20 Years into Interoperable Communication Standards
Why Aren't We There Yet?

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Why EPRI is involved: purpose of EPRI's AMI research

- **Collaborative research to**
  - Maximize value
  - Minimize risks
  - Improve the feature of AMI
- **Research drivers**
  - Changes in available systems, technology, standards
  - Diverse and evolving regulatory expectations
  - New AMI system uses and value streams
  - Solid state meter performance and reliability

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Research Area: Standards and Interoperability

Description

This research area address utility needs for interoperability at interfaces throughout AMI systems. Activities include:

- Direct participation in standards group to accelerate development and represent utility needs
- Reference implementations, open source
- Interoperability test tools and events

Recent Activities

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~~Current~~ State of the AMI Industry
Desired

- All devices are 100% interoperable

- Easily change from one vendor to another

- Communications are standardized

- Easily mix and match comms, meters, software

- Modular communications components easy to use

- Simple integration of non-AMI assets into AMI network

- Consistent and reliable system interface at the head end

- System integration is trivially simple

- Standardization has reduced costs

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Agenda

- What do we want?
- Where we really are
- A brief history of Ethernet
- What's left to do
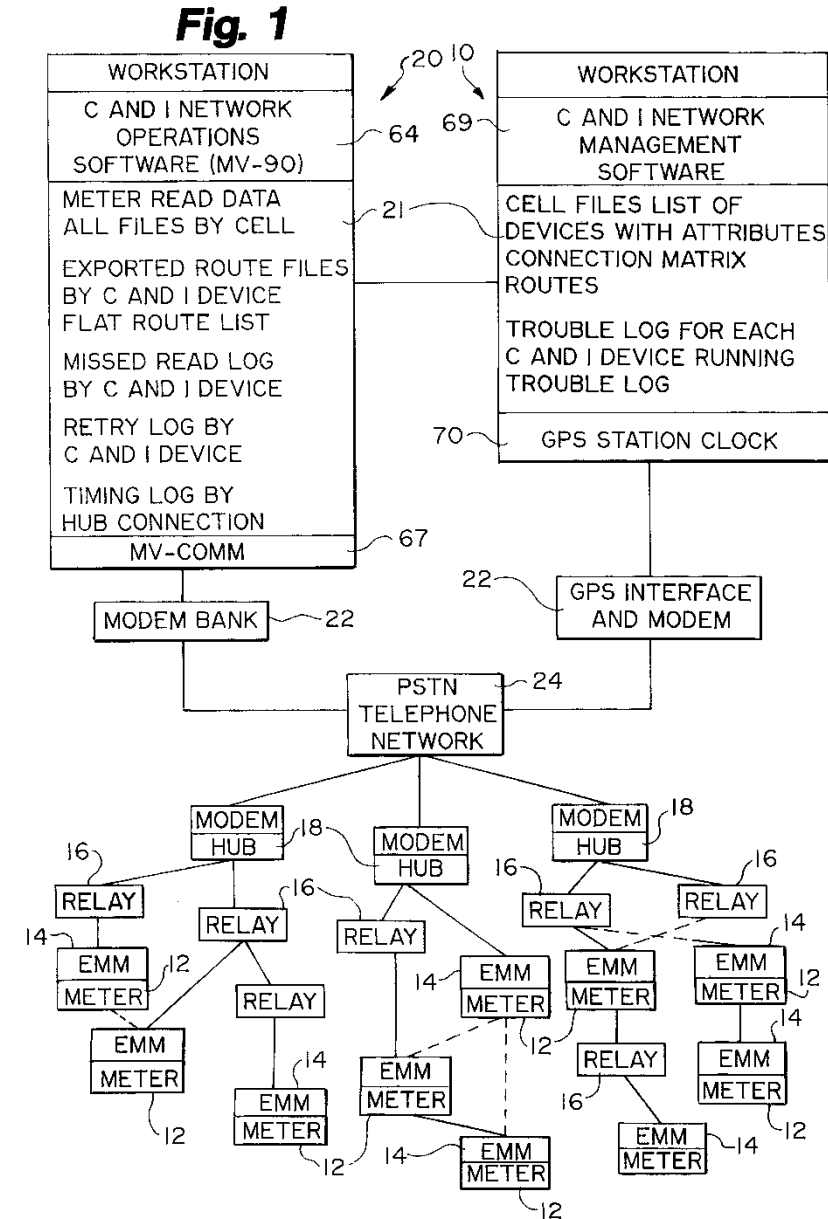- What you can do

