Defender for IoT	An application which is hosted on the ExtremeCloud Appliance and ensures the security of IoT devices connected via the switch ports of the AP3912 or via the Defender Adapter, which was purpose built for connecting older devices which may not have the security required for today's networks.	Hosted on ExtremeCloud Appliance
ExtremeLocation™	Provides enterprises powerful multi-tier location services with cloud scales to thousands of branch sites. ExtremeLocation offers a range of granular location accuracy to address various application scenarios with extensive real-time and historical location analytics, such as; new and repeat visitors, visitor engagement times, location of associates and specifics of site or zone performance.	Cloud Hosted Service
Extreme AirDefense®	Leads the industry in Wireless Intrusion Prevention and supports advanced forensics analysis required for PCI, HIPAA, and other compliance regulations.	Premise
Extreme Management Center™	Management Center is a single pane of glass management system that provides wired/wireless visibility and control from the data center to the mobile edge. The intelligence, automation, and integration of your management software enable the IT organization to optimize the efficiency of network operations and reduce total cost of ownership.	Premise
ExtremeAnalytics™	ExtremeAnalytics lets you understand what applications are running on your network, who is using them and what the response time is for each application. It gives you granular visibility into network and application performance, users, locations and devices. Information from the network and the applications empower you to make data-driven decisions.	Premise
ExtremeControl™	ExtremeControl lets you manage secure and automated access for both, BYOD and IoT devices from one convenient dashboard. It makes it easy to roll out granular policies across your wired and wireless networks to meet industry and company compliance obligations. Identity based network access control keeps unauthorized people and devices from accessing your network.	Premise

ExtremeCloud Appliance Summary Table


Category	Products	
Network Architecture	Campus, Distributed, Hybrid	
Access Points	ExtremeWireless™ AP3912, AP3915, AP3916, AP3917, AP3935, AP3965, AP505, AP510	ExtremeWireless WiNG™ AP7612, AP7632, AP7662, AP8533, AP8432, AP7522, AP7532, AP7562 AP505, AP510
Ethernet Switches	210, 220, X440-G2 (12/24/48), X620-16p	
ExtremeCloud Appliance	Hardware Appliance E1120 - 250 APs, E2120 - 4000 APs, E3120 - 10000 APs	Software Appliance VEV6120, up to 1000 APs
Software	ExtremeAI, ExtremeLocation, AirDefense, Management Center, ExtremeControl, ExtremeAnalytics	

Source: https://cloud.kapostcontent.net/pub/aa85e332-3cf6-4502-a9e5-393c480a57ed/extremecloud-appliance-data-sheet?kui=CuPMY6j6ZecRs2unh_ZLXw, page 8

11. Extreme Networks provides a communication system comprising a wireless client. For example, the Smart OmniEdge solutions which when equipped with ExtremeWireless Access Points (such as AP3912, AP3915, AP3916, AP3917, AP3935, AP3965, AP505, AP510) provide connectivity for devices (“wireless clients”) which support IEEE 802.11 a/b/g/n/ac standard.



SOLUTIONSPRODUCTSSERVICESSUPPORTRESOURCESPARTNERS



Wi-Fi Infrastructure That Makes the Customer-Driven Network a “Wi-Not?” Reality.

Search ExtremeMobility Products...

Campus

Controllers (4)

Indoor Access Points (4) x

Outdoor Access Points (2) x

Distributed

WING Controllers (3)

WING Indoor (6)


WING Outdoor (3)

WING T-S System (2)

WING Wireless Wall Plate (4)

ExtremeMobility


ExtremeMobility (2)



AP3917

Enterprise-Grade and Wave 2 Outdoor Performance without the Premium Cost


[Data sheet](#)



AP3935

Enterprise-Grade, Ultra-High Performance for Demanding High-Density Deployments


[Data sheet](#)



AP3965


Extends Ultra-High Performance and High-Density Outdoors

[Data sheet](#)




AP3916

Flow-Based Access Ppoint with integrated HD video camera, 802.11ac Wave 2, up to 1.17Gbps capacity, dual radio, 2x2:2, integrated BTLE/802.15.4 radio



AP3915

Enterprise-Grade with Wave 2 Performance without the Premium Price



AP3912

802.11ac Wave 2 Wall-Plate access point, up to 1.17Gbps capacity, dual radio, 2x2:2, integrated BTLE/802.15.4 radio

Source: <https://www.extremenetworks.com/products/extrememobility/>

[8]

Extreme Application Support

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Features and Capabilities

Supported Features

- CAPWAP (Pre-Standard)
- Multi-Site support
- Site Based configuration
- Auto-discovery of new managed devices
- Rules Based Adoption of Access Points (Assign to Site based on device model, IP address, name)
- Visibility through Extreme ManagementCenter
- Integration with ExtremeAnalytics
- Integration with ExtremeAirDefense
- Integration with ExtremeLocation
- Multi-Site Management
- Simultaneous management of ExtremeWireless (Centralized) and ExtremeWireless WiNG™ (Distributed) Sites
- Integrated RF visibility (Coverage, Channel, Quality)
- Integrated Site occupancy view (Associated, non-associated and presence traffic)
- Integrated Enrollment control (Device Grouping and Rules based policy assignment)
- Integrated Policy management (Roles, filters, VLANs)
- Inter-Controller mobility extension for ExtremeWireless migrations
- High availability with automatic failover to a backup controller (license included)
- Client mobility with fast failover and session availability (for Centralized Sites)
- Dynamic Radio Management (DRM), Flexible Client Access (airtime fairness), Band-steering
- Client load balancing with 802.11k
- Management Frame Protection (802.11w)
- Automatic discovery of networks by pre-authenticated devices (802.11u)
- Flexible hybrid traffic forwarding: local switching at AP or controller-based switching (for Centralized Sites)
- Fabric attach Topologies for APs
- Robust standards-based security: WPA2
- 802.1x Authentication: EAP-TLS, EAP-SIM, EAP-TTLS, EAP-AKA, PEAP, EAP-MD5, EAP-FAST
- RADIUS Authentication and Accounting
- Active Directory Authentication
- Encryption Algorithms: AES (CCMP)
- Guest Services (captive portal, URL redirect and Control) and Walled Garden (unauthorized access to URL)
- Voice-over-WLAN Optimization: 802.11e/WMM, U-APSD, TSPEC, CAC, QBSS
- Wired-Wireless (DSCP/TOS-to-WMM) QoS Mapping
- SNMPv2c/v3
- REST API interface/SDK
- 802.11-802.3 bridging
- IEEE 802.1D-compliant bridging
- IEEE 802.1Q VLAN tagging and trunking
- Proxy ARP

Source: https://cloud.kapostcontent.net/pub/aa85e332-3cf6-4502-a9e5-393c480a57ed/extremeccloud-appliance-data-sheet?kui=CuPMY6j6ZecRs2unh_ZLXw, page 9

Smart OmniEdge™

A New Era in Edge Networking

Extreme's Smart OmniEdge provides enterprises a new framework for how edge networks should be designed, deployed and consumed. It allows enterprises to shift their focus from managing the network to growing their business. At the core of our strategy is delivering a superior customer-driven experience that is consistent across different architectures, locations and consumption models. Smart OmniEdge eliminates the complexity of edge networks with a secure, unified wired/wireless infrastructure which is augmented with AI/ ML powered applications and managed through a single pane of glass. Purpose built with a single operating model that scales to address the growth of IoT, Smart OmniEdge delivers a consistent customer-driven experience across campus and distributed environments, cloud and on-premise deployments. Smart OmniEdge provides operational efficiency via AI/ ML and automation, new customer experiences via pervasive intelligence, diversified business models with its adaptive hybrid-cloud capabilities and strong network security.

