Single Pair **Ethernet**

The Evolution of Automation Device Communications

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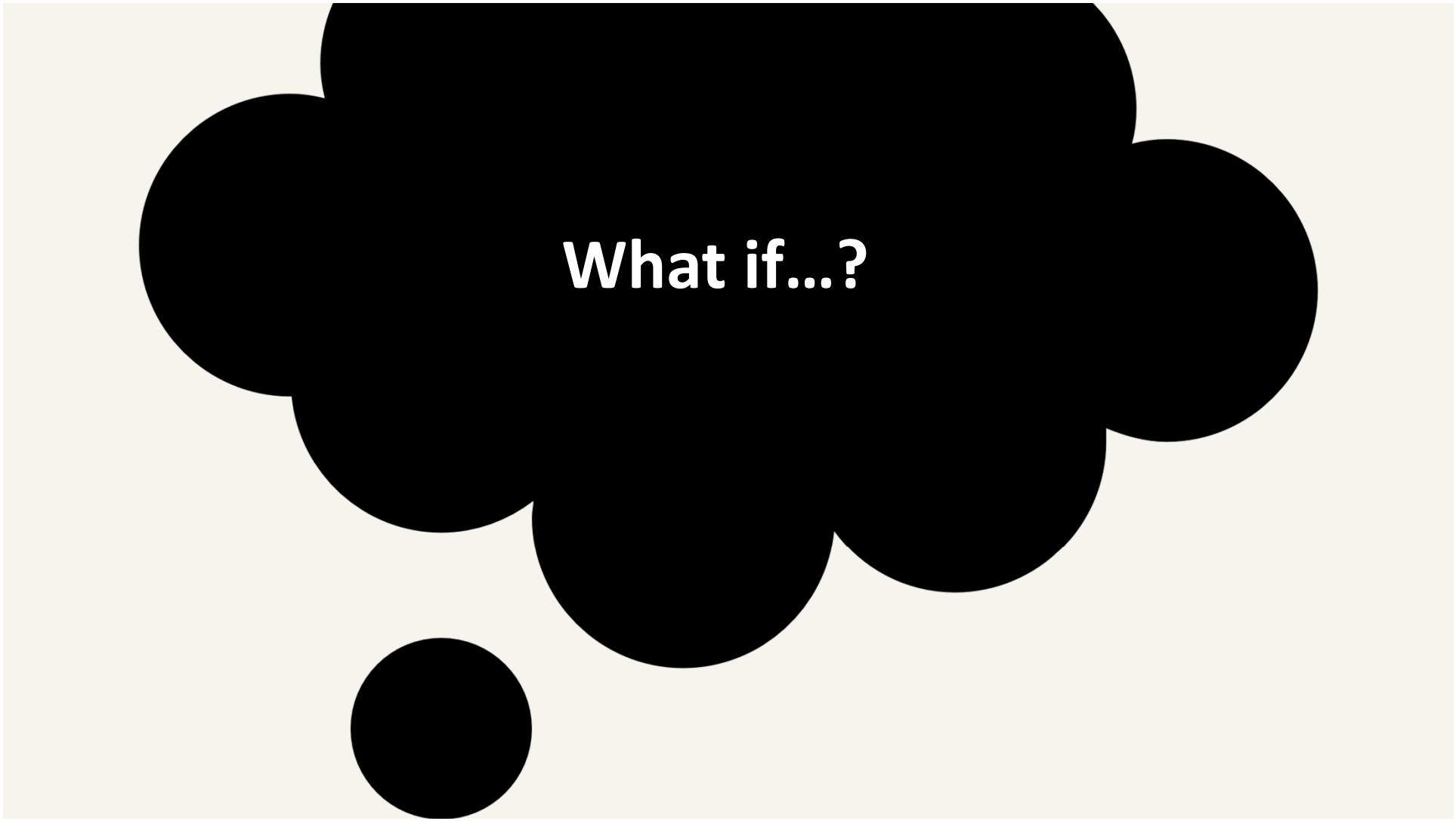
Topics

- Why Single Pair Ethernet?
- SPE Standards & Applications
- SPE Development
- SPE Moving the Industry Forward…
- Discussion


What if…?

WHAT IF…

Devices could be powered by their data connection?