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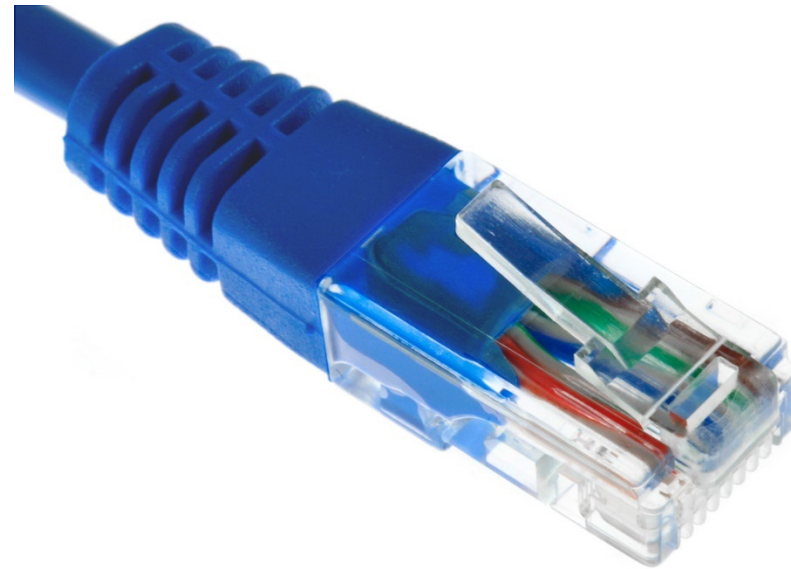
Where we really are
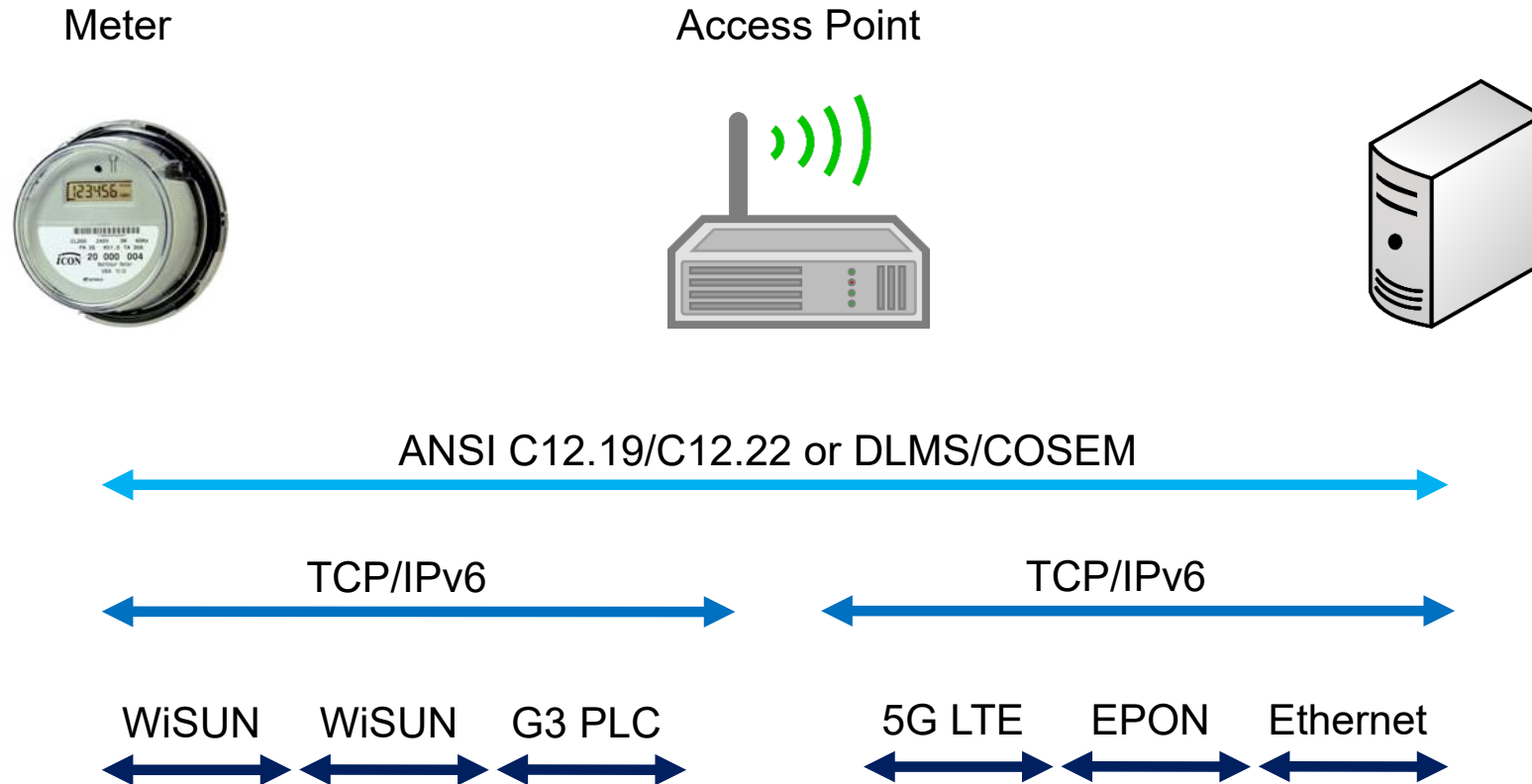
- Standards now exist, but…
  - Conformance testing and certification are largely missing
- There are many possible standards choices…
  - DLMS/COSEM and ANSI C12.19/C12.22 and OSGP
  - UDP v4 and UDP v6 and TCP v4 and TCP v6
  - Wi-SUN and ZigBee and Lora
- The most popular standard is…
  - None (proprietary)
- There are still some gaps in both standards and implementation

