

# 5160

## Service Aggregation Switch



### Features and Benefits

- Features industry-leading 10GE density in a non-blocking, wire-speed architecture with 24 10GE/1GE multi-rate SFP+ ports
- Offers dual hot-swappable AC or DC power in a high-availability, temperature-hardened, 1RU package
- Supports zero-touch provisioning to minimize OPEX and accelerate service turn-up while providing a service “birth certificate” with built-in service activation testing
- Complies with MEF CE2.0 specifications for E-Line, E-LAN, E-Tree, and E-Access services
- Incorporates flexible transport options including G.8032 rings, 802.1q VLANs, 802.1ad Provider VLANs (Q-in-Q), IP/MPLS, MPLS-TP, and PBB-TE
- Includes on-board, line-rate performance benchmark testing capabilities for end-to-end SLA verification
- Employs hardware-assisted OAM capabilities for performance and fault management
- Provides for highly accurate synchronization support with SyncE and 1588v2 PTP protocols, backed up by an on-board Stratum 3E oscillator
- Works in concert with Ciena’s OneControl Unified Management System

Ciena’s 5160 Service Aggregation Switch changes the economics of 10GE services, addressing the need to efficiently deliver and aggregate large quantities of data while meeting stringent Service Level Agreements (SLAs).

The 5160 provides exceptional 10GE density in a small 1RU form factor, with the added flexibility of supporting 1G SFPs in addition to 10GE SFP+ transceivers for easy migration as end-user demand grows. Its industry-leading feature set allows operators a cost-effective entry point into premium Ethernet business services or 3G/4G mobile backhaul applications.

The 5160 is based on Ciena’s field-proven packet networking technology, with hundreds of thousands of systems deployed by operators worldwide. Its software architecture is based on a common Service-Aware Operating System (SAOS) used in all Ciena’s Packet Networking Portfolio switches to provide operational efficiency and consistent system and service attributes. SAOS delivers consistent benefits across all packet networking applications, including:

- Rapid implementation of the latest advances in Ethernet technologies, as well as new services and standards proposed by the IEEE, IETF, MEF, and ITU
- Improved efficiency and cost savings resulting from a common deployment and service provisioning model
- Service offering ubiquity, permitting rapid rollout of new services across the entire network
- Multi-vendor equipment interoperability
- Complete MEF CE 2.0-compliant Ethernet service offerings for E-Line, E-VPLane; EP-LAN; E-VPLAN; E-Tree, E-VPTree, and E-Access