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Today's enterprises each have different needs – they require choice. Choice of campus, distributed and hybrid architectures, choice of cloud and/or premise deployments, all with the simplicity of annualized subscription licensing to best fit their operating needs. And as their business grows, their networks need to evolve and change quickly, in lock step with the business, to stay competitive and meet their digital transformation goals. Extreme's Smart OmniEdge provides the agility enterprises have been asking for. Extreme delivers on these new enterprise requirements with ExtremeCloud and ExtremeCloud Appliance, using a common user interface and workflows with unified wired and wireless solutions, as a service or an appliance – or both.

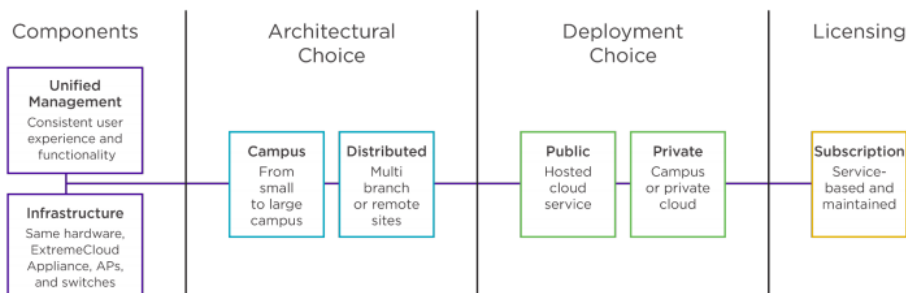


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12. Extreme Networks provides a communication system comprising a wireless network. For example, the ExtremeWireless Access Points (such as AP3912, AP3915, AP3916, AP3917, AP3935, AP3965, AP505, AP510) work on the wireless networking standards (such as IEEE 802.11 (WLAN) standard on 2.4 GHz and 5 GHz band frequencies).

Features and Capabilities

Supported Features

- CAPWAP (Pre-Standard)
- Multi-Site support
- Site Based configuration
- Auto-discovery of new managed devices
- Rules Based Adoption of Access Points (Assign to Site based on device model, IP address, name)
- Visibility through Extreme ManagementCenter
- Integration with ExtremeAnalytics
- Integration with ExtremeAirDefense
- Integration with ExtremeLocation
- Multi-Site Management
- Simultaneous management of ExtremeWireless (Centralized) and ExtremeWireless WiNG™ (Distributed) Sites
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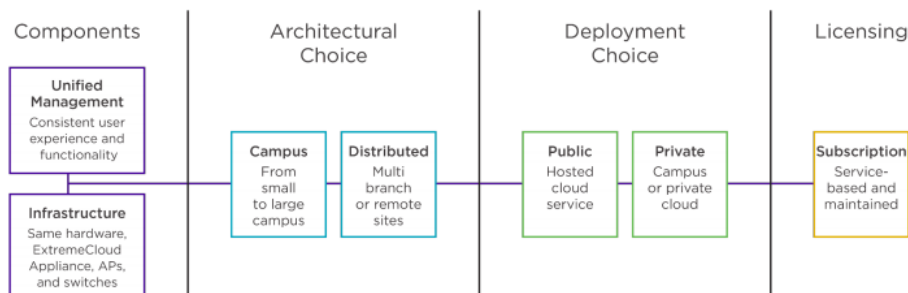


Figure 1: Smart OmniEdge Agile and Adaptive

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13. Extreme Networks provides a communication system comprising a land-line client. For example, the Smart OmniEdge solutions comprises an ExtremeSwitching an Ethernet LAN Switch to support a land-line client.

The screenshot displays the Extreme Networks website's product page for Industrial Switches. The header features the Extreme logo and navigation links for SOLUTIONS, PRODUCTS, SERVICES, SUPPORT, RESOURCES, and PARTNERS. The main content area includes the ExtremeSwitching logo, the title "Industrial Switches", and the subtitle "Switches Design for Industrial Use". To the right, three industrial switch units are shown. Below the title, there is a small icon of a switch. A dark navigation bar at the bottom of the main section contains links for FEATURES, TECH SPECS, and SUPPORTED APPS, along with a CONTACT SALES button. The lower section of the page highlights two key features: "Industrial Ethernet Switches" and "Industrial Strength Performance". The "Industrial Ethernet Switches" section states that these switches provide continuous uptime, manageability, and operational efficiency, making them ideal for industrial environments like intelligent transportation systems, utilities, and smart cities. The "Industrial Strength Performance" section notes that with full PoE+ power per PoE port, each switch offers the performance needed for today's power-hungry surveillance devices and WLAN access points.

Extreme

SOLUTIONS PRODUCTS SERVICES SUPPORT RESOURCES PARTNERS

ExtremeSwitching

Industrial Switches

Switches Design for Industrial Use

FEATURES TECH SPECS SUPPORTED APPS CONTACT SALES

Industrial Ethernet Switches

Extreme Industrial Switches provide continuous uptime, manageability, and operational efficiency. Extreme Industrial Switches are an excellent choice for industrial environments, including intelligent transportation systems, utilities, and smart cities.

Industrial Strength Performance

With full PoE+ power per PoE port, each switch offers the performance needed for today's power-hungry surveillance devices and WLAN access points.

Source: <https://www.extremenetworks.com/product/industrial-switches/#features>



Data Sheet

Highlights

Models

- 4 10/100 POE+ ports, 2 10/100 ports, and 2 100FX/1000Base-X SFP ports
- 4 10/100/1000 POE+ ports, 2 10/100/1000 ports, and 2 100FX/1000Base-X SFP ports
- 8 10/100 POE+ ports, and 4 100FX/1000Base-X SFP ports
- 8 10/100/1000 POE+ ports, and 4 100FX/1000Base-X SFP ports

Performance

- Full Wire Speed Layer 2 Switching
- All PoE ports IEEE 802.3af and 802.3at compliant and support up to 30W concurrently
- Dual DC power input and reverse power protection
- -40°C to +75°C operating temperature

Form Factor

- DIN Rail or Wall Mountable
- Rugged IP30 Enclosure

Features

- Highly Resilient LACP, Spanning tree STP, RSTP & MSTP, fast Ring fail-over and G.8032 ERPS protection options
- Port-based /tag-based VLAN, IEEE 802.1ad/QinQ VLAN
- IGMP v1/v2/v3, multicast proxy and snooping
- Multicast/Broadcast/Flooding Storm Control
- IEEE 802.1x access control
- Per VLAN mirroring
- CLI/Web/SNMP management interfaces
- PoE PSE power management and PD power consumption
- IEEE 802.3az Energy Efficient Ethernet



ExtremeSwitching™ Industrial Ethernet Switches

Industrial Networking

Designed for industrial use, Extreme Industrial Switches provide continuous uptime, manageability and operational efficiency. With full PoE+ power per PoE port, each switch offers the performance needed for today's power-hungry surveillance devices and WLAN access points.

Extreme Industrial Switches are an excellent choice for industrial environments, including intelligent transportation systems, utilities, and smart cities. Full redundant ring technology creates fault-tolerant networks with high availability with industry standard technologies.