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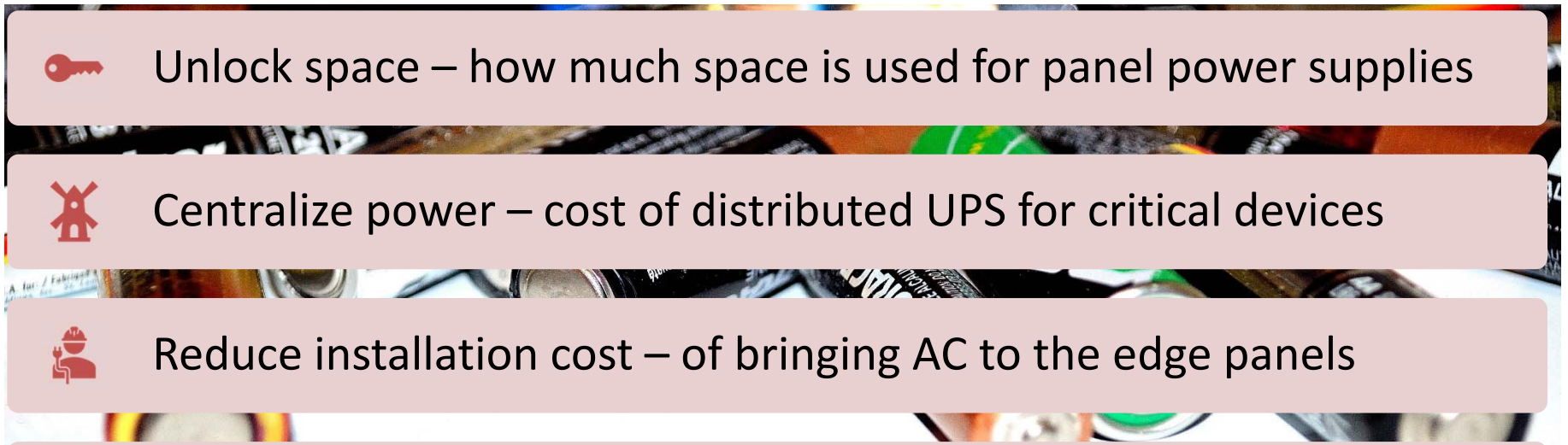
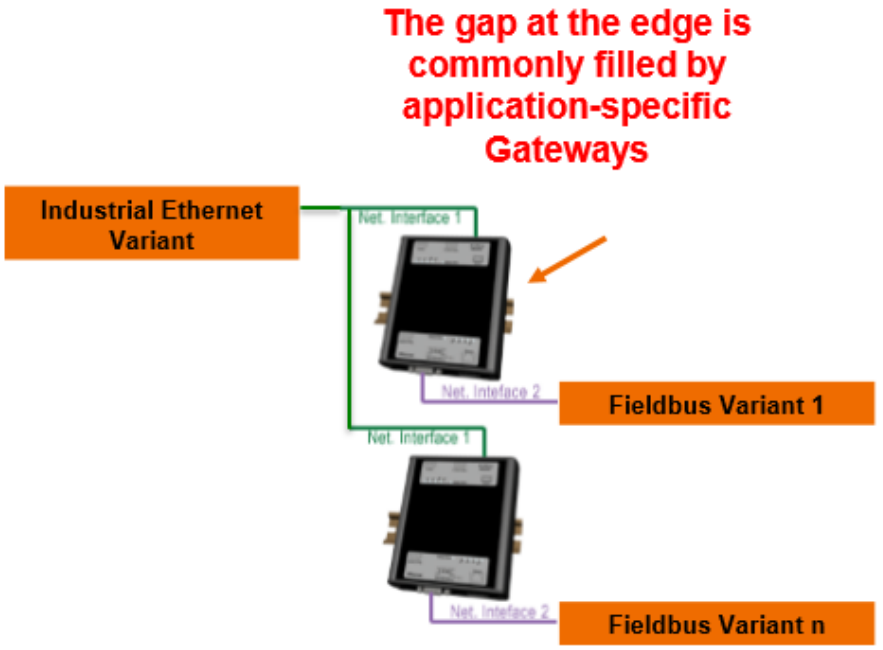


- Unlock space – how much space is used for panel power supplies
- Centralize power – cost of distributed UPS for critical devices
- Reduce installation cost – of bringing AC to the edge panels
- How many IoT devices/sensors use Batteries?

WHAT IF…

Data could be freely accessed without gateways?



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Source: 2017 Industry Conference & 18th Annual Meeting

WHAT IF…

Security on the OT network could be easier to implement?

Application	• Telnet, FTP, https, snmp
Transport	• TCP/UDP
Network	• IP, ICMP, Routing Protocols
Link	• Network Interface, Drivers
Physical	• Device access

Defense in Depth

WHAT IF…

Controls networking expertise could be easier to find?

" Technical limitation and **lack of skilled expertise** is expected to hamper the growth of building automation system market during forecast period 2016-2022.. "

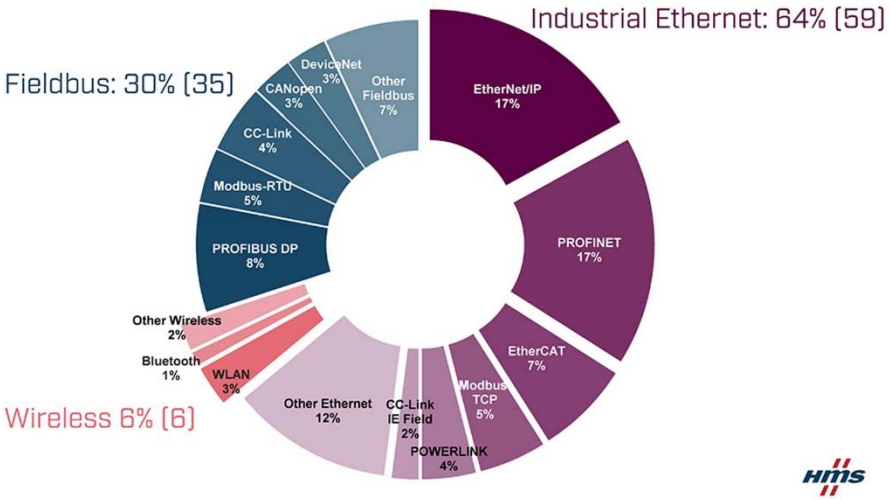
Market Watch, October 2018, marketwatch.com

