Ruckus Power over Ethernet (PoE) Interoperability

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Scope

This document provides a quick overview of the Power over Ethernet (PoE) standards and industry definitions, and describes the PoE implementation behavior of Ruckus ICX switches and Ruckus access points (APs) to highlight their interoperability and the Ruckus advantage.

Introduction

In the Information Age, everything is connected. Therefore, there is a need to increase the ease of command and control of such devices as IP phones, sensors, security devices, wireless access points, and even lighting.

Power over Ethernet (PoE) is a mature technology that offers tangible benefits such as low voltage DC power delivered over a centralized and standardized cabling infrastructure. Structured cabling is the norm in new buildings, paving the road to even newer applications such as PoE lighting. For these and other reasons, customers want to deploy PoE in their networks. In addition to traditional network Powered Devices (PDs), intelligent buildings (wherein "building automation" is becoming very close to the infrastructure itself), take advantage of PoE's benefits to deliver intelligent management and control of network devices and buildings.

The ability to provide power over the same wiring that provides the data connection is not new technology, though it has been evolving from proprietary implementations and industry specifications. PoE continues to evolve to provide support for newer applications, beyond the original requirement to power up IP phones.

All Ruckus ICX switches supporting PoE adhere to the IEEE standards as a baseline. Thus, ICX switches are able to power up any standards-compliant Powered Device (PD).

Ruckus access points and Ruckus ICX switches support the IEEE 802.3 (PoE) standards with some added proprietary implementations, behaviors, and enhancements.

PoE Standards and Proprietary Specifications

Standards

The hardware feature (PoE) evolved from proprietary implementations until it became an IEEE standard. The standards are rather slow to be defined and ratified, so the industry defines and delivers pre-standards and specifications to provide solutions more quickly. The IEEE 802.3af, 802.3at, and 802.3bt specifications define the standards for delivering power over existing network cabling infrastructure that supports wireless connectivity, audio, and video applications for converged services, such as Voice over IP (VoIP), IP surveillance cameras, access points, and so on.

Ruckus ICX switches support the most advanced PoE alternatives in the market:

- IEEE 802.3af: The original standard, known as PoE (up to 15.4W)
- IEEE 802.3at: The second standard, known as PoE+ (up to 30W)
- IEEE 802.3bt: The latest standard ratified at the end of 2018 (up to 90W)

The PoE standard (802.3af) is known for its 1-Event classification, the PoE+ standard (802.3at) utilizes 2-Event classification, and the 802.3bt standard uses 5-Event classification.

FIGURE 1 PoE+ Example
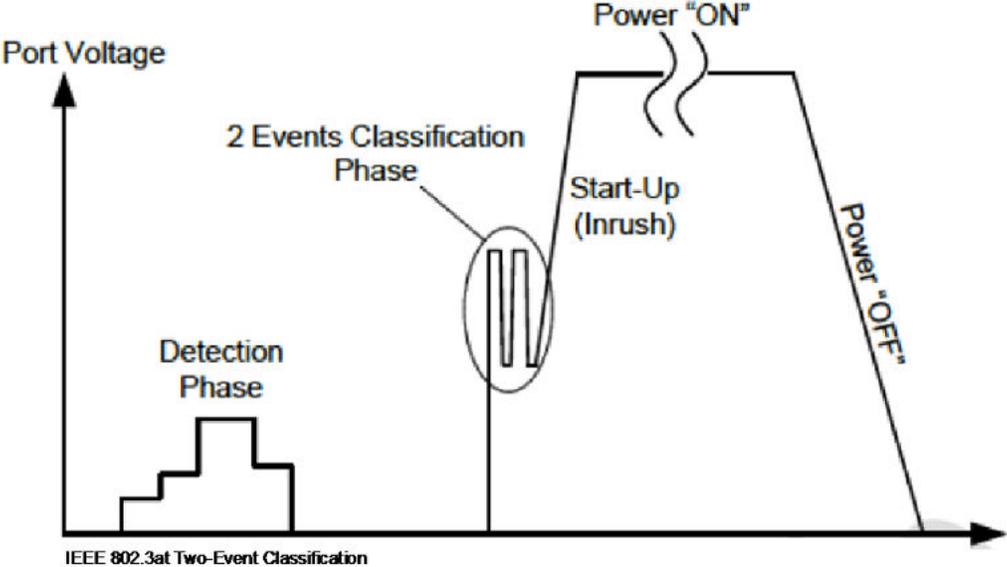
NOTE
Ruckus ICX switches have the built-in hardware necessary to support the 802.3bt standard, but the firmware support is roadmapped.

Proprietary and Industry Specifications

In addition to supporting IEEE PoE standards, Ruckus ICX switches support a Ruckus proprietary enhancement called PoE+ Overdrive. ICX switches also support PoH, which is an industry specification for up to 95W. Power over HDBaseT (PoH) is another way for ICX switches to provide any amount of power up to 95W (thus competing directly with Cisco UPOE).