Part No.	Switch Models	Port Counts					Aggregate Bandwidth	Forwarding Rate
		10/100	10/100 POE+	10/100 /1000	10/100/1000 POE+	SFP		
16801	ISW 4-10/100P, 2-10/100T, 2-SFP	2	4	-	-	2	5.2 Gbps	3.87 Mpps
16802	ISW 8-10/100P, 4-SFP	-	8	-	-	4	9.6 Gbps	7.14 Mpps
16803	ISW 4 Gbps, 2 Gbps, 2-SFP	-	-	2	4	2	16 Gbps	11.90 Mpps
16804	ISW 8 Gbps, 4-SFP	-	-	-	8	4	24 Gbps	17.85 Mpps

Source: <https://cloud.kapostcontent.net/pub/d50d38ac-7cbd-4468-8d4b-35fcd49fc2b6/extremeswitching-industrial-ethernet-switches-data-sheet.pdf?kui=97A134dcPla2FDjyEKb5A>, page 1

Smart OmniEdge™

A New Era in Edge Networking

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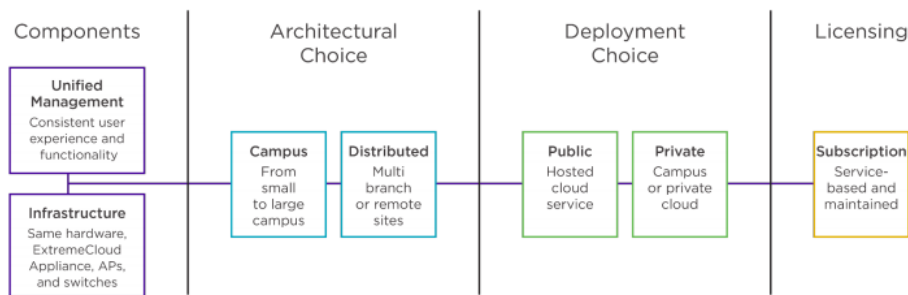


Figure 1: Smart OmniEdge Agile and Adaptive

Source: https://cloud.kapostcontent.net/pub/aa85e332-3cf6-4502-a9e5-393c480a57ed/extremeccloud-appliance-data-sheet?kui=CuPMY6j6ZecRs2unh_ZLXw, page 2

ExtremeCloud Appliance

On-Premise and Private Cloud

While ExtremeCloud delivers the public cloud and subscription options, ExtremeCloud Appliance complements it for premise and private cloud solutions.

ExtremeCloud Appliance shares the same unified wired and wireless UI and workflows with ExtremeCloud, but includes the additional functionality required for a robust on-premise, campus and private cloud, distributed solution.

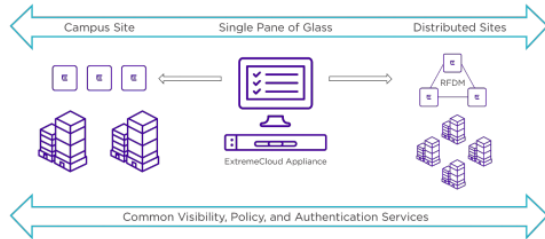


Figure 2: ExtremeCloud Appliance On-Premise and Hybrid Cloud

Designed to handle the dense user environments of campuses, as well as many distributed branch sites, or the combination of both, ExtremeCloud Appliance ensures enterprises have the maximum agility to tune their networks to meet their specific needs, without compromising functionality.

Campus Solution

ExtremeCloud Appliance leverages the award winning features from ExtremeWireless campus solutions. Incorporating the policy and role based BYOD on-boarding, flow-based technology for dense user solutions, and integrated application visibility and control applied at the access points to deliver the best customer-driven experience.

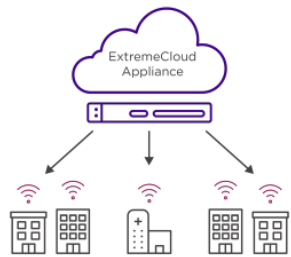


Figure 3: ExtremeCloud Appliance Campus Solution

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14. Extreme Networks provides a communication system comprising a land-line network. For example, the Smart OmniEdge solutions comprises an ExtremeSwitching an Ethernet LAN Switch to support a land-line network.

The screenshot shows the Extreme Networks website's product page for Industrial Switches. The header includes the Extreme logo and navigation links: SOLUTIONS, PRODUCTS, SERVICES, SUPPORT, RESOURCES, and PARTNERS. The main content area features the 'ExtremeSwitching' logo, the title 'Industrial Switches', and the subtitle 'Switches Design for Industrial Use'. To the right, three industrial switch models are displayed: SXR 250-48, SXR 480-48, and SXR 960-48. Below the title, there is a small icon of a switch. A dark navigation bar at the bottom contains links for FEATURES, TECH SPECS, and SUPPORTED APPS, along with a CONTACT SALES button. The lower section of the page highlights 'Industrial Ethernet Switches' and 'Industrial Strength Performance' with descriptive text and icons.

ExtremeSwitching

Industrial Switches

Switches Design for Industrial Use

100% 250-48
48 ports, 24 PoE+
48 SFP ports
48 SFP ports

100% 480-48
48 ports, 24 PoE+
48 SFP ports
48 SFP ports

100% 960-48
48 ports, 24 PoE+
48 SFP ports
48 SFP ports

FEATURES TECH SPECS SUPPORTED APPS CONTACT SALES

Industrial Ethernet Switches

Extreme Industrial Switches provide continuous uptime, manageability, and operational efficiency. Extreme Industrial Switches are an excellent choice for industrial environments, including intelligent transportation systems, utilities, and smart cities.

Industrial Strength Performance

With full PoE+ power per PoE port, each switch offers the performance needed for today's power-hungry surveillance devices and WLAN access points.

Source: <https://www.extremenetworks.com/product/industrial-switches/#features>



Data Sheet

Highlights

Models

- 4 10/100 PoE+ ports, 2 10/100 ports, and 2 100FX/1000Base-X SFP ports
- 4 10/100/1000 PoE+ ports, 2 10/100/1000 ports, and 2 100FX/1000Base-X SFP ports
- 8 10/100 PoE+ ports, and 4 100FX/1000Base-X SFP ports
- 8 10/100/1000 PoE+ ports, and 4 100FX/1000Base-X SFP ports

Performance

- Full Wire Speed Layer 2 Switching
- All PoE ports IEEE 802.3af and 802.3at compliant and support up to 30W concurrently
- Dual DC power input and reverse power protection
- -40°C to +75°C operating temperature

Form Factor

- DIN Rail or Wall Mountable
- Rugged IP30 Enclosure

Features

- Highly Resilient LACP, Spanning tree STP, RSTP & MSTP, fast Ring fail-over and G.8032 ERPS protection options
- Port-based /tag-based VLAN, IEEE 802.1ad/QinQ VLAN
- IGMP v1/v2/v3, multicast proxy and snooping
- Multicast/Broadcast/Flooding Storm Control
- IEEE 802.1x access control
- Per VLAN mirroring
- CLI/Web/SNMP management interfaces
- PoE PSE power management and PD power consumption
- IEEE 802.3az Energy Efficient Ethernet



ExtremeSwitching™ Industrial Ethernet Switches

Industrial Networking

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Extreme Industrial Switches are an excellent choice for industrial environments, including intelligent transportation systems, utilities, and smart cities. Full redundant ring technology creates fault-tolerant networks with high availability with industry standard technologies.