" In contrast to other industries, where employers cite worries about declining workforce productivity, dynamism and outdated skillsets, the manufacturing industry's greatest concern associated with the aging workforce is "brain drain," the **loss of institutional and technical knowledge**. "

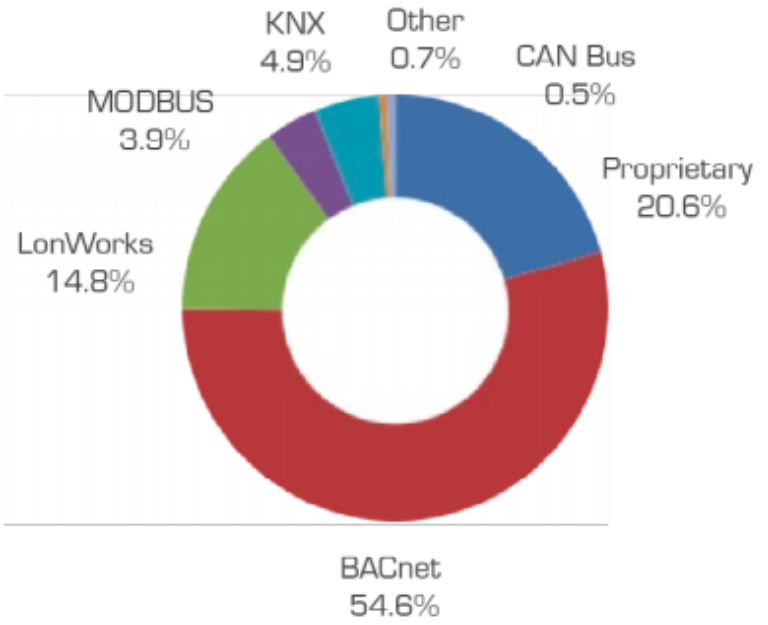
The Aging of the Manufacturing Workforce. Manufacturing Institute. July 2019.