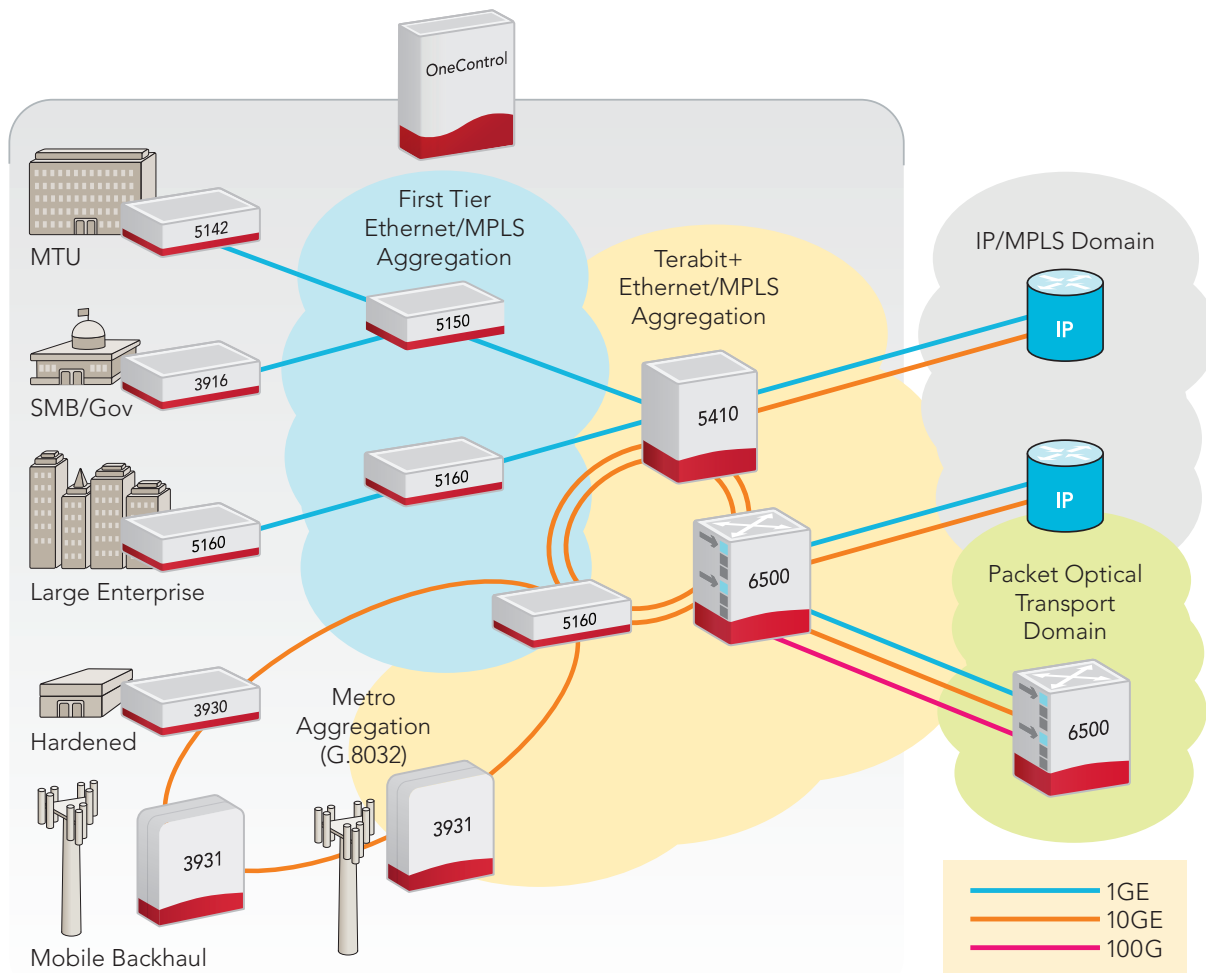


Figure 1. Sample metro aggregation network

### Flexible Networking and Deployment

The 5160 provides unmatched flexibility in a compact form factor, enabling operators to address a multitude of applications, networking models, and deployment environments without sacrificing service capabilities. With support for extended operating temperature, optimized power and space footprint, and a comprehensive range of operations administration and maintenance capabilities, the 5160 provides the ideal solution for a wide variety of applications, including:

- Carrier Ethernet metro network aggregation
- Metro network head-end node consolidation
- High-capacity Ethernet Business Service delivery for multi-tenant deployments
- Carrier exchange interconnect
- Data center service demarcation
- High-capacity mobile backhaul access and aggregation

The 5160 can be deployed in a variety of packet-over-fiber topologies or as part of a converged packet-optical architecture, in combination with Ciena's 6500 Packet-Optical Platform. Using Ciena's E-Suite Modules, the 6500 also leverages the SAOS feature set, allowing for smooth interoperability between the platforms and maximum operational efficiencies.

### Extensive Carrier Ethernet Transport Options

The 5160 gives operators a wide range of transport options including G.8032 rings, 802.1q VLANs, 802.1ad Provider VLANs (Q-in-Q), MPLS, MPLS-TP, and PBB-TE. Operators can use any combination of these capabilities to accommodate the specific needs of their packet network deployment. The 5160 supports interworking between these transport options via a sophisticated and scalable virtual switching architecture, leading to complete service flexibility and optimal utilization of network resources. With an extensive set of MPLS features, the solution also supports resilient L2VPNs and enables service providers to offer connection-oriented MPLS-TP-based services

on metro networks, extending the functionality and scalability of existing MPLS networks to accommodate the behavior and operational practices of traditional transport networks.