- Proprietary PoE+ Overdrive: Ruckus PoE+ Overdrive of up to 45W over 2-Pairs

- Industry specification PoH: MicroSemi HDBaseT up to 95W over 4-Pairs (Similar to UPOE, but higher power.)

- Proprietary UPOE: Cisco implementation of 60W over 4-Pairs (Also known as PoE++ or PoE+ over 4-Pairs.)

PoE+ Overdrive is based on the ability to support 802.3at. Ruckus implemented a mechanism to request higher amounts of power above the Class 4 (30W) by way of LLDP. This ability requires the ICX switch hardware to be robust enough to handle the extra current, temperature, and overall stress of supporting up to 45W over the same 2-Pairs—this is a Ruckus differentiator.

TABLE 1 ICX Switches and PoE+ Overdrive

ICX Switch Model	PoH Ports	PoE+ Ports	PoE+ Overdrive Max Current	PoE+ Overdrive Max Output at PSE	PoE+ Overdrive Max Power at PD
ICX-7650	8	40	925mA	45W	35.5W
ICX-7150-48ZP	16	32	925mA	45W	35.5W
ICX-7150	0	12 or 24 or 48	650mA	33W	28.5W
ICX-7250	8	16 or 40	650mA	33W	28.5W
ICX-7450	8	16 or 40	-	-	25.5W
ICX-7450-32ZP	8	24	-	-	-

PoH is an industry specification which provides 95W, while IEEE 802.3bt with 5-Event classification is the standard that defines PoE Types 3 and 4 (known as 60W and 90W types) over 4-Pairs, along with Classes 5, 6, 7, and 8. These classes provide power in increments of 15W up to 90W. The following table summarizes the PoE alternatives available on a Ruckus ICX switch.

TABLE 2 PoE Alternatives on Ruckus ICX Switches

PoE Type/Class	802.3at				Type 2	PoE+ Ruckus Overdrive	802.3bt				HDBaseT Ruckus PoH
	802.3af		Type 1				Type 3		Type 4		
Class	0	1	2	3	4	-	5	6	7	8	-
PSE Watt	15.4	4	7	15.4	30	45	45	60	75	90	95
PD Watt	12.95	3.84	6.49	13	25.5	-	40	51	62	71	-
Number of wire pairs	2-Pairs						4-Pairs				

The Power Sourcing Equipment (PSE) Watt is the maximum output power as measured at the RJ45 connector of the PSE (switch port).

The Powered Device (PD) Watt is the worst-case maximum output power delivered at the PD (assuming 100m of Cat5e wiring between the PSE and the PD).

Ruckus Power over Ethernet

ICX Switch

Switch behavior as defined by the IEEE standards is to "detect" and "classify" the devices attached to the Ethernet ports (RJ45). The first stage is detection and the method of detection is based on impedance and current measuring. This method is well defined by the standards, and Ruckus ICX switches follow these standards faithfully.

Once the attached device is "detected" as a valid PD, the second stage is to "classify" the PD as per the PoE classes defined by the 802.3af, 802.3at, and 802.3bt standards. The classification is achieved by a method similar to the detection—a series of one, two, or five events (current measuring) but with different time periods, voltage, and amplitude. The combination of events and current values in the PD signature allows the switch to identify the PD class.

FIGURE 2 PD Detection and Classification
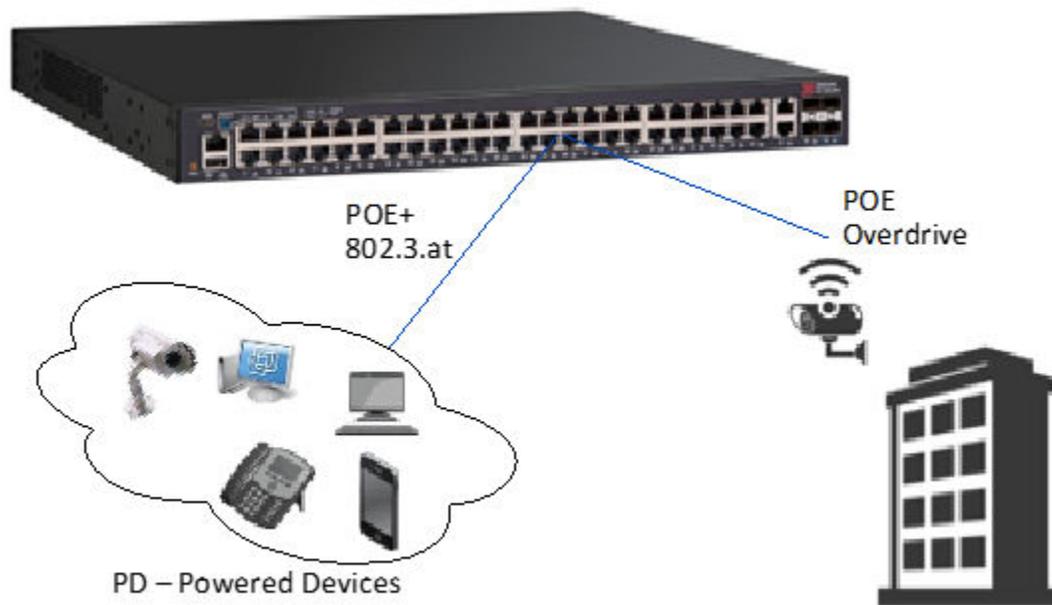
This is hardware negotiation as in detection and classification. Once the negotiation is completed, a PD receives the classified amount of power: classes 0, 1, 2, 3, 4, 5, 6, 7, or 8 as defined by the standards (refer to Proprietary and Industry Specifications on page 5). Once the PD is booted up and begins running its application software, it can utilize LLDP (if supported) to further negotiate a more granular amount of power required by the PD to optimize its performance.

