Standards and Interoperability

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Where does Interoperability Exist?

- Consider a cell phone (or computer) browser viewing a web site
  - At the physical and data link layer we could use GSM, CDMA, Ethernet, WiFi, other
  - At the transport layer, is it always IP? No. The endpoints (phone and web server) may both support it, but it goes through many translations between (BSSGP, RLC, IP tunnelling, mobile IP, NAT, etc.)
  - At the application layer, it is HTTP

The key to interoperability is at the application layer

Application Layer Protocols

- Already identified standards for AMI (which is a part of the smart grid)

- ANSI C12.19 describes the data structures and content of meter tables
  - includes a straightforward means of encoding many kinds of data
  - was designed for computationally constrained devices
  - includes facility for expansion as part of original definition

- ANSI C12.22 describes how to communicate table data over networks
  - includes a generic mechanism for reading and writing tables
  - includes a very robust security mechanism that provides confidentiality, integrity and authentication
  - described in component form for scalability

Another web analogy

- ANSI C12.19 ←→ HTML
  - both include languages which describe the structure of the data and how their domain information should be **interpreted**.
  - both presume a means of delivering this information which lies below

- ANSI C12.22 ←→ HTTP
  - both describe mechanisms by which their domain information should be **transported.**
  - both presume that there is an underlying mechanism for actually sending and receiving packets

C12.22 over IP

- Just as HTTP can be used over IP, so can C12.22
  - In fact, we can and do use it exactly that way
  - Testing shows that it's fast, even over high latency links
  - In the same way that using HTML but not HTTP would be strange and only quasi-standard, choosing C12.19 but not C12.22 (or C12.18 or C12.21) would be strange.
  - What standard will you use to transport C12.19 tables?

The Role of Standards

- Standards Development Organizations such as ANSI, IEEE, and IEC create true standards. E.g. ANSI meter socket standards, IEEE
- With computers, there are mostly industry standards (ATX, USB, PCI, Infiniband)
- In some cases, as with IETF, they're not quite either. There are over 5000 RFCs, but very few (68 to date) ever become internet standards.

- Do standards of any type address all questions?
- Are standards alone sufficient to ensure interoperability of all devices?
- How does real interoperability actually get created?

How Does Real Interoperability Happen?

Example: Comms board from company A in meter from company B

1. Companies start with standards (C12.19 tables, C12.21 or C12.22)
2. Then soon get to details not covered by any standard
3. Details always include a cost component

There is no end-to-end standard that exists today that covers everything.

How is AMI Different from IT?

- Meter design considerations include:
  - cost
    - typical cost of a networked smart meter today is less than $100
    - don’t forget about operational costs!
  - power consumption
    - ANSI C12.1 (and IEC 62053-61) state that the maximum energy consumption for multifunction meters must be no greater than 5W
    - by contrast, typical laptop microprocessor *only* consumes over 30W
  - environment
    - must operate in -40C to +85C range
    - thermal considerations for internal heating

How is AMI Different from IT (cont.)?

- Meter design considerations also include:
  - longevity
    - meters are expected to work for years, unattended and outdoors without intervention
    - meter cost is typically less than the cost of sending a truck & crew to visit it
  - remoteness
    - enterprise server is typically located in server room
    - meters are always far away and are much less well connected than servers
  - regulatory
    - environmental and electrical standards
    - regulatory requirements for time accuracy
    - security requirements in some jurisdictions
  - physical security
    - head end server is usually installed within a physically secured room, within a temperature and access controlled building, often with backup power
    - none of these are true of a typical meter

NIST SP 800-82

- title is “Guide to Industrial Control Systems (ICS) Security”
- formerly “Guide to SCADA and Industrial Control Systems...”
- title change mirrors shift in emphasis, but still relevant for some AMI systems which include control elements, e.g. remote disconnect
- “ICS have **unique performance and reliability requirements** and often use operating systems and applications that may be considered **unconventional to typical IT personnel**. Furthermore, the **goals of safety and efficiency sometimes conflict with security** in the design and operation of control systems.” -- (emphasis mine)
- I would also add **cost** and **energy usage** restraints

Questions and Answers

- Any questions?
  - My contact information:

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Thank you