Power over Ethernet (PoE) Watts in your Network?

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Power over Ethernet (PoE)
Watts in your Network?

Agenda
Introduction
PoE Definitions and Standards
PoE Extension Technologies
Case Studies
Q and A
About Omnitron Systems

Corporate Profile

• Design and Manufacture PoE, fiber optic, and Ethernet network connectivity products since 1992

• Corporate headquarters and manufacturing facilities are based in Irvine, California

Markets Served:

- Enterprise
- Telecom
- Government
- Security
- Industrial
- Data Center
Power over Ethernet (PoE)
Watts in your Network?

PoE Definitions and Standards
What is PoE?

**Power over Ethernet (PoE)** is a standard based technology for the safe delivery of data and power to remote devices over copper cabling.

- Uses standard Ethernet UTP cables
  - Ex. Cat 5e or Cat 6 cable
- Power and data co-exist on same copper conductors
PoE Terminology

- **Endspan PSE** – located at the end of a link segment

![PoE Terminology Diagram](image-url)
PoE Terminology

- **Midspan PSE** – located in the middle of a link segment
IEEE PoE Standards

IEEE 802.3af PoE
• Ratified in 2003
• Allows up to 15.4W per connection
  – 12.95W assured to be available at the PD at 100m

IEEE 802.3at PoE+
• Ratified in 2009
• Allows up to 30.0W per connection
  – 25.5W assured to be available at the PD at 100m

IEEE 802.3bt – 60W – 100W High-Power PoE
• Ratified in 2018
• Allows up to 100W per connection
  – 71W assured to be available at the PD at 100m
<table>
<thead>
<tr>
<th>Spec / Name</th>
<th>Ratified</th>
<th>Pairs needed</th>
<th>PoE Type</th>
<th>PoE Class</th>
<th>Power at PSE</th>
<th>Power at PD</th>
<th>Cable Type</th>
<th>Data Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>802.3af PoE</strong></td>
<td>2003</td>
<td>2 Pairs (10M/100M)</td>
<td>Type 1</td>
<td>Class 1</td>
<td>4W</td>
<td>3.8W</td>
<td>Cat 3, 5, 6, 7</td>
<td>10M 100M Gigabit</td>
</tr>
<tr>
<td><strong>(15 W)</strong></td>
<td></td>
<td></td>
<td></td>
<td>Class 2</td>
<td>7W</td>
<td>6.5W</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Class 3</td>
<td>15.4W</td>
<td>13W</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>802.3at PoE+</strong></td>
<td>2009</td>
<td>4 Pairs (Gigabit)</td>
<td>Type 2</td>
<td>Class 4</td>
<td>30W</td>
<td>25.5W</td>
<td>Cat 5, 5e, 6, 7</td>
<td>10M 100M Gigabit</td>
</tr>
<tr>
<td><strong>(30W)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>802.3bt 4 Pair PoE</strong></td>
<td>2018</td>
<td>4 Pairs</td>
<td>Type 3</td>
<td>Class 5</td>
<td>45W</td>
<td>40W</td>
<td>Cat 5e, 6, 7</td>
<td>10M 100M Gigabit</td>
</tr>
<tr>
<td><strong>(60/100W)</strong></td>
<td></td>
<td></td>
<td></td>
<td>Class 6</td>
<td>60W</td>
<td>51W</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type 4</td>
<td>Class 7</td>
<td>75W</td>
<td>62W</td>
<td>Cat 5e, 6, 7</td>
<td>2.5G 5G 10G</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Class 8</td>
<td>90W</td>
<td>71.3W</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## PoE Standards Reference Chart

<table>
<thead>
<tr>
<th>Type</th>
<th>Standard</th>
<th>Watts</th>
<th>PoE Powered Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 4</td>
<td>802.3bt</td>
<td>60-100W</td>
<td>Digital Signage, Small Cell, Smart LED Lighting</td>
</tr>
<tr>
<td>Type 3</td>
<td>802.3bt</td>
<td>45-60W</td>
<td>PTZ Camera, WiFi 6 Access Point, POS Terminal</td>
</tr>
<tr>
<td>Type 2</td>
<td>802.3at</td>
<td>15-30W</td>
<td>IP Camera, WiFi 4 or 5 Access Point, Video Phone</td>
</tr>
<tr>
<td>Type 1</td>
<td>802.3af</td>
<td>0-15W</td>
<td>IP Camera, Fire Alarm, Access Control</td>
</tr>
</tbody>
</table>
IEEE Standards – Compatibility

- **Future-Proof networks** – all IEEE PoE Standards are backward-compatible to support the lower wattage requirements 😊

<table>
<thead>
<tr>
<th></th>
<th>IEEE Standard PoE Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>802.3af 15W</td>
</tr>
<tr>
<td><strong>15W</strong></td>
<td>X</td>
</tr>
<tr>
<td><strong>30W</strong></td>
<td>X</td>
</tr>
<tr>
<td><strong>60W</strong></td>
<td></td>
</tr>
<tr>
<td><strong>100W</strong></td>
<td></td>
</tr>
</tbody>
</table>
How Does PoE Work?