Part No.	Switch Models	Port Counts					Aggregate Bandwidth	Forwarding Rate
		10/100	10/100 PoE+	10/100 /1000	10/100/1000 PoE+	SFP		
16801	ISW 4-10/100P, 2-10/100T, 2-SFP	2	4	-	-	2	5.2 Gbps	3.87 Mpps
16802	ISW 8-10/100P, 4-SFP	-	8	-	-	4	9.6 Gbps	7.14 Mpps
16803	ISW 4GBP, 2GBT, 2-SFP	-	-	2	4	2	16 Gbps	11.90 Mpps
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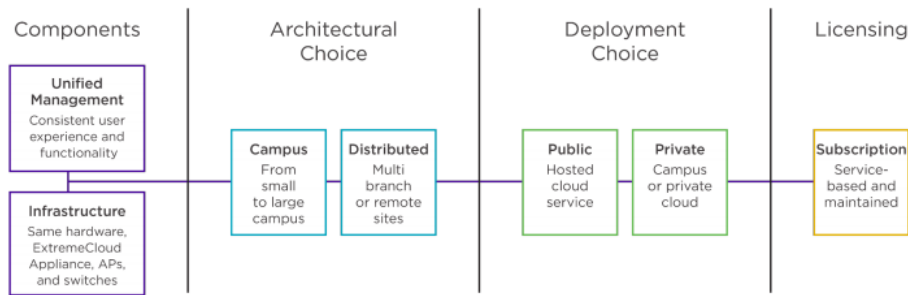


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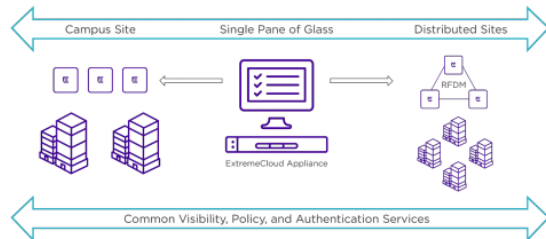


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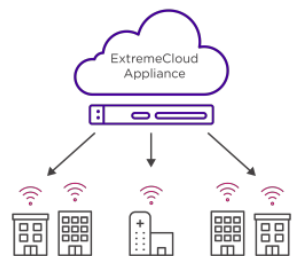


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15. Extreme Networks provides a communication system comprising a network backbone interfacing said land-line network and said wireless network to allow data packets to be exchanged between said wireless client and said land-line client. For example, Extreme Networks provides WLAN network products such as WLAN Access Points, Access Points, Ethernet Switches, and software (such as ExtremeAI, ExtremeLocation, AirDefense, Management Center, ExtremeControl and/or ExtremeAnalytics) for interfacing a land-line network and a wireless network. The WLAN network products support TCP/IP (Transmission Control Protocol/Internet Protocol) which allow exchange of packets between wireless network and land-line/wired network.

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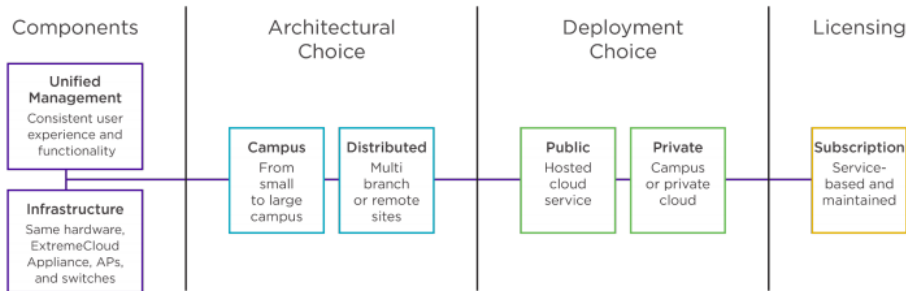


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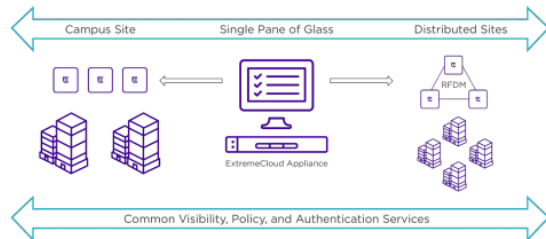


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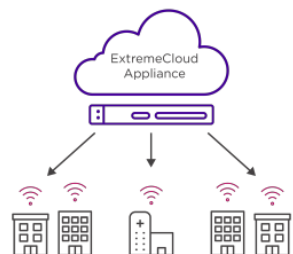


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Extreme Application Support


The following Extreme applications are supported by, or can integrate with ExtremeCloud Appliance:

Extreme Application	Description	Type
Defender for IoT	An application which is hosted on the ExtremeCloud Appliance and ensures the security of IoT devices connected via the switch ports of the AP3912 or via the Defender Adapter, which was purpose built for connecting older devices which may not have the security required for today's networks.	Hosted on ExtremeCloud Appliance
ExtremeLocation™	Provides enterprises powerful multi-tier location services with cloud scales to thousands of branch sites. ExtremeLocation offers a range of granular location accuracy to address various application scenarios with extensive real-time and historical location analytics, such as: new and repeat visitors, visitor engagement times, location of associates and specifics of site or zone performance.	Cloud Hosted Service
Extreme AirDefense®	Leads the industry in Wireless Intrusion Prevention and supports advanced forensics analysis required for PCI, HIPAA, and other compliance regulations.	Premise
Extreme Management Center™	Management Center is a single pane of glass management system that provides wired/wireless visibility and control from the data center to the mobile edge. The intelligence, automation, and integration of your management software enable the IT organization to optimize the efficiency of network operations and reduce total cost of ownership.	Premise
ExtremeAnalytics™	ExtremeAnalytics lets you understand what applications are running on your network, who is using them and what the response time is for each application. It gives you granular visibility into network and application performance, users, locations and devices. Information from the network and the applications empower you to make data-driven decisions.	Premise
ExtremeControl™	ExtremeControl lets you manage secure and automated access for both, BYOD and IoT devices from one convenient dashboard. It makes it easy to roll out granular policies across your wired and wireless networks to meet industry and company compliance obligations. Identity based network access control keeps unauthorized people and devices from accessing your network.	Premise


ExtremeCloud Appliance Summary Table

Category	Products	
Network Architecture	Campus, Distributed, Hybrid	
Access Points	ExtremeWireless™ AP3912, AP3915, AP3916, AP3917, AP3935, AP3965, AP505, AP510	ExtremeWireless WING™ AP7612, AP7632, AP7662, AP8533, AP8432, AP7522, AP7532, AP7562 AP505, AP510
Ethernet Switches	210, 220, X440-G2 (12/24/48), X620-16p	
ExtremeCloud Appliance	Hardware Appliance E1120 - 250 APs, E2120 - 4000 APs, E3120 - 10000 APs	Software Appliance VEV6120, up to 1000 APs
Software	ExtremeAI, ExtremeLocation, AirDefense, Management Center, ExtremeControl, ExtremeAnalytics	

Source: https://cloud.kapostcontent.net/pub/aa85e332-3cf6-4502-a9e5-393c480a57ed/extremecloud-appliance-data-sheet?kui=CuPMY6j6ZecRs2unh_ZLXw, page 8



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Wi-Fi Infrastructure That Makes the Customer-Driven Network a “Wi-Not?” Reality.

Search ExtremeMobility Products...