Key protocol capabilities include:

- MPLS Pseudowire Emulation Edge-to-Edge (PWE3), which supports MPLS Virtual Private Wire Services (VPWS)
- Virtual Private LAN Services (VPLS) and Hierarchical-VPLS (H-VPLS) supporting L2VPNs
- MPLS label edge router functionality, enabling application as a VPLS/H-VPLS Provider Edge switch and as an H-VPLS MTU-s customer edge switch
- Dynamic MPLS control plane, including Label Distribution Protocol (LDP) for VC signaling; OSPF-TE and IS-IS-TE for MPLS Tunnel Routes; and RSVP-TE for Label Switched Path (LSP) establishment
- MPLS-TP static bidirectional co-routed LSPs for deterministic traffic paths with centralized service provisioning via Ciena's OneControl Unified Management System
- MPLS OAM capabilities including LSP Ping and LSP traceroute, with support for MPLS-TP in-band GAL/GACH, and AIS/LDI enhanced fault detection

The design of the 5160 also provides flexibility to enable deployment in a wide range of physical operating environments, supporting:

- Extended temperature rating (-40°C to +65°C), enabling deployment in a wide variety of locations
- Universal power options for wide range DC (+/-24V DC; +/-36V DC; +/-48V DC), AC (100-240V) and simplex or duplex powering applications

### Zero-Touch Provisioning

Ciena's zero-touch provisioning simplifies system turn-up and enables device deployment, service turn-up, and SLA performance testing to be run from the Network Operations Center (NOC). This efficiency dramatically lowers OPEX, eliminating the need for on-site personnel or adjunct test equipment and ensuring consistent, reproducible test reports ready for immediate transmission to the customer for service acceptance. Operators can ramp service roll-outs faster, and at lower cost, because the minimized training requirement permits use of a wider pool of technicians.

The 5160 includes a hardware engine to provide RFC2544 and Y.1564 performance benchmark testing enabling full line-rate traffic measurements end-to-end across the Ethernet virtual

circuit. This ability dramatically lowers OPEX by again eliminating the need for on-site personnel or expensive test gear. This approach also improves end-customer satisfaction by enabling NOC personnel to be very responsive to network events and increasing the performance metrics available for end-customer SLA reporting.

### Fine-Grained SLA Monitoring and Enforcement

As end-customer applications become increasingly dependent on tight SLA guarantees, successful operators need to deliver advanced Quality of Service (QoS) offerings and then accurately and efficiently monitor the health and performance of those services.

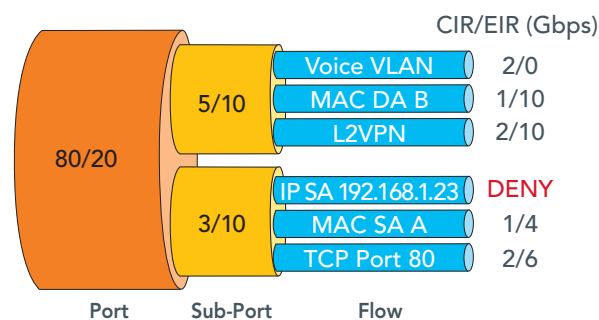


Figure 2. Granular Classification and SLA Enforcement

The 5160 implements carrier-class hierarchical QoS that permits delivery of a wide range of traffic types and rates over a single access infrastructure without interference or degradation. These capabilities enable greater revenue generation by utilizing available network resources efficiently, while improving customer relations with enforceable and reliable SLAs.

Ciena's portfolio incorporates an extensive Operations, Administration, and Maintenance (OAM) feature suite providing comprehensive link, service, and network monitoring and performance metrics. The 5160's OAM features include:

- ITU-T Y.1731 performance monitoring: delay, jitter, loss with hardware-assisted performance
- IEEE 802.1ag Connectivity Fault Management (CFM) with hardware-assisted performance
- IEEE 802.3ah Ethernet in the First Mile (EFM)
- IEEE 802.1AB Link Layer Discovery Protocol (LLDP)
- IETF RFC 5618 TWAMP sender and responder for L3 SLA Monitoring
- Full line-rate (10GE), built in RFC 2544/ITU-T Y.1564 performance benchmark test generation and reflection