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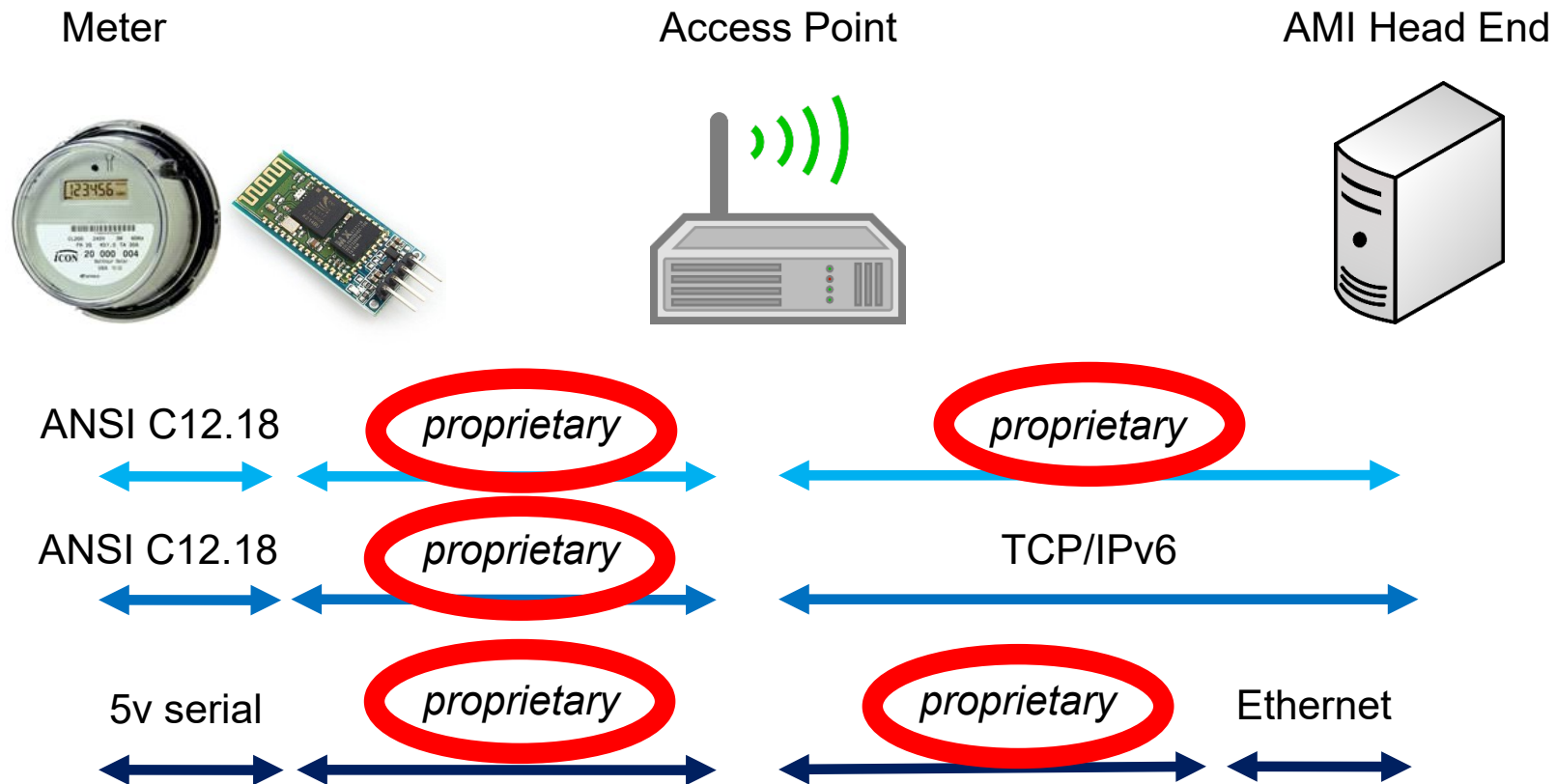
AMI network circa 1998