One Protocol to Rule them All

Industrial Automation



Building Automation

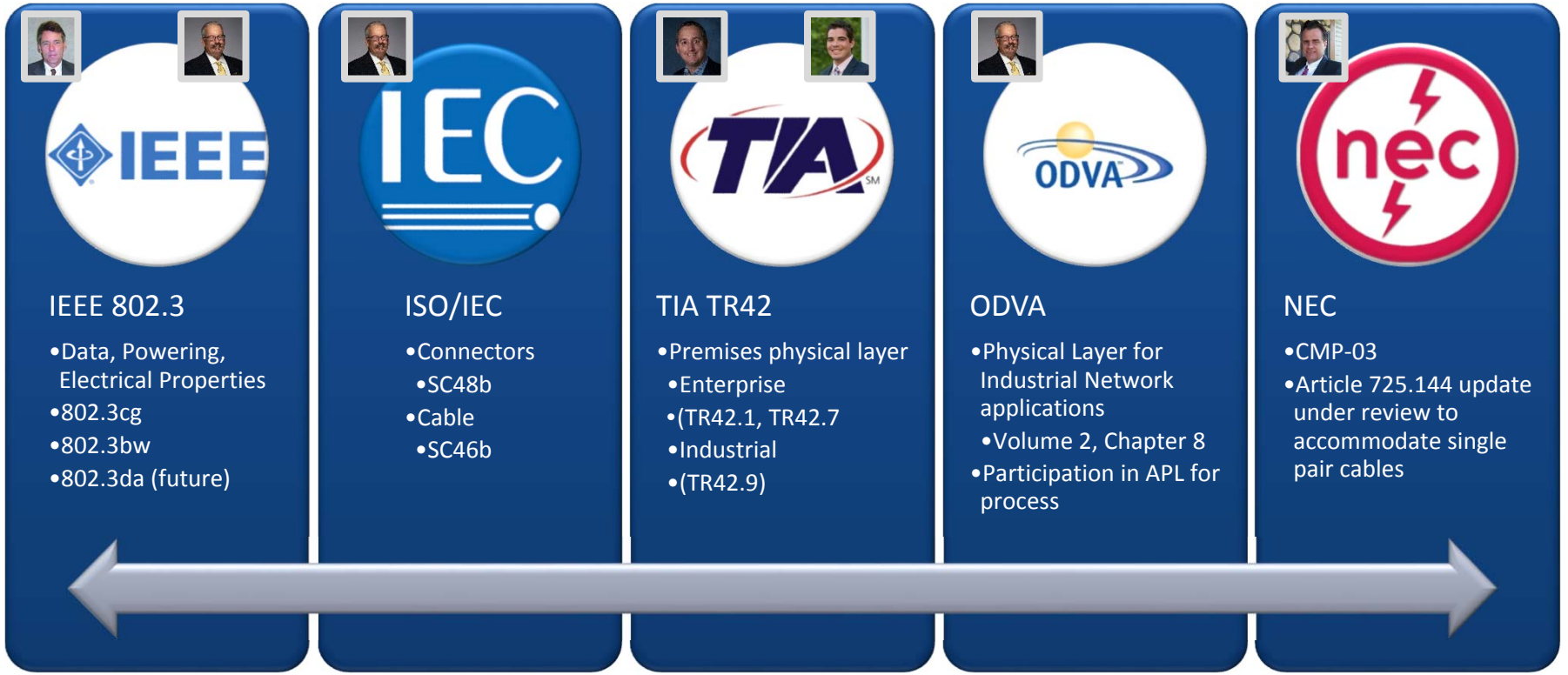


Source: BSRIA, 2017

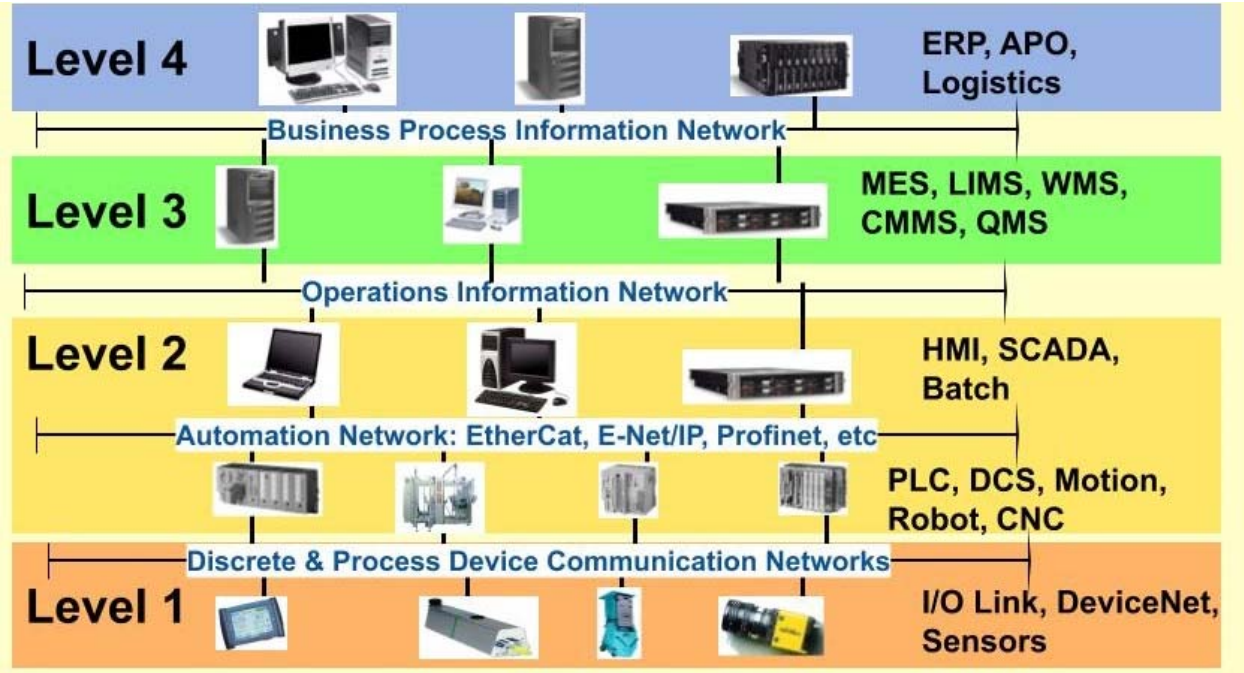
Single Pair Ethernet

STANDARDS & APPLICATIONS

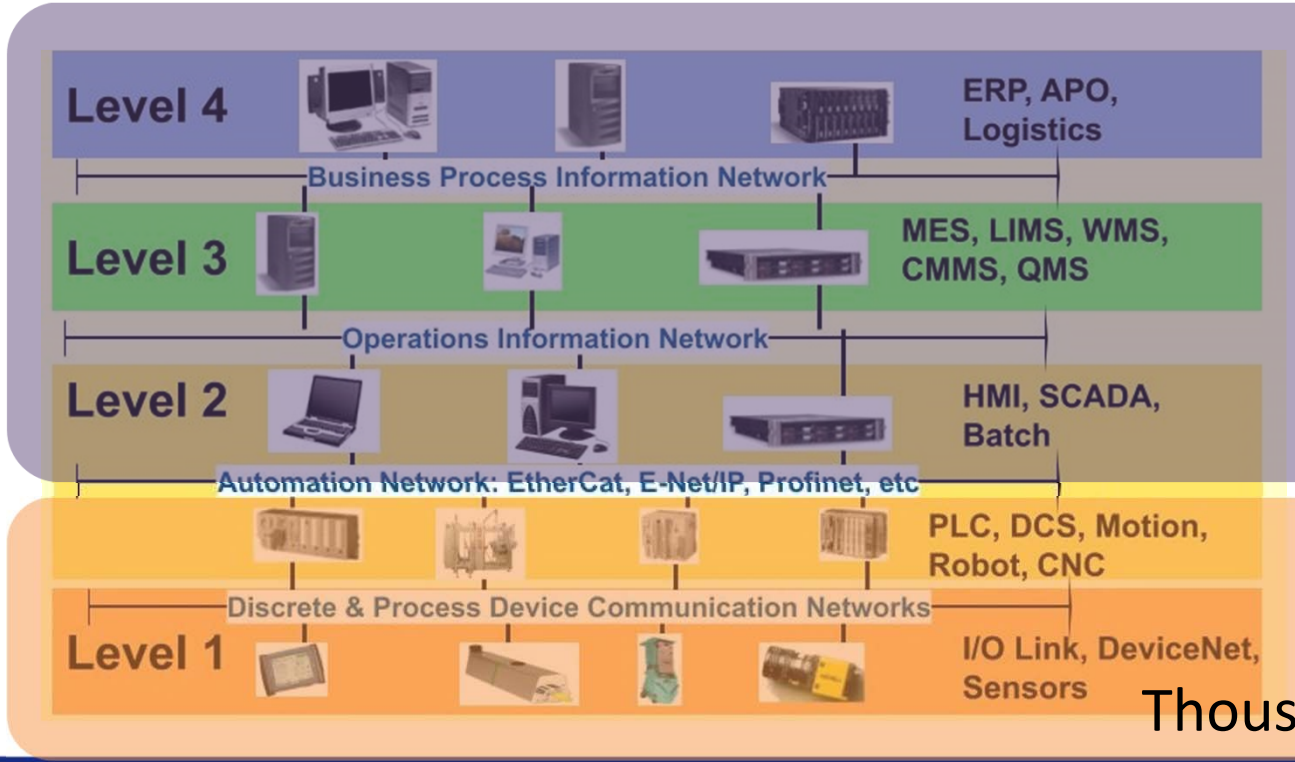
Deep & Broad Industry Leadership on SPE



ISA 95 and Industrial Networks



ISA 95 and Industrial Networks



Already Ethernet

Hundreds of connections

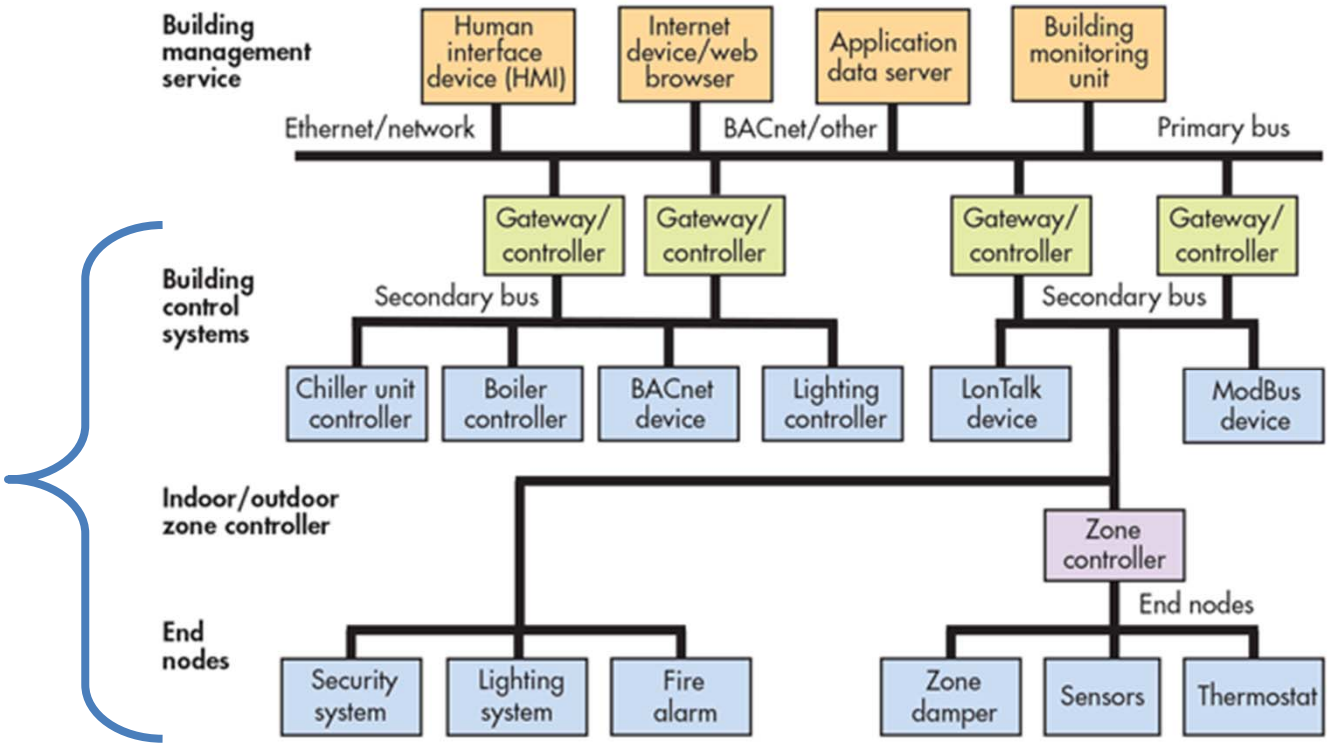