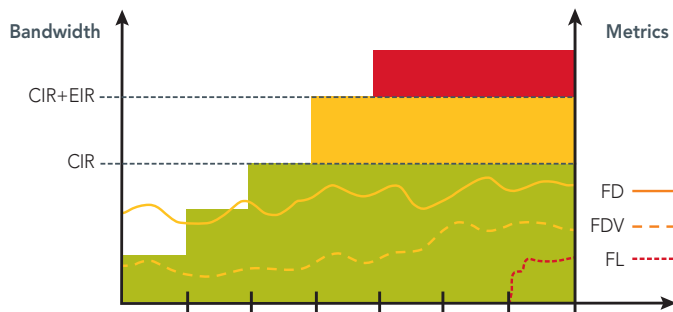


Figure 3. RFC 2544/Y.1564 Performance Testing and SLA Verification

### Synchronization and Timing

The cost-effectiveness and versatility of packet networking is driving the convergence of services, and placing new network synchronization requirements onto the packet aggregation network. Provision of accurate frequency, phase, or time references from the network is also beginning to emerge as a service in its own right. The 5160 is designed to enable accurate and scalable delivery and distribution of frequency, phase, and time across the network to support applications such as LTE mobile backhaul, synchronization as a service, or smart grid aggregation. Support includes:

- ITU-T G.8262 Synchronous Ethernet on all Ethernet ports for frequency distribution and reference
- IEEE 1588v2 Precision Time Protocol (PTP), including Ordinary Clock and Boundary Clock support for frequency, phase, and time distribution
- Hybrid timing distribution model using synchronous Ethernet for frequency and PTP for phase and time

- A Stratum 3E oscillator provides exceptional accuracy and stability as a timing master or slave
- Dedicated external BITS, GPS, 1PPS, and ToD ports for local frequency, phase, and time references
- Dedicated hardware support for IEEE 1588v2 scalability and accuracy

### OneControl Unified Management System

Ciena's OneControl offers a unique and comprehensive solution to manage mission-critical networks that span across domains (access, metro, and core), with unprecedented visibility through protocol layers (packet as well as photonic and transport). With this innovative approach, OneControl returns network and services control to the operator.

OneControl unites the management of Ciena's Packet Networking, Converged Packet Optical, and Optical Transport portfolios under a single solution. With its unique toolset of comprehensive management features, OneControl puts the control of critical networks at the operator's fingertips. Through a unified GUI and common management model, NOC operators can rapidly deploy new service offerings that cut across domains (access, metro, and core) and coordinate across network protocol layers to ensure efficient use of critical network assets and bandwidth optimization.

This efficiency provides comprehensive management and control from the access customer hand-off points, through the metro, and into the network core. The OneControl GUI allows NOC personnel to create and activate end-to-end packet services. OneControl provides complete visualization of the entire end-to-end service multi-layer correlation, facilitating proactive root cause analysis and troubleshooting.

## Technical Information

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### Interfaces

24 x 1/10GE SFP+ ports  
1 x 10/100/1000M RJ-45 Management port  
1 x Console Port (RJ-45, EIA-561)  
16 x External Alarm Inputs  
1 x RJ-45 sync input/output port  
2 x SMB sync input/output ports

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### Ethernet

IEEE 802.3 Ethernet  
IEEE 802.3z Gigabit Ethernet  
IEEE 802.3-2008 10-Gigabit Ethernet  
IEEE 802.3u 100Base-TX via copper SFP  
IEEE 802.3ab 1000Base-T via copper SFP  
IEEE 802.1D MAC Bridges  
IEEE 802.1Q VLANs - Including .1p Priority  
IEEE 802.1ad Provider Bridging (Q-in-Q) VLAN full S-VLAN range  
VLAN tunneling (Q-in-Q) for Transparent LAN Services (TLS)  
IEEE 802.3ad Link Aggregation Control Protocol (LACP)  
ITU-T G.8032 Ethernet Rings Protection Switching  
Rapid / Multiple Spanning Tree (RSTP/MSTP)  
Per-VLAN MAC Learning Control  
Per-Port MAC Learning Control  
Jumbo Frames to 9216 bytes  
Layer 2 Control Frame Tunneling  
Private Forwarding Groups  
MEF CE 2.0 Compliant  
E-LINE: EPL, EVPL  
E-LAN: EP-LAN, EVP-LAN  
E-Access: Access EPL, Access EVPL  
E-Tree: EP-Tree, EVP-Tree

