Industry-Level Architecture Development: Integrating the Developing Infrastructures

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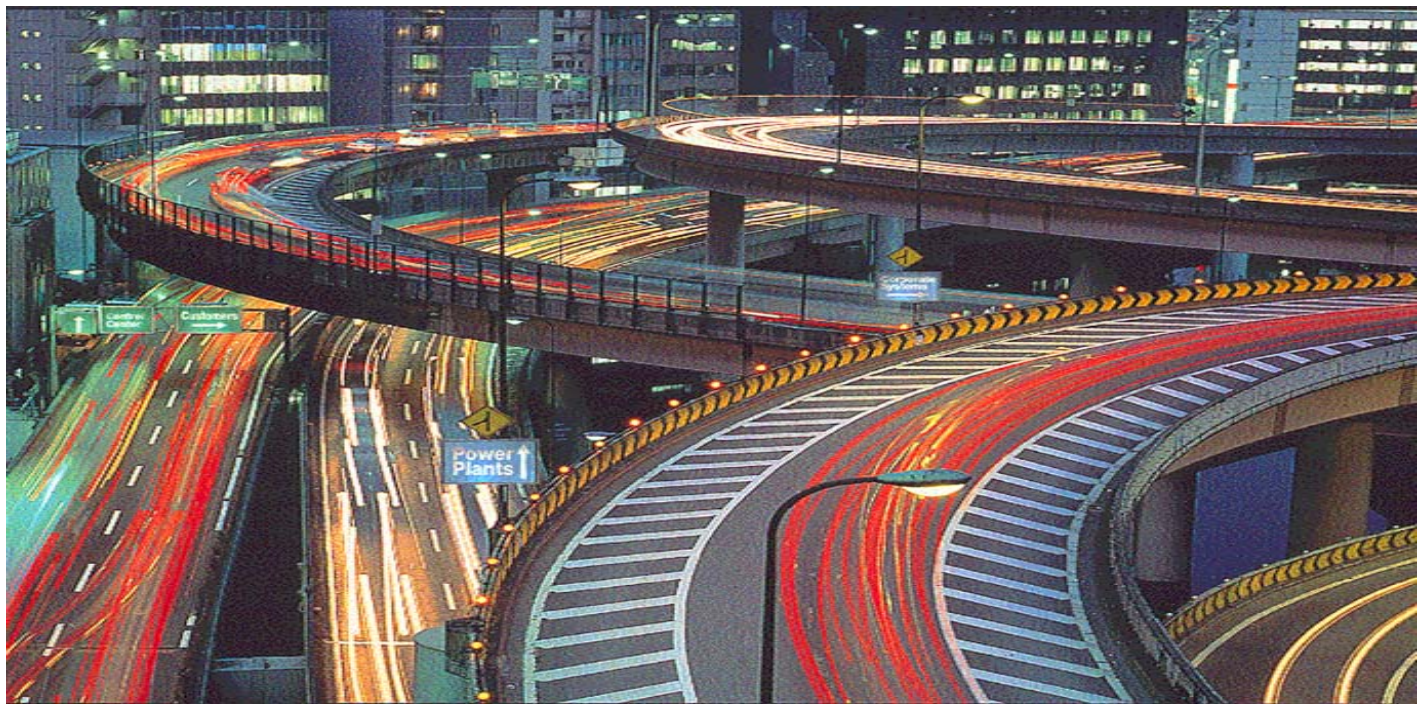
Developing System Architecture

- Definition of an “Architecture”
  - Defines the overall structure, organization, performance and management of a distributed computing system
  - Enables:
    - Analysis of system-wide technical and business issues such as interoperability, scaleability, management, security and related technical infrastructure
    - Communications among stakeholders

What is an Industry Level Architecture?

Architecture: The Structure of Components, their relationships, and the principles and guidelines governing their design and evolution over time*.