Will evolve to Ethernet

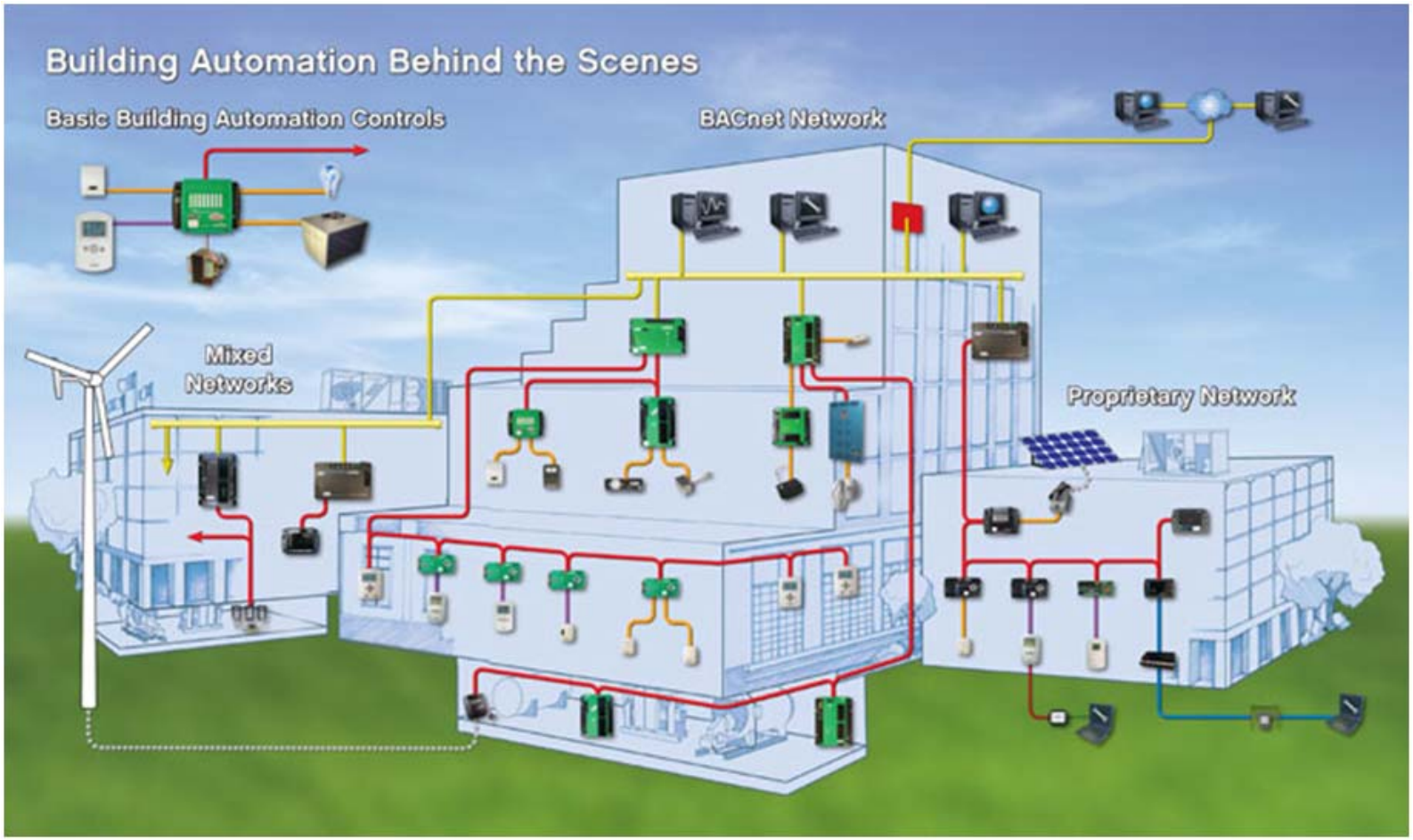
Thousands of connections


Operational Edge Assets

Ethernet to the Edge of Building Automation

A secure, reliable, cost-effective way to bring Ethernet to the field device level




Building Automation Behind the Scenes
Basic Building Automation Controls
BACnet Network
Mixed Networks
Proprietary Network

Case Study

Panduit World Headquarters

- 600,000 feet of 4-pair
- 500,000 feet of 2-wire
- Proprietary gateways for HVAC, glass break, duress, lighting, etc.

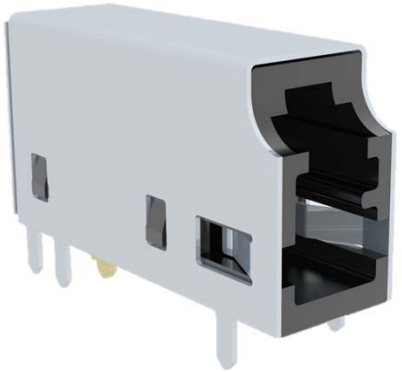
What could it have been?

Single Pair Ethernet

WHAT IS SPE?
HOW DOES IT WORK?

Single Pair Ethernet Overview

- SPE can provide:
  - Power + Data
  - 2 point to point reaches: 15m and 1000m
  - Reuse of 2-wire cable and topology
  - Noise immunity
  - Compact Connector
  - Easy deployment
- Multidrop in the future – 25m and 8 stations