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### Quality of Service

8 Hardware Queues per Port  
Committed, Excess Information Rate (CIR, EIR)  
Classification based on  
IEEE 802.1D priority  
VLAN, source port, destination port,  
IP Precedence and IPDSCP  
Layer 2, 3, 4 Quality of Service  
Ingress metering per-port  
Ingress metering per-port per-CoS  
Ingress metering per-port per-VLAN  
Up to 8,000 Ingress Meters per-port  
Up to 8,000 Ingress Meters per-system

C-VLAN Priority to S-VLAN Priority Mapping  
S-VLAN Priority based on C-VLAN ID  
Per-VLAN Classification, Metering, and Statistics  
Per-port, per-VLAN QoS with CIR and EIR traffic on Egress Queues

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### Multicast Management

RFC 2236 IGMPv2 Snooping  
IGMP Domains  
IGMP Message Filtering  
IGMP Inquisitive Leave  
Broadcast/Multicast Storm Control  
Unknown Multicast Filtering  
Well-known Protocol Forwarding

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### Carrier Ethernet OAM

IEEE 802.1ag Connectivity Fault Management (CFM)  
IEEE 802.3ah Ethernet in the First Mile (EFM)  
IEEE 802.1AB Link Layer Discovery Protocol (LLDP)  
ITU-T Y.1731 Performance Monitoring  
RFC 2544 Performance Benchmarking Test Generation and Reflection at 10GE  
ITU-T Y.1564 Ethernet Service Activation  
RFC 5618 TWAMP Responder and Receiver  
TWAMP Sender  
TWAMP +/- 1ms timestamp accuracy  
Dying Gasp with Syslog and SNMP Traps

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### Synchronization

ITU-T G.8262/G.8264 EEC option1 and option2  
ITU-T G.781  
IEEE 1588v2 (OC & BC\*)  
ITU-T G.8261  
ITU-T G.8265/G8265.1  
ITU-T G.8271  
ITU-T G.8275/G.8275.1/G.8275.2  
ITU-T G.823/G.824  
ITU-T G.813  
GR-1244  
Stratum3E oscillator  
External Timing Interfaces  
BITS in or out (1.544MHz, 2.048MHz, 2Mbps, 64kcc/6312kcc)  
10MHz, 1.544MHz, 2.048MHz in or out  
GPS 1PPS in or out  
ToD in or out (NMEA 0183, MST5)

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### MPLS/VPLS

RFC 2205, 3031, 3036, 3985 MPLS PWE3 Pseudowire Emulation Edge-to-Edge  
RFC 5654 MPLS-Transport Profile (TP)  
LSP Static provisioning  
1:1 Tunnel protection  
LSP BFD via Gal/Gach  
MPLS Virtual Private Wire Service (VPWS)  
RFC 4762 VPLS (Virtual Private LAN Service) and Hierarchical VPLS (H-VPLS)  
Provider Edge (PE-s) Functionality for VPLS and H-VPLS  
VPLS with multiple VPLS Mesh Virtual Circuits  
H-VPLS with Hub and Spoke Virtual Circuits  
MTU-s Functionality for H-VPLS deployment  
MTU-s Multi-homing (redundant VCs to different PE-s switches)  
MPLS Virtual Circuit as H-VPLS spoke Virtual Circuit  
PBB-TE Service Instance as H-VPLS spoke Virtual Circuit  
Q-in-Q Ethernet Virtual Circuit as H-VPLS spoke Virtual Circuit  
MPLS Label Switch Path (LSP) Tunnel Groups  
MPLS Label Switch Path (LSP) Tunnel Redundancy  
Layer 2 Control Frame Tunneling over MPLS Virtual Circuits  
RFC 3209 RSVP-TE (for MPLS Tunnel Signaling)  
RFC 3630 OSPF-TE (for MPLS Tunnel Routes)  
RFC 3784 IS-IS-TE (for MPLS Tunnel Routes)  
RFC 3036 LDP & Targeted LDP (for VPLS VC signaling)  
RFC 4090 MPLS Fast ReRoute signaling  
LSP Ping & Traceroute