• PSE asks connected device if it needs PoE power, and how much?
• If it’s a PD, it will let the PSE know how much power it requires
• Power is then supplied by the PSE to the PD
• If it’s not a PD, the PSE will NOT send power (equipment is safe)
  – But WILL still pass data
Ethernet Data Can Only Travel 100 Meters over Copper

- Data deteriorates after 100m (might be undetectable by receiver)

- Use Fiber to Extend Data beyond 100M
  - PoE Media Converters & Switches
- Use Copper to Extend Data and Power beyond 100M
  - PoE Extenders
Power over Ethernet (PoE) Watts in your Network?

PoE Extension Technologies
PoE Extension

PoE Extension Technologies
- Ethernet (VDSL) Extenders
- PoE Copper Extenders
- PoE Fiber Media Converters
- PoE Fiber Switches

Comparison and Contrast
- Distance
- PoE PSE Power Provided
- Bandwidth
- Availability of Local Power
- Features
- Cable Media
- Price
PoE VDSL Extenders (Very High Speed Digital Subscriber Line)

- Two port or multi-port devices
- Requires external AC or DC power
- Up to 30W PoE+ over short distances

**Strengths**
- Plug and Play
- Up to 2400 meters over RJ11 Copper

**Weaknesses**
- PoE power only at short distances
- Limited bandwidth at long distance
- Proprietary, unique to manufacturer
How do VDSL Extenders Work?

- Where twisted pair or Coax is available, and installing fiber is cost prohibitive.
- Head end device is powered, and requires a power injecting device.
- Line power is proprietary over extended cable distance.
## VDSL Extenders

<table>
<thead>
<tr>
<th>Criterion</th>
<th>PoE Ethernet Extenders</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distance</strong></td>
<td>Up to 2400 meters over Coax</td>
</tr>
<tr>
<td><strong>PoE PSE Power</strong></td>
<td>Up to 30W PoE+ over short distances</td>
</tr>
<tr>
<td><strong>Local Power</strong></td>
<td>• AC or DC power required for VDSL Extenders</td>
</tr>
<tr>
<td></td>
<td>• <strong>May require additional power injectors</strong></td>
</tr>
<tr>
<td><strong>Number of PDs</strong></td>
<td>1 or 2</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td>• 100Mbs over short distances (200 to 300 meters)</td>
</tr>
<tr>
<td></td>
<td>• 1 to 4Mbps over longer distances (1000 to 2400 meters)</td>
</tr>
<tr>
<td><strong>Features</strong></td>
<td>• Typically unmanaged, plug-and-play devices</td>
</tr>
<tr>
<td></td>
<td>• Auto-negotiation of duplex modes and data rates</td>
</tr>
</tbody>
</table>
PoE Copper Extenders

• Two port or multi-port devices
• Functions as both Powered Device (PD) and Power Sourcing Equipment (PSE)
• Requires no external AC power

**Strengths**
- Plug-and-play
- Full Gigabit data rate to end device
- Powers PoE, PoE+, and HPoE devices

**Weaknesses**
- Extender required every 100m
- Head end must provide power
How do Copper Extenders work?

- PoE Extender Receives Power through PD Port
- PoE Extender Provides Power through PSE Port
Voltage Boosting Technology

- Installing PoE Copper extenders with Voltage Boosting Technology guarantees voltage requirement to the PDs.

**PoE Extenders without Voltage Boosting Technology**

- PD Detects Low Voltage
- 56V 50V 48V 44V 42V 38V
- 100 Meters

**PoE Extenders with Voltage Boosting Technology**

- PD Detects Normal Voltage
- 56V 50V 56V 50V 56V 50V
- 100 Meters
PoE Copper Extender Distances

- Up to 700m to 802.3af PD, up to 800m to non-PoE (AC/DC powered) device

Power and distance dependent on:

- Power provided by PSE (Power Budget)
- Power consumed by PoE Extenders and PD(s)
- Type of Cabling
PoE Extender with Drop Locations

- Additional ports enable PD drop locations along daisy chain
  - Power consumption reduces overall distance
  - Provides network design flexibility
PoE Copper Extenders