Access Points (APs)

Ruckus APs support the most commonly used standards—802.3af, 802.3at, and 802.3bt—and even UPOE (proprietary). The Ruckus AP, the R730, supports all PoE alternatives matching the Ruckus ICX switches. That is, the R730 can power up from an ICX switch because it supports all of the PoE standards, as well as PoE+ Overdrive and PoH (PoE++ or UPOE). Consequently, a Ruckus ICX switch is the ideal match to provide connectivity and power to Ruckus APs, as well as the most demanding PDs in the market.

Other Ruckus APs take a more conservative approach because a customer might attach an AP to an unknown switch with limited or unknown PoE capabilities. Although the AP is capable of PoE+, the AP requests a lesser amount of power during bootup to ensure it will have an opportunity to boot up.

Once the AP has received power from the switch and booted up, only then does the AP utilize LLDP to request more power, usually Class 4 (30W). If the unknown switch has enough power budget or capability to support PoE+, it will grant the 30W requested.

Deploying Ruckus ICX switches and Ruckus APs guarantees the interoperability and capability to provide all the power needed by an AP to properly function at full capability as designed.

TABLE 3 Ruckus APs and PoE Support

AP Model	802.3af (PoE) Class 0, 1, 2, 3 2-Pair	802.3at (PoE+) Class 4, 30W 2-Pair	PoE+ Overdrive (PoE+) 45W 2-Pair	UPOE (PoE+) 60W 4-Pair	PoH 95W 4-Pair
R730	-	Yes	Yes	Yes	Yes
R720	Yes[1]	Yes	Yes	Yes	Yes
R710	Yes[1]	Yes	-	-	-
R610	Yes[1]	Yes	-	-	-
R510	Yes	-	-	-	-

[1]   Reduced set of operating characteristics.

Ruckus Switch and Access Point Interoperability

Ruckus ICX switches running FastIron 08.0.90 or later can interoperate flawlessly and automatically negotiate the appropriate amount of power APs need to function at full potential, that is, using 2.4 GHz and 5.0 GHz radios, USB ports, and all Ethernet ports.

FastIron 08.0.90 changes the default mode on the PoH ports (usually Multi-Gigabit Ethernet ports) to 30W. This change reduces the impact on the power budget when 95W is budgeted for a port that may not need more than 60W (30W+30W UPOE).

PoH ports run over 4-Pairs, which means that up to 47.5W can be delivered over each of the 2-Pairs for a total of 95W. With this new default, the port provides 60W instead of 95W. Should there be a device requiring more than 60W, the port can be configured for that.

For example, a PoH port has 95W assigned, but the R730 AP only uses 38W. This results in 57W deducted from the PoE power budget that never gets used, limiting the total number of APs that one switch could power up.

Fortunately, the R730 supports LLDP and Ruckus PoE+ Overdrive. When the AP is connected to an ICX-7650, it requests 38W of power, which the switch honors and properly adjusts the PoE power budget of the switch.

If the AP is connected to a PoH port, the switch provides 60W at the port.

If the AP is connected to a non-PoH port, the switch detects the need for more than 30W and goes into Overdrive mode to provide the exact amount of power requested by the AP by way of LLDP.

Thanks to the Ruckus wired and wireless integration, an ICX switch can deliver the power needed to the R730 AP, whether that means providing more than 30W by way of a 2-Pair PoE port (PoE+ Overdrive) or 60W by way of a 4-Pair PoE port (PoH port).

The following table shows the PoE capabilities along with the power assigned and negotiated by way of LLDP for the Ruckus ICX switches and the R730 AP.