- Dial-up modems were often part of the system

- All RF portions were proprietary
  - Often one-way (transmit only)
  - Always low bandwidth
  - Security not yet generally prioritized

- ANSI C12.21 (modem standard) was new and not yet widely implemented

- Hand-held-format (HHF) from Itron was not standardized but commonly used

- Network essentially did not yet exist
  - Point-to-point communications only
  - Session-oriented communications generally

Fig. 1

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Theoretical fully standard AMI network

Meter

Access Point

ANSI C12.19/C12.22 or DLMS/COSEM
←——→

TCP/IPv6
←————————————————————→

TCP/IPv6
←————————————————————→

WiSUN   WiSUN   G3 PLC
←——→   ←——→   ←——→

5G LTE   EPON   Ethernet
←——→   ←——→   ←——→

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Actual as-built AMI network

Meter   Access Point   AMI Head End

ANSI C12.18   *proprietary*   *proprietary*

ANSI C12.18   *proprietary*   TCP/IPv6

5v serial   *proprietary*   *proprietary*   Ethernet

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Ethernet – a brief history

- 1973 - Invented by Bob Metcalfe (Xerox)
- Alto Aloha Network ⬜♏■♋◯♏♎ "Ethernet"
  - 2.94MBps
  - CSMA/CD
- 1977 – First patent for Ethernet
- 1980 – 10MBps DEC/Intel/Xerox (DIX) standard published
- 1983 – first IEEE standard (802.3)
- 1985 – 10BASE2 ("cheapernet")
- 1990 – 10BASE –T
- 1997 – Full Duplex/Flow control
- 1999 – 1000BASE-T
- 2004 – Gigabit EPON
- 2017 – 24 GPON

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How is Ethernet like/unlike AMI standards?

Ethernet

- Took 10 years to become a standard
- Process largely vendor-driven
- Some but not all competitors cooperated
- Resulted in a usable standard, but was revised in subsequent years

- Was not reliant on underlying standards
- Implemented and deployed before standardization
- Compliance tests standardized

ANSI C12.22

- Took 10 years to become a standard
- Process largely vendor-driven
- Some but not all competitors cooperated
- Resulted in a usable standard, but was revised in subsequent years

- Is reliant on underlying standards
- Standardized before implementation and deployment
- Compliance tests not standardized

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What's left to do?

- Better security
- Compliance and conformance testing
- Real-world compatibility testing
- Work to address real gaps in standards
- End-to-end linking of standards
- Condensing/harmonization of standards
- More financial incentive for faithful implementation

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What can I do?

- Participate in standards making process
- $upport compliance and conformance testing
- Do your own testing *and share results*
- Help to identify and address real gaps in standards
- Think of the system as *a system*
- Inform yourself about international standards
- When you buy systems and components, consider how your decision will be interpreted

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EPRI Technical Report

- **Toward a World Standard Advanced Meter Application Layer Protocol:** An Analysis of the Current and Possible Future State of the Industry
- Product ID: 3002013398

- https://www.epri.com/#/pages/product/3002013398/

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