Campus

Controllers (4)

Indoor Access Points (4) x

Outdoor Access Points (2) x

Distributed

WING Controllers (3)

WING Indoor (6)


WING Outdoor (3)

WING T-S System (2)

WING Wireless Wall Plate (4)

ExtremeMobility


ExtremeMobility (2)



AP3917

Enterprise-Grade and Wave 2 Outdoor Performance without the Premium Cost


[Data sheet](#)



AP3935

Enterprise-Grade, Ultra-High Performance for Demanding High-Density Deployments


[Data sheet](#)



AP3965


Extends Ultra-High Performance and High-Density Outdoors

[Data sheet](#)




AP3916

Flow-Based Access Ppoint with integrated HD video camera, 802.11ac Wave 2, up to 1.17Gbps capacity, dual radio, 2x2:2, integrated BTLE/802.15.4 radio



AP3915

Enterprise-Grade with Wave 2 Performance without the Premium Price



AP3912

802.11ac Wave 2 Wall-Plate access point, up to 1.17Gbps capacity, dual radio, 2x2:2, integrated BTLE/802.15.4 radio

Source: <https://www.extremenetworks.com/products/extrememobility/>

[25]

2. TCP/IP Overview

The generic term "TCP/IP" usually means anything and everything related to the specific protocols of TCP and IP. It can include other protocols, applications, and even the network medium. A sample of these protocols are: UDP, ARP, and ICMP. A sample of these applications are: TELNET, FTP, and rcp. A more accurate term is "internet technology". A network that uses internet technology is called an "internet".

2.1 Basic Structure

To understand this technology you must first understand the following logical structure:

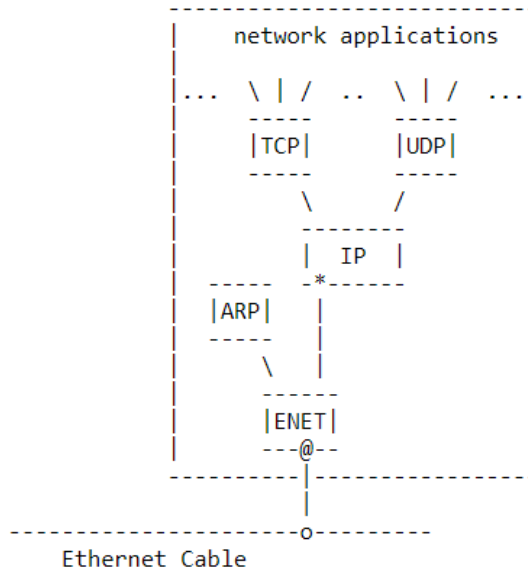


Figure 1. Basic TCP/IP Network Node

Source: <https://tools.ietf.org/html/rfc1180>, page 1

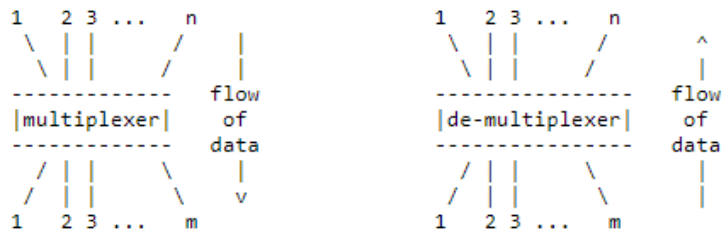


Figure 4. n-to-m multiplexer and m-to-n de-multiplexer

It performs this multiplexing in either direction to accommodate incoming and outgoing data. An IP module with more than 1 network interface is more complex than our original example in that it can forward data onto the next network. Data can arrive on any network interface and be sent out on any other.

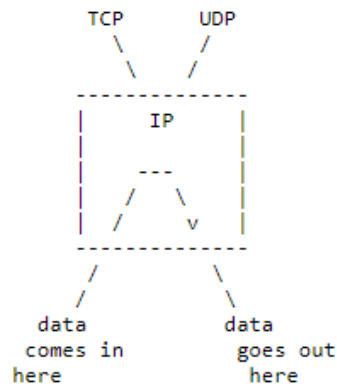


Figure 5. Example of IP Forwarding a IP Packet

The process of sending an IP packet out onto another network is called "forwarding" an IP packet. A computer that has been dedicated to the task of forwarding IP packets is called an "IP-router".

As you can see from the figure, the forwarded IP packet never touches the TCP and UDP modules on the IP-router. Some IP-router implementations do not have a TCP or UDP module.

Source: <https://tools.ietf.org/html/rfc1180>, page 5

Features and Capabilities

Supported Features

- CAPWAP (Pre-Standard)
- Multi-Site support
- Site Based configuration
- Auto-discovery of new managed devices
- Rules Based Adoption of Access Points (Assign to Site based on device model, IP address, name)
- Visibility through Extreme ManagementCenter
- Integration with ExtremeAnalytics
- Integration with ExtremeAirDefense
- Integration with ExtremeLocation
- Multi-Site Management
- Simultaneous management of ExtremeWireless (Centralized) and ExtremeWireless WiNG™ (Distributed) Sites
- Integrated RF visibility (Coverage, Channel, Quality)
- Integrated Site occupancy view (Associated, non-associated and presence traffic)
- Integrated Enrollment control (Device Grouping and Rules based policy assignment)
- Integrated Policy management (Roles, filters, VLANs)
- Inter-Controller mobility extension for ExtremeWireless migrations
- High availability with automatic failover to a backup controller (license included)
- Client mobility with fast failover and session availability (for Centralized Sites)
- Dynamic Radio Management (DRM), Flexible Client Access (airtime fairness), Band-steering
- Client load balancing with 802.11k
- Management Frame Protection (802.11w)
- Automatic discovery of networks by pre-authenticated devices (802.11u)
- Flexible hybrid traffic forwarding: local switching at AP or controller-based switching (for Centralized Sites)
- Fabric attach Topologies for APs
- Robust standards-based security: WPA2
- 802.1x Authentication: EAP-TLS, EAP-SIM, EAP-TTLS, EAP-AKA, PEAP, EAP-MD5, EAP-FAST
- RADIUS Authentication and Accounting
- Active Directory Authentication
- Encryption Algorithms: AES (CCMP)
- Guest Services (captive portal, URL redirect and Control) and Walled Garden (unauthorized access to URL)
- Voice-over-WLAN Optimization: 802.11e/WMM, U-APSD, TSPEC, CAC, QBSS
- Wired-Wireless (DSCP/TOS-to-WMM) QoS Mapping
- SNMPv2c/v3
- REST API interface/SDK
- 802.11-802.3 bridging
- IEEE 802.1D-compliant bridging
- IEEE 802.1Q VLAN tagging and trunking
- Proxy ARP

Source: https://cloud.kapostcontent.net/pub/aa85e332-3cf6-4502-a9e5-393c480a57ed/extremecloud-appliance-data-sheet?kui=CuPMY6j6ZecRs2unh_ZLXw, page 9

16. Extreme Networks provides a communication system which uses a wireless transport layer protocol for data frame transmission over said land-line and wireless networks, each data frame including connection handling information specifying at least one data transport connection to be used to transmit data between said wireless client and said land-line client over said wireless and land-line networks. For example, Extreme Networks provides WLAN network products such as WLAN Access Points, Access Points, Ethernet Switches, and software (such as ExtremeAI, ExtremeLocation, AirDefense, Management Center, ExtremeControl and/or ExtremeAnalytics) which support wireless protocols such as TCP/IP for transmission of data packets (such as Ethernet frame, IP packet, UDP datagram, and TCP segment and/or application message) over land-line and wireless networks. Further, TCP/IP data frames (such as Ethernet frame) contain connection handling information such as the destination address, source address (“connection addressing information”), type field and data.