TABLE 4 Interoperability: ICX Switches and R730 AP

Platform-Tested Ruckus R730	Switch-Allocated Power		ICX Switch		Ruckus AP Sofware Version	PoH PoE+ Port Numbers
	PoH	PoE+	FastIron Image Version	PoE Firmware Version		
7650-48ZP	38.1W	42.8W	08.0.90	2.1.1	108.2.0.0.830	PoH ports: 25-48 PoE+ ports: 1-24
7650-48P	38.1W	42.8W	08.0.90	2.1.1	108.2.0.0.830	PoH ports: 1-8 PoE+ ports: 9-48
7150-48ZP	38.1W	42.8W	08.0.90	2.1.1	108.2.0.0.830	PoH ports: 1-16

TABLE 4 Interoperability: ICX Switches and R730 AP (continued)

| Platform-Tested Ruckus R730 | Switch-Allocated Power | | ICX Switch | | Ruckus AP Sofware Version | PoH PoE+ Port Numbers |
	PoH	PoE+	FastIron Image Version	PoE Firmware Version		
						PoE+ ports: 17-48
7450 (all)	38.1W	28.5W	08.0.90	2.1.1	108.2.0.0.830	PoH ports: 1-8
						PoE+ ports: 9-48

NOTE
The power levels displayed are allocated power levels at the switch port, not power consumed by the PD.

Similarly, the Ruckus R720 AP is supported by an ICX switch with all of its PoE alternatives: Gigabit Ethernet and Multi-Gigabit Ethernet ports (PoE+ Overdrive or PoH).

TABLE 5 Interoperability: ICX Switches and R720 AP

| Platform-Tested Ruckus R720 | Switch-Allocated Power | | ICX Switch | | Ruckus AP Software Version | PoH PoE+ Port Numbers |
	PoH	PoE+	FastIron Image Version	PoE Firmware Version		
7650-48ZP	38.1W	42.8W	08.0.90	2.1.1	110.0.0.0.663	PoH ports: 25-48
						PoE+ ports: 1-24
7650-48P	38.1W	42.8W	08.0.90	2.1.1	110.0.0.0.663	PoH ports: 1-8
						PoE+ ports: 9-48
7150-48ZP	38.1W	42.8W	08.0.90	2.1.1	110.0.0.0.663	PoH ports: 1-16
						PoE+ ports: 17-48
7450 (all)	38.1W	28.5W	08.0.90	2.1.1	110.0.0.0.663	PoH ports: 1-8
						PoE+ ports: 9-48

The Ruckus R710 AP is supported by any ICX switch (standard Gigabit Ethernet port or non-PoH port).

TABLE 6 Interoperability: ICX Switches and R710 AP

| Platform-Tested Ruckus R710 | Switch-Allocated Power | | ICX Switch | | Ruckus AP Software Version | PoH PoE+ Port Numbers |
	PoH	PoE+	FastIron Image Version	PoE Firmware Version		
7650-48ZP	26.5W	26.5W	08.0.90	2.1.1	3.2.0.0.539	PoH ports: 25-48
						PoE+ ports: 1-24
7650-48P	28.5W	28.5W	08.0.90	2.1.1	3.2.0.0.539	PoH ports: 1-8
						PoE+ ports: 9-48
7150-48ZP	30W	28.3W	08.0.90	2.1.1	3.2.0.0.539	PoH ports: 1-16
						PoE+ ports: 17-48
7450 (all)	26.5W	28.5W	08.0.90	2.1.1	3.2.0.0.539	PoH ports: 1-8

Summary

Standards continue to evolve to address new or enhanced features on end devices. New wireless standards address a larger density of clients and the need to provide better connectivity and more bandwidth. Along with these needs comes the need to increase the power used by network devices, continuing the need for PoE standards to evolve and support current and future power demands.

Standards take longer to get ratified while the market needs to march at a faster pace. In response, industry leaders defined advanced PoE specifications such as PoH (HDBaseT), UPOE (Cisco), and Ruckus proprietary implementations such as PoE+ Overdrive.

To great advantage, Ruckus Networks wired and wireless products support all PoE standards, industry specifications, and proprietary implementations to address the power needs of leading-edge Ruckus wireless access points today.

The power negotiation is transparent to the user. When an access point requires more power, it simply requests the power by way of LLDP from the switch and the switch provides the appropriate amount of power over standard Gigabit Ethernet or Multi-Gigabit Ethernet ports, either 2-Pair or 4-Pair, up to 95W.

Managing the PoE power budget is critical to any switch; consequently, interoperability between the Ruckus ICX switch and the AP is critical to the utmost. For best PoE power management, Ruckus ICX switches provide the most effective PoE offerings in the industry, along with all of the networking technology expected in an intelligent switch.

And Ruckus access points work at their best when connected to a Ruckus ICX switch.