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### PBB-TE (Provider Backbone Bridging-Traffic Engineering)

IEEE 802.1Qay PBB-TE  
IEEE 802.1ah PBB frame format  
PBB-TE Multi-homed Protection Failover  
IEEE 802.1ag CFM for PBB-TE Tunnels  
IEEE 802.1ag CFM for PBB-TE Service Interfaces  
PBB-TE Full B-VID & I-SID address ranges  
PBB-TE Tunnel & Service metering

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### Network Management

Enhanced CLI  
CLI-based configuration files  
SNMP v1/v2c/v3

SNMPv3 Authentication and Message Encryption  
RFC 1213 SNMP MIB II  
RFC 1493 Bridge MIB  
RFC 1643 Ethernet-like Interface MIB  
RFC 1573 MIB II interfaces  
RFC 1757 RMON MIB - including persistent configuration  
RFC 2021 RMON II and RMON Statistics  
Per-VLAN Statistics  
RADIUS Client and RADIUS Authentication  
TACACS + AAA  
RFC 2131 DHCP Client  
RFC 1305 NTP Client  
RFC 1035 DNS Client  
Telnet Server  
RFC 1350 Trivial File Transfer Protocol (TFTP)  
RFC 959 File Transfer Protocol (FTP)  
Secure File Transfer Protocol (SFTP)  
Secure Shell (SSHv2)  
Syslog with Syslog Accounting  
Port State Mirroring  
Virtual Link Loss Indication / Remote Link Loss Forwarding (VLLI/RLLF)  
Dual-Stack IPv4/IPv6 management plane  
Local Console Port  
Comprehensive Management via Ethernet Services Manager  
Remote Auto configuration via TFTP

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### Service Security

Common Criteria EAL2 compliant and certified  
Egress Port Restriction  
IEEE 802.1X Port-Based Network Access Control (RADIUS/MD5)  
Layer 2, 3, 4 Protocol Filtering  
Broadcast Containment  
User Access Rights  
Per-port or per-VLAN Service Access Control  
Hardware-based DOS Attack Prevention

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### MAC Address Table Capacity

128,000 MAC addresses

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### Power Requirements

DC Input: -48, -/+36, -/+24 VDC (nominal)  
AC Input: 100V, 240V AC (nominal)  
AC Frequency: 50/60 Hz  
Maximum Power Input: 175 W

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### Agency Approvals

Agency Marks:  
NRTL (Canadian Standards Association)  
CE mark (European Union)  
EMC Directive (2004/108/EC)  
LVD Directive (2006/95/EC)  
RoHS2 Directive (2011/65/EU)  
Australia C-Tick (Australia/New Zealand)  
VCCI (Japan)  
Emissions:  
FCC Part 15 Class A  
Industry Canada ICES-003 Class A  
VCCI Class A  
CISPR 22 Class A  
GR-1089 Issue 6  
EN 55022  
Immunity (EMC):  
CISPR 24  
EN 55024  
GR-1089 Issue 6  
EN 300 386  
Power:  
ETSI EN 300 132  
Safety:  
EN 60950-1  
CAN/CSA C22.2 No. 60950-1-07  
UL 60950-1 2nd Ed  
Environmental:  
RoHS Directive (2011/65/EU)  
WEEE 2002/96/EC

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### Environmental Characteristics

GR-63-CORE, Issue 4 – NEBS Level 3  
GR-1089 Issue 6 – NEBS Level 3  
GR-3108 Issue 2 Network Equipment in the Outside Plant (OSP) Class 2  
  
ETSI 300 019 Class 1.2, 2.2, 3.2  
Operating Temperature:  
-40°F to +149°F (-40°C to +65°C)  
Storage Temperature:  
-40°F to +158°F (-40°C to +70°C)  
Relative Humidity:  
5% to 90% (non-condensing)

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### Physical Characteristics

Dimensions:  
17.5" (W) x 9.9" (D) x 1.75" (H);  
444mm (W) x 252mm (D) x 44mm (H)  
Weight:  
11.6 lbs; 5.3 kg

\* Denotes features available in a future release

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