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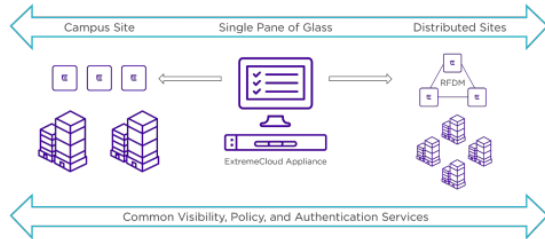


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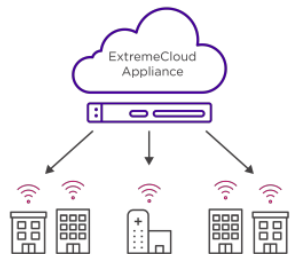


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Category	Products	
Network Architecture	Campus, Distributed, Hybrid	
Access Points	ExtremeWireless™ AP3912, AP3915, AP3916, AP3917, AP3935, AP3965, AP505, AP510	ExtremeWireless WING™ AP7612, AP7632, AP7662, AP8533, AP8432, AP7522, AP7532, AP7562 AP505, AP510
Ethernet Switches	210, 220, X440-G2 (12/24/48), X620-16p	
ExtremeCloud Appliance	Hardware Appliance E1120 - 250 APs, E2120 - 4000 APs, E3120 - 10000 APs	Software Appliance VEV6120, up to 1000 APs
Software	ExtremeAI, ExtremeLocation, AirDefense, Management Center, ExtremeControl, ExtremeAnalytics	

Source: https://cloud.kapostcontent.net/pub/aa85e332-3cf6-4502-a9e5-393c480a57ed/extremecloud-appliance-data-sheet?kui=CuPMY6j6ZecRs2unh_ZLXw, page 8

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802.11ac Wave 2 Wall-Plate access point, up to 1.17Gbps capacity, dual radio, 2x2:2, integrated BTLE/802.15.4 radio

Source: <https://www.extremenetworks.com/products/extrememobility/>

[31]

Features and Capabilities

Supported Features

- CAPWAP (Pre-Standard)
- Multi-Site support
- Site Based configuration
- Auto-discovery of new managed devices
- Rules Based Adoption of Access Points (Assign to Site based on device model, IP address, name)
- Visibility through Extreme ManagementCenter
- Integration with ExtremeAnalytics
- Integration with ExtremeAirDefense
- Integration with ExtremeLocation
- Multi-Site Management
- Simultaneous management of ExtremeWireless (Centralized) and ExtremeWireless WiNG™ (Distributed) Sites
- Integrated RF visibility (Coverage, Channel, Quality)
- Integrated Site occupancy view (Associated, non-associated and presence traffic)
- Integrated Enrollment control (Device Grouping and Rules based policy assignment)
- Integrated Policy management (Roles, filters, VLANs)
- Inter-Controller mobility extension for ExtremeWireless migrations
- High availability with automatic failover to a backup controller (license included)
- Client mobility with fast failover and session availability (for Centralized Sites)
- Dynamic Radio Management (DRM), Flexible Client Access (airtime fairness), Band-steering
- Client load balancing with 802.11k
- Management Frame Protection (802.11w)
- Automatic discovery of networks by pre-authenticated devices (802.11u)
- Flexible hybrid traffic forwarding: local switching at AP or controller-based switching (for Centralized Sites)
- Fabric attach Topologies for APs
- Robust standards-based security: WPA2
- 802.1x Authentication: EAP-TLS, EAP-SIM, EAP-TTLS, EAP-AKA, PEAP, EAP-MD5, EAP-FAST
- RADIUS Authentication and Accounting
- Active Directory Authentication
- Encryption Algorithms: AES (CCMP)
- Guest Services (captive portal, URL redirect and Control) and Walled Garden (unauthorized access to URL)
- Voice-over-WLAN Optimization: 802.11e/WMM, U-APSD, TSPEC, CAC, QBSS
- Wired-Wireless (DSCP/TOS-to-WMM) QoS Mapping
- SNMPv2c/v3
- REST API interface/SDK
- 802.11-802.3 bridging
- IEEE 802.1D-compliant bridging
- IEEE 802.1Q VLAN tagging and trunking
- Proxy ARP

Source: https://cloud.kapostcontent.net/pub/aa85e332-3cf6-4502-a9e5-393c480a57ed/extremecloud-appliance-data-sheet?kui=CuPMy6j6ZecRs2unh_ZLXw, page 9

2.2 Terminology

The name of a unit of data that flows through an internet is dependent upon where it exists in the protocol stack. In summary: if it is on an Ethernet it is called an Ethernet frame; if it is between the Ethernet driver and the IP module it is called a IP packet; if it is between the IP module and the UDP module it is called a UDP datagram; if it is between the IP module and the TCP module it is called a TCP segment (more generally, a transport message); and if it is in a network application it is called a application message.

These definitions are imperfect. Actual definitions vary from one publication to the next. More specific definitions can be found in [RFC 1122, section 1.3.3](#).

A driver is software that communicates directly with the network interface hardware. A module is software that communicates with a driver, with network applications, or with another module.

Source: <https://tools.ietf.org/html/rfc1180>, page 2

3. Ethernet

This section is a short review of Ethernet technology.

An Ethernet frame contains the destination address, source address, type field, and data.

An Ethernet address is 6 bytes. Every device has its own Ethernet address and listens for Ethernet frames with that destination address. All devices also listen for Ethernet frames with a wild-card destination address of "FF-FF-FF-FF-FF-FF" (in hexadecimal), called a "broadcast" address.

Ethernet uses CSMA/CD (Carrier Sense and Multiple Access with Collision Detection). CSMA/CD means that all devices communicate on a single medium, that only one can transmit at a time, and that they can all receive simultaneously. If 2 devices try to transmit at the same instant, the transmit collision is detected, and both devices wait a random (but short) period before trying to transmit again.

Source: <https://tools.ietf.org/html/rfc1180, page 7>

RFC 1180

A TCP/IP Tutorial

January 1991

4. ARP

When sending out an IP packet, how is the destination Ethernet address determined?

ARP (Address Resolution Protocol) is used to translate IP addresses to Ethernet addresses. The translation is done only for outgoing IP packets, because this is when the IP header and the Ethernet header are created.

4.1 ARP Table for Address Translation

The translation is performed with a table look-up. The table, called the ARP table, is stored in memory and contains a row for each computer. There is a column for IP address and a column for Ethernet address. When translating an IP address to an Ethernet address, the table is searched for a matching IP address. The following is a simplified ARP table:

IP address	Ethernet address
223.1.2.1	08-00-39-00-2F-C3
223.1.2.3	08-00-5A-21-A7-22
223.1.2.4	08-00-10-99-AC-54

TABLE 1. Example ARP Table

The human convention when writing out the 4-byte IP address is each byte in decimal and separating bytes with a period. When writing out the 6-byte Ethernet address, the conventions are each byte in hexadecimal and separating bytes with either a minus sign or a colon.