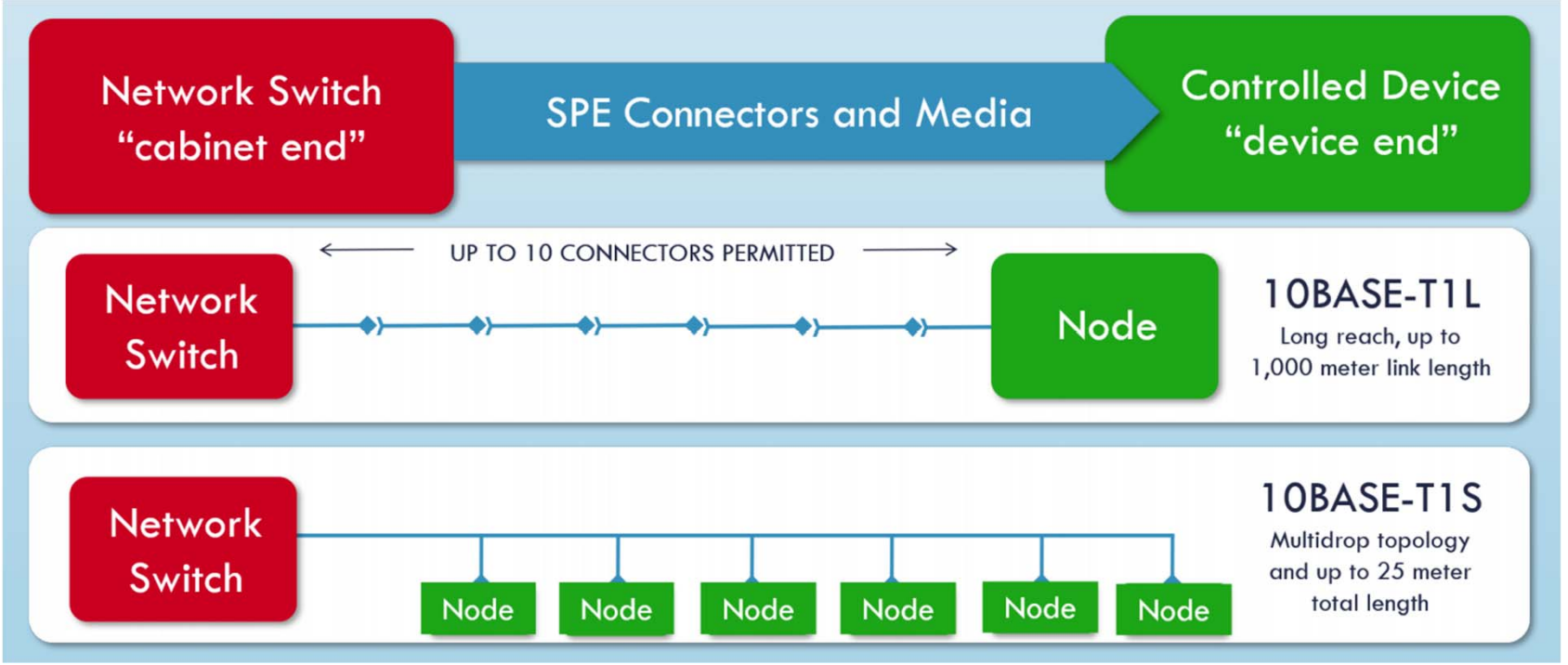


Typical Jack Design

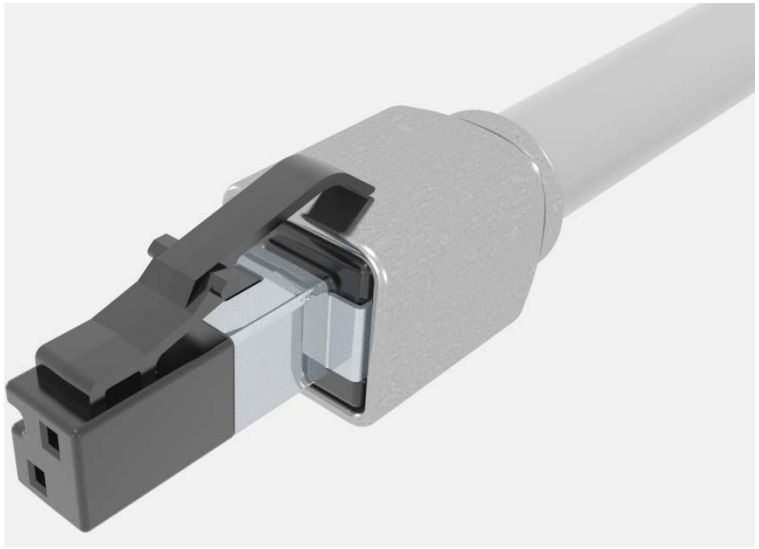
Single Pair Comparison

Protocol	Cable Length	Bit Rate	Power Delivered	Number of Conductors	Connector
10/100/1000/2.5/5/ 10GBASE-T	100 m	10 Gbit, full duplex	Yes, up to 90 W	4 to 8	RJ45
10BASE-T1L	1000 m (2.4 V) with up to 10 joints (terminal boxes)	10 Mbit, full duplex	Yes, up to 60 W	2	LC style IDC connector
10BASE-T1S	25 m with up to 8 connections on one port	10 Mbit, full duplex	No	2	LC style IDC connector
PROFIBUS PA	1200 m	31.25 kbps, bus, half duplex	Yes	2	M12, terminal screw
Modbus RTU and Other RS-485 Profocols	1200 m (up to approximately 185 kbps, at 375 kb 300 m, at 500 kb, 200 m)	Typically 19.2 kbps, bus, half duplex	No	2	DB9, M12
I/O Link	20 m	Max 230.4 kbps, half duplex	No	2	M12
4 mA to 20 mA	>10 km	-/-	Yes, 36 mW	2	Screw
HART	>1500 m	1200 bps, bus, half duplex	Yes, 36 mW	2	Screw

SPE General Topologies



SPE Connectors: IP20



- Approved by IEC SC48B, standardized as IEC 63171-1
- Approved by TIA as connector for Single Pair Ethernet
- Based on fiber optic LC form factor
- Positive latch Engagement
- IDC connection
- **Simple, tool-less field termination**

SPE Connectors: IP67

- IP67 version still in standards definition with ODVA, APL and other bodies
- May have extra pins for positive shield engagement to pin (still 2 wires)

SPE Cable

- 18 AWG, shielded twisted pair cable
  - Cable construction optimized to achieve 1000-meter maximum link distance
  - Shielded to perform in E2/E3 environments
- 23 AWG
  - Can reach up to 400m distance
  - Could be shielded or unshielded

"I've heard talk of cable reuse …"

Cable Reuse for SPE

- Electrically, it **may be possible** to reuse cables that carry legacy protocols today
  - The forces that degrade cable performance are available in abundance in factories
  - Some installed cable is very old
  - Network topologies **may** be compatible, legacy routes versus new SPE routes
- Field test procedures are being developed to determine cable reuse viability

Single Pair Ethernet

WHAT NEXT?