<table>
<thead>
<tr>
<th>Criterion</th>
<th>PoE Copper Extenders</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distance</strong></td>
<td>Up to 700 meters in daisy chain (Extender provides power)</td>
</tr>
<tr>
<td><strong>PoE PSE Power</strong></td>
<td>~55W @ 200 Meters, ~25W @ 500 Meters, ~7W @ 700 Meters</td>
</tr>
<tr>
<td><strong>Local Power</strong></td>
<td>No AC or DC power required for PoE Copper Extenders</td>
</tr>
<tr>
<td><strong>Number of PDs</strong></td>
<td>Up to 4 (deployed with drop locations)</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td>Gigabit data rate at all distances</td>
</tr>
<tr>
<td><strong>Features</strong></td>
<td>• Voltage Boosting Technology</td>
</tr>
<tr>
<td></td>
<td>• Typically unmanaged, plug-and-play devices</td>
</tr>
<tr>
<td></td>
<td>• Auto-negotiation of duplex modes and data rates</td>
</tr>
</tbody>
</table>
PoE Media Converters

- Extend distances to PoE devices with fiber
- PoE Media Converter is powered by AC or DC power
- Multiple Fiber and RJ-45 PoE port configurations

**Strengths**

- Plug and Play, or Configurable features:
- Remote PoE Reset
- Enables distances up to 140 Km (87 miles)

**Weaknesses**

- Requires local AC/DC Powering
- Requires fiber
How PoE Media Converters Work

- Use switch fiber ports at the Head End
- Or copper switch with media converters
- Install PoE Media Converter near AC or DC power
- Install PDs on Poles, Ceilings, Enclosures etc.
  - 100m Copper max. from the media converter
# PoE Media Converters

<table>
<thead>
<tr>
<th>Criterion</th>
<th>PoE Media Converters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distance</strong></td>
<td>Up to 140 Km (87 miles). Can be daisy chained for additional links</td>
</tr>
<tr>
<td><strong>PoE PSE Power</strong></td>
<td>PoE, PoE+, HPoE and 4 Pair PoE (802.3bt)</td>
</tr>
<tr>
<td><strong>Local Power</strong></td>
<td>• AC or DC power required for PoE Media Converter</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td>Up to 10 Gigabit data rate at all distances</td>
</tr>
<tr>
<td><strong>Features</strong></td>
<td>• Managed or unmanaged</td>
</tr>
<tr>
<td></td>
<td>• One or Two Fiber Ports</td>
</tr>
<tr>
<td></td>
<td>• DIP-Switch configuration of PoE reset, restore modes, ....</td>
</tr>
<tr>
<td></td>
<td>• Auto-negotiation of duplex modes and data rates</td>
</tr>
</tbody>
</table>
PoE Fiber Switches

- Compact PoE Fiber Switches extend distances to MULTIPLE PoE devices
- Requires AC or DC power
- Enables distances up to 140 Km (87 miles)

**Strengths**

Remote PoE Reset, Dual Device Mode, VLANs, Heartbeat, QoS, MRP and RSTP, Link Aggregation
Powers PoE, PoE+, and 60W / 100W BT PDs from same PoE Fiber Switch
Managed or Unmanaged devices

**Weaknesses**

Requires local AC/DC Power
Requires fiber
How PoE Fiber Switches Work

• Run fiber from head end (fiber switch or copper switch and media converters)
• Install **PoE Fiber Switch** near AC or DC power
• Install PDs
  – 100m Copper max. from the PoE Fiber Switch
PoE Fiber Switch Application – Topologies

Point-to-Point

Daisy Chain

Redundant (LAG)

Ring (STP / MRP)
Industrial PoE Fiber Switches

- Also available as ruggedized industrial products
- Similar features as commercial products
- Temperature hardened: -40 to 75 deg C
- Industrial hardened enclosure
- DIN-Rail mount included standard
- Managed or Unmanaged devices
Industrial PoE Fiber Switch Application

- **Point to Point**
- **Daisy Chain**
- **Redundant (LAG)**
- **Ring (STP / MRP)**
Other Industrial PoE Fiber Switch Applications

- Critical Infrastructure
- Perimeter Security
- Historic Sites
- Sports Arenas
- Transportation
- Cell Towers
PoE Fiber Switches

<table>
<thead>
<tr>
<th>Criterion</th>
<th>PoE Fiber Switches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>Up to 140 Km (87 miles). Can be daisy chained for additional links</td>
</tr>
<tr>
<td>PoE PSE Power</td>
<td>PoE, PoE+, HPoE, and 4 Pair PoE (802.3bt) for multiple devices</td>
</tr>
<tr>
<td>Local Power</td>
<td>AC or DC power required for PoE Fiber Switch</td>
</tr>
<tr>
<td>Number of PDs</td>
<td>Typically up to 48 PDs (mixed power levels)</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Up to 10 Gigabit at all distances</td>
</tr>
<tr>
<td>Features</td>
<td>• Managed or unmanaged</td>
</tr>
<tr>
<td></td>
<td>• One or Two Fiber Ports, and up to 48 RJ-45 PSE ports</td>
</tr>
<tr>
<td></td>
<td>• Remote PoE reset, PoE heartbeat, Dual Device Mode, VLAN, QoS, MRP and spanning tree</td>
</tr>
</tbody>
</table>
## PoE Extension Technology Comparison