The ARP table is necessary because the IP address and Ethernet address are selected independently; you can not use an algorithm to translate IP address to Ethernet address. The IP address is selected by the network manager based on the location of the computer on the internet. When the computer is moved to a different part of an internet, its IP address must be changed. The Ethernet address is selected by the manufacturer based on the Ethernet address space licensed by the manufacturer. When the Ethernet hardware interface board changes, the Ethernet address changes.

Source: <https://tools.ietf.org/html/rfc1180#page-2>, page 8

application, the TCP module, and the IP module. At this point the IP packet has been constructed and is ready to be given to the Ethernet driver, but first the destination Ethernet address must be determined.

The ARP table is used to look-up the destination Ethernet address.

4.3 ARP Request/Response Pair

But how does the ARP table get filled in the first place? The answer is that it is filled automatically by ARP on an "as-needed" basis.

Two things happen when the ARP table can not be used to translate an address:

1. An ARP request packet with a broadcast Ethernet address is sent out on the network to every computer.
2. The outgoing IP packet is queued.

Every computer's Ethernet interface receives the broadcast Ethernet frame. Each Ethernet driver examines the Type field in the Ethernet frame and passes the ARP packet to the ARP module. The ARP request packet says "If your IP address matches this target IP address, then please tell me your Ethernet address". An ARP request packet looks something like this:

```

-----
|Sender IP Address  223.1.2.1      |
|Sender Enet Address 08-00-39-00-2F-C3|
-----
|Target IP Address  223.1.2.2      |
|Target Enet Address <blank>       |
-----

```

TABLE 2. Example ARP Request

Each ARP module examines the IP address and if the Target IP address matches its own IP address, it sends a response directly to the source Ethernet address. The ARP response packet says "Yes, that target IP address is mine, let me give you my Ethernet address". An ARP response packet has the sender/target field contents swapped as compared to the request. It looks something like this:

Source: <https://tools.ietf.org/html/rfc1180#page-2>, page 9

Smart OmniEdge™

A New Era in Edge Networking

Extreme's Smart OmniEdge provides enterprises a new framework for how edge networks should be designed, deployed and consumed. It allows enterprises to shift their focus from managing the network to growing their business. At the core of our strategy is delivering a superior customer-driven experience that is consistent across different architectures, locations and consumption models. Smart OmniEdge eliminates the complexity of edge networks with a secure, unified wired/wireless infrastructure which is augmented with AI/ ML powered applications and managed through a single pane of glass. Purpose built with a single operating model that scales to address the growth of IoT, Smart OmniEdge delivers a consistent customer-driven experience across campus and distributed environments, cloud and on-premise deployments. Smart OmniEdge provides operational efficiency via AI/ ML and automation, new customer experiences via pervasive intelligence, diversified business models with its adaptive hybrid-cloud capabilities and strong network security.

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Today's enterprises each have different needs – they require choice. Choice of campus, distributed and hybrid architectures, choice of cloud and/or premise deployments, all with the simplicity of annualized subscription licensing to best fit their operating needs. And as their business grows, their networks need to evolve and change quickly, in lock step with the business, to stay competitive and meet their digital transformation goals. Extreme's Smart OmniEdge provides the agility enterprises have been asking for. Extreme delivers on these new enterprise requirements with ExtremeCloud and ExtremeCloud Appliance, using a common user interface and workflows with unified wired and wireless solutions, as a service or an appliance – or both.

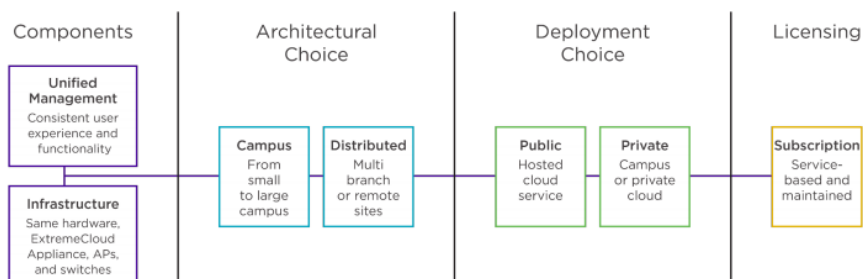


Figure 1: Smart OmniEdge Agile and Adaptive

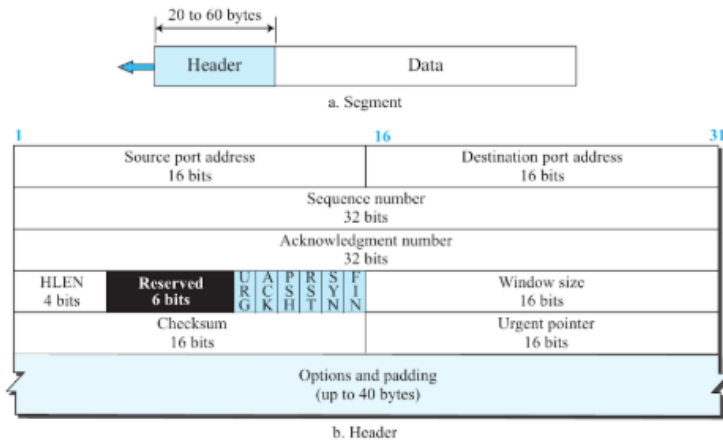
Source: https://cloud.kapostcontent.net/pub/aa85e332-3cf6-4502-a9e5-393c480a57ed/extremecloud-appliance-data-sheet?kui=CuPMY6j6ZecRs2unh_ZLXw, page 2

17. Extreme Networks provides a user data field including a data packet to be transmitted from one client to another client. For example, the WLAN network products such as WLAN Access Points, Access Points, Ethernet Switches, and software (such as ExtremeAI, ExtremeLocation, AirDefense, Management Center, ExtremeControl and/or ExtremeAnalytics) support wireless transport protocol such as TCP/IP. The protocol allows transmission of user data between wired and wireless devices (“client”) in the form of TCP segments/data packets.

CHAPTER 3 TRANSPORT LAYER

there are no options and up to 60 bytes if it contains options. We will discuss some of the header fields in this section. The meaning and purpose of these will become clearer as we proceed through the section.

Figure 3.44 TCP segment format



Source:

<https://books.google.co.in/books?id=o8CjAgAAQBAJ&printsec=frontcover&dq=forouzan+computer+networks&hl=en&sa=X&ved=0ahUKEwjV95WPruPhAhVFQo8KHWsUBtsQ6AEIKDAA#v=onepage&q=forouzan%20computer%20networks&f=false>, page 186

18. Extreme Networks provides at least one sequencing field identifying the last packet received by the client that is transmitting a current data packet. For example, the WLAN network products such as WLAN Access Points, Access Points, Ethernet Switches, and software (such as ExtremeAI, ExtremeLocation, AirDefense, Management Center, ExtremeControl and/or ExtremeAnalytics) support wireless protocols such as TCP/IP for transmission. Further, TCP/IP uses sequence numbers and acknowledgement numbers for maintaining the sequence of the packets. Initial Sequence Number (ISN) is given to the first byte of the data to reassemble the bytes at the receiver end (wired and/or wireless devices). Acknowledgement number ("sequencing field") is the next byte number that the receiver expects to receive which also provides acknowledgement for receiving the previous bytes/packets.