Industry groups coalesce around SPE

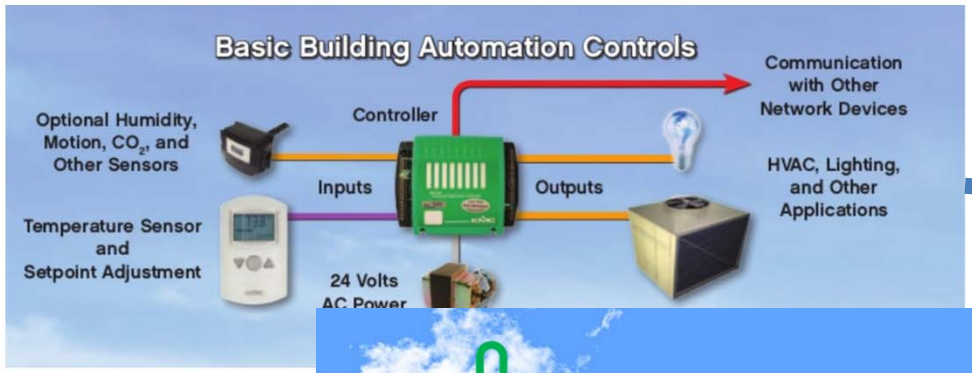
Telecommunications Industry Association (TIA) TR-42

- Develops and maintains Telecom industry standards for cabling infrastructure
- Single Pair Ethernet Consortium (SPEC) to accelerate the adoption of next generation Operational Technology (OT) and Internet of Things (IoT) connectivity

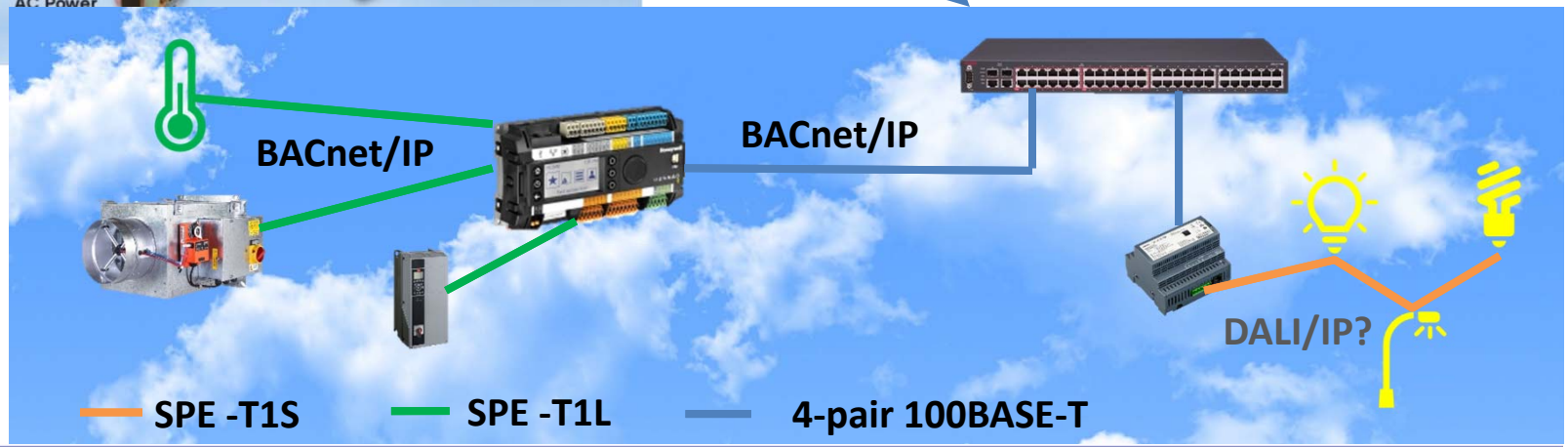
Ethernet Alliance

- Dedicated to the advancement of Ethernet
- Single Pair Ethernet team partnering on content and technology development
- Partnering with OT standards organizations

Evolving from…



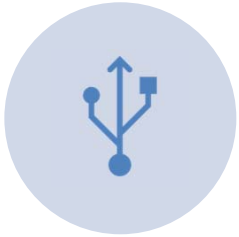
to…



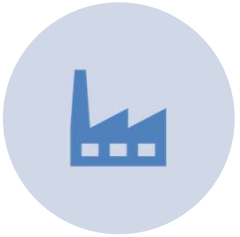
Expect to See

Growing industry support, see www.ethernetalliance.org/single-pair-ethernet and spec.tiaonline.org

Initial use cases to launch in Q1 ’21



Device vendors turning to SPE for simple device connectivity & DC power



Growing importance of Structured Cabling in Ethernet Networks

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