<table>
<thead>
<tr>
<th>Criterion</th>
<th>VDSL Extenders</th>
<th>PoE Copper Extenders</th>
<th>PoE Media Converters</th>
<th>PoE Fiber Switches</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PoE Power</strong></td>
<td>PoE, PoE+</td>
<td>PoE, PoE+, BT</td>
<td>PoE, PoE+, BT</td>
<td>PoE, PoE+, BT</td>
</tr>
<tr>
<td><strong>Distance</strong></td>
<td>2400 M</td>
<td>700 M</td>
<td>140 Km</td>
<td>140 Km</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td>1- 100Mbps</td>
<td>1 Gigabit</td>
<td>1 Gigabit/10G</td>
<td>1 Gigabit/10G</td>
</tr>
<tr>
<td><strong># of PDs</strong></td>
<td>1 or 2</td>
<td>Up to 4</td>
<td>1 or 2</td>
<td>Up to 48</td>
</tr>
<tr>
<td><strong>Local Power</strong></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Cable</strong></td>
<td>Phone, Coax</td>
<td>UTP</td>
<td>Fiber, UTP</td>
<td>Fiber, UTP</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>$</td>
<td>$</td>
<td>$$</td>
<td>$$$</td>
</tr>
</tbody>
</table>
Power over Ethernet (PoE) Watts in your Network?

Case Studies
Case Study – Smart Building

• Integrates all of a facility's systems into a centrally controlled Ethernet network with IP-based structured cabling

• Benefits include:
  • Energy efficiency
  • Improved safety
  • Reduced labor costs
  • Reduced operating costs
  • Simplified asset Mgt.

• PoE enables PDs at any location, regardless if a site has electrical outlets
Case Study – Smart Building

PoE Powered Devices
- IP Phones
- LED Lighting
- Sensors
- Access Control
- Wi-Fi APs
- Wi-Fi APs
- IP Cameras
- IP Cameras
- Displays
- Displays
- Data Closet

100 Meter Distance Limitation
Case Study – Smart Building

PoE Powered Devices
- IP Phones
- LED Lighting
- Sensors
- Access Control
- Wi-Fi APs
- IP Cameras
- Displays
- Data Closet

PoE Extender
PoE PSE Switch
PoE Fiber Switch
PoE Powered Media Converter
Case Study – International Airport

• Due to customer demand, a new Wi-Fi network was installed throughout the airport terminals and concourses

• Required over 300 Wi-Fi access points throughout the 6.8 million square foot terminal complex

• The new Wi-Fi network was installed in less than 30 days

• The network provides access to 15,000 simultaneous users
Case Study – International Airport

- Each concourse has multiple Intermediate Data Frames (IDF)
- Each IDF provides connectivity to Wi-Fi Access Points
- Fiber is used to extend distances to PDs outside the reach of copper
- PoE Power Reset feature saved time and technician costs
Case Study – International Airport

Managed Gigabit Media Converters installed in a high-density Chassis

PoE Switch

To Network Core

PoE+ Wi-Fi Access Points

PoE Media Converters

Up To 18 Gigabit Fiber Runs

Fiber
UTP with PoE
UTP
Case Study – Casino Floor

PoE Powered Devices
- Wi-Fi APs
- IP Cameras
- Displays
- Data Closet

100 Meter Distance Limitation

UTP with PoE & Data
- Fiber with Data
Case Study – Hospitals
Case Study – Shopping Mall – Security and WiFi Installation

PoE Powered Devices
- Wi-Fi APs
- IP Cameras
- Data Closet

PoE Fiber Switch
PoE Extender

100 Meter Distance Limitation

UTP with PoE & Data
Fiber with Data
Case Study – Smart City
Choosing the Right Type of PoE PSE

- PoE/PoE+/60W or 100W PoE power sourcing
- Commercial Temperature or Wide / Industrial Temp
- Number of Fiber and Copper Ports needed
- Connector Type - SFP, ST, SC, LC
- Ethernet Data Rate (speed) - 10/100, 10/100/1000, 10G
- Fiber Type - Multimode, Single-Mode, Dual or Single
- Fiber Distance - up to 140km
- Managed or Unmanaged
- Powering option - AC, DC, PoE (extenders only)
- Mounting – Tabletop, Wall or Rack Mount Shelf, DIN-Rail
Power over Ethernet (PoE)
Watts in your Network?

Thank You!
Power over Ethernet (PoE)
Watts in your Network?

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