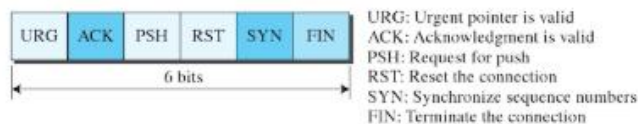
- ❑ **Source port address.** This is a 16-bit field that defines the port number of the application program in the host that is sending the segment.
- ❑ **Destination port address.** This is a 16-bit field that defines the port number of the application program in the host that is receiving the segment.
- ❑ **Sequence number.** This 32-bit field defines the number assigned to the first byte of data contained in this segment. As we said before, TCP is a stream transport protocol. To ensure connectivity, each byte to be transmitted is numbered. The sequence number tells the destination which byte in this sequence is the first byte in the segment. During connection establishment (discussed later) each party uses a random number generator to create an **initial sequence number** (ISN), which is usually different in each direction.
- ❑ **Acknowledgment number.** This 32-bit field defines the byte number that the receiver of the segment is expecting to receive from the other party. If the receiver of the segment has successfully received byte number x from the other party, it returns $x + 1$ as the acknowledgment number. Acknowledgment and data can be piggybacked together.
- ❑ **Header length.** This 4-bit field indicates the number of 4-byte words in the TCP header. The length of the header can be between 20 and 60 bytes. Therefore, the value of this field is always between 5 ($5 \times 4 = 20$) and 15 ($15 \times 4 = 60$).

Source:

<https://books.google.co.in/books?id=o8CjAgAAQBAJ&printsec=frontcover&dq=forouzan+computer+networks&hl=en&sa=X&ved=0ahUKEwjV95WPruPhAhVFQo8KHWsUBtsQ6AEIKDAA#v=onepage&q=forouzan%20computer%20networks&f=false>, page 186

- ❑ **Control.** This field defines 6 different control bits or flags, as shown in Figure 3.45. One or more of these bits can be set at a time. These bits enable flow control, connection establishment and termination, connection abortion, and the mode of data transfer in TCP. A brief description of each bit is shown in the figure. We will discuss them further when we study the detailed operation of TCP later in the chapter.

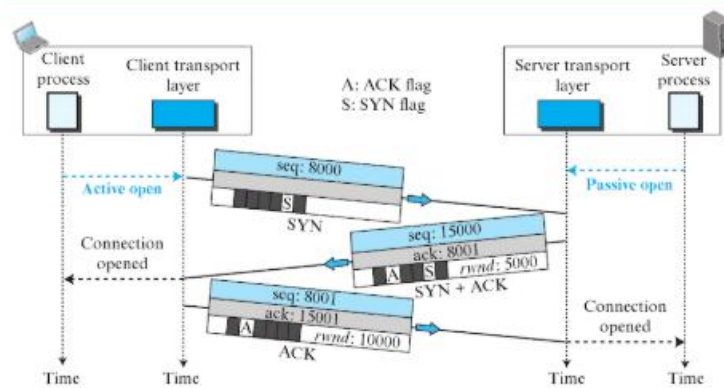
Figure 3.45 Control field



Source:

<https://books.google.co.in/books?id=o8CjAgAAQBAJ&printsec=frontcover&dq=forouzan+computer+networks&hl=en&sa=X&ved=0ahUKEwjV95WPruPhAhVFQo8KHWsUBtsQ6AEIKDAA#v=onepage&q=forouzan%20computer%20networks&f=false>, page 187

Figure 3.47 Connection establishment using three-way handshaking



number, the control flags (only those that are set), and window size if relevant. The three steps in this phase are as follows.

1. The client sends the first segment, a SYN segment, in which only the SYN flag is set. This segment is for synchronization of sequence numbers. The client in our example chooses a random number as the first sequence number and sends this number to the server. This sequence number is called the initial sequence number (ISN). Note that this segment does not contain an acknowledgment number. It does not define the window size either; a window size definition makes sense only when a segment includes an acknowledgment. The segment can also include some options that we discuss later in the chapter. Note that the SYN segment is a control segment and carries no data. However, it consumes one sequence number because it needs to be acknowledged. We can say that the SYN segment carries one imaginary byte.

A SYN segment cannot carry data, but it consumes one sequence number.

Source:

<https://books.google.co.in/books?id=o8CjAgAAQBAJ&printsec=frontcover&dq=forouzan+computer+networks&hl=en&sa=X&ved=0ahUKEwjV95WPruPhAhVFQo8KHWsUBtsQ6AEIKDAA#v=onepage&q=forouzan%20computer%20networks&f=false>, page 189

2. The server sends the second segment, a SYN + ACK segment with two flag bits set as: SYN and ACK. This segment has a dual purpose. First, it is a SYN segment for communication in the other direction. The server uses this segment to initialize a sequence number for numbering the bytes sent from the server to the client. The server also acknowledges the receipt of the SYN segment from the client by setting the ACK flag and displaying the next sequence number it expects to receive from the client. Because it contains an acknowledgment, it also needs to define the receive window size, *rwnd* (to be used by the client), as we will see in the flow control section. Since this segment is playing the role of a SYN segment, it needs to be acknowledged. It, therefore, consumes one sequence number.

**A SYN + ACK segment cannot carry data,
but it does consume one sequence number.**

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3 TRANSPORT LAYER

3. The client sends the third segment. This is just an ACK segment. It acknowledges the receipt of the second segment with the ACK flag and acknowledgment number field. Note that the ACK segment does not consume any sequence numbers if it does not carry data, but some implementations allow this third segment in the connection phase to carry the first chunk of data from the client. In this case, the segment consumes as many sequence numbers as the number of data bytes.

An ACK segment, if carrying no data, consumes no sequence number.

Source:

<https://books.google.co.in/books?id=o8CjAgAAQBAJ&printsec=frontcover&dq=forouzan+computer+networks&hl=en&sa=X&ved=0ahUKEwjV95WPruPhAhVFQo8KHWSUBtsQ6AEIKDAA#v=onepage&q=forouzan%20computer%20networks&f=false>, page 190

19. In the alternative, because the manner of use by Defendant differs in no substantial way from language of the claims, if Defendant is not found to literally infringe, Defendant infringes under the doctrine of equivalents.

20. Defendant's aforesaid activities have been without authority and/or license from Plaintiff.

21. In addition to what is required for pleadings in patent cases, and to the extent any marking was required by 35 U.S.C. § 287, Plaintiff and all predecessors in interest to the '095 Patent complied with all marking requirements under 35 U.S.C. § 287.

22. Plaintiff is entitled to recover from Defendant the damages sustained by Plaintiff as a result of the Defendant's wrongful acts in an amount subject to proof at trial, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff respectfully requests that this Court enter:

1. A judgment in favor of Plaintiff that Defendant has infringed the '813 Patent;
2. A judgment and order requiring Defendant to pay Plaintiff its damages, costs, expenses, and prejudgment and post-judgment interest for Defendant's infringement of the '813 Patent as provided under 35 U.S.C. § 284;
3. An award to Plaintiff for enhanced damages resulting from the knowing, deliberate, and willful nature of Defendant's prohibited conduct with notice being made at least as early as the date of the filing of this Complaint, as provided under 35 U.S.C. § 284;
4. A judgment and order finding that this is an exceptional case within the meaning of 35 U.S.C. § 285 and awarding to Plaintiff its reasonable attorneys' fees; and
5. Any and all other relief to which Plaintiff may show itself to be entitled.

DEMAND FOR JURY TRIAL

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

Respectfully Submitted,

WIRELESS TRANSPORT LLC

/s/ Jimmy Chong

Dated: July 29, 2019

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