*DoD Integrated Architecture Panel, based on IEEE Std 610.12

Drivers behind Architecture Development

- Systems development lack an overall enterprise-wide implementation perspective
- Infrastructure is underspecified
  - Unable to scale up from demonstration “pilots”
  - Major issues not addressed systematically
    - Integration across the enterprise
    - Integration across the industry
    - Data sharing, hardware resource sharing
    - No Integrated System Management
    - “Stovepiped” systems
    - Disparate Standards Initiatives

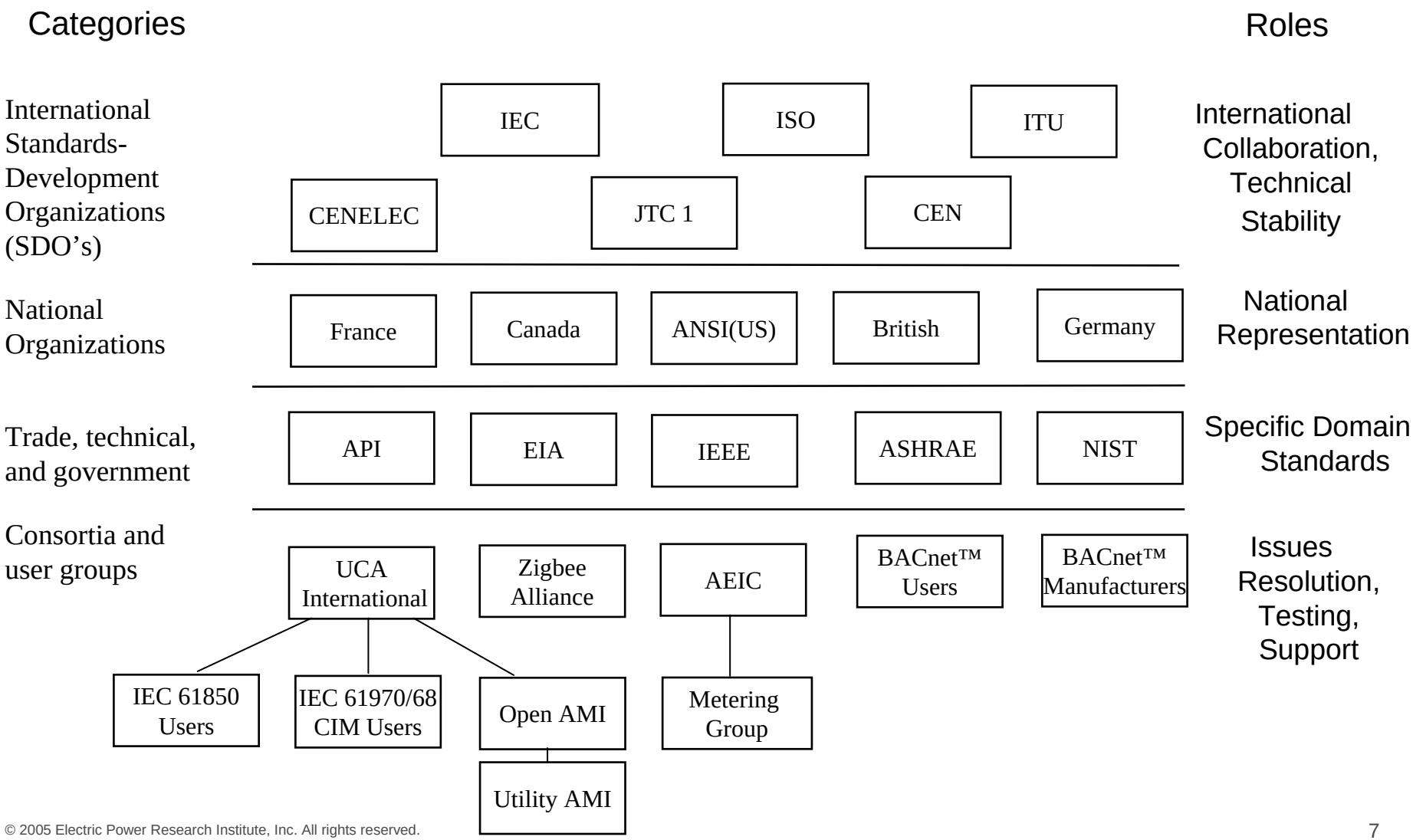
Need For Architecture Level Development

- Applications cut across traditional technical domains:
  - Real Time Systems and Information Technology
  - Generation, Transmission, Distribution, Consumer Systems Integration
  - Standards need to be more rigorously integrated as they develop
  - Cross Industry Integrations are necessary:
    - Communications and Advanced Automation
    - T&D operations and Building Automation
    - In Building Integration, HVAC, Appliance, Consumer Electronics

Architecture Challenges

- Technical Discipline of Architecting Large Scale systems still seeking to mature
- Standards for Architecture Development in development
- Standardized Notation(s) known as “Architecture Definition Language” are still under development
- Developing Standards at a component level is inadequate for future higher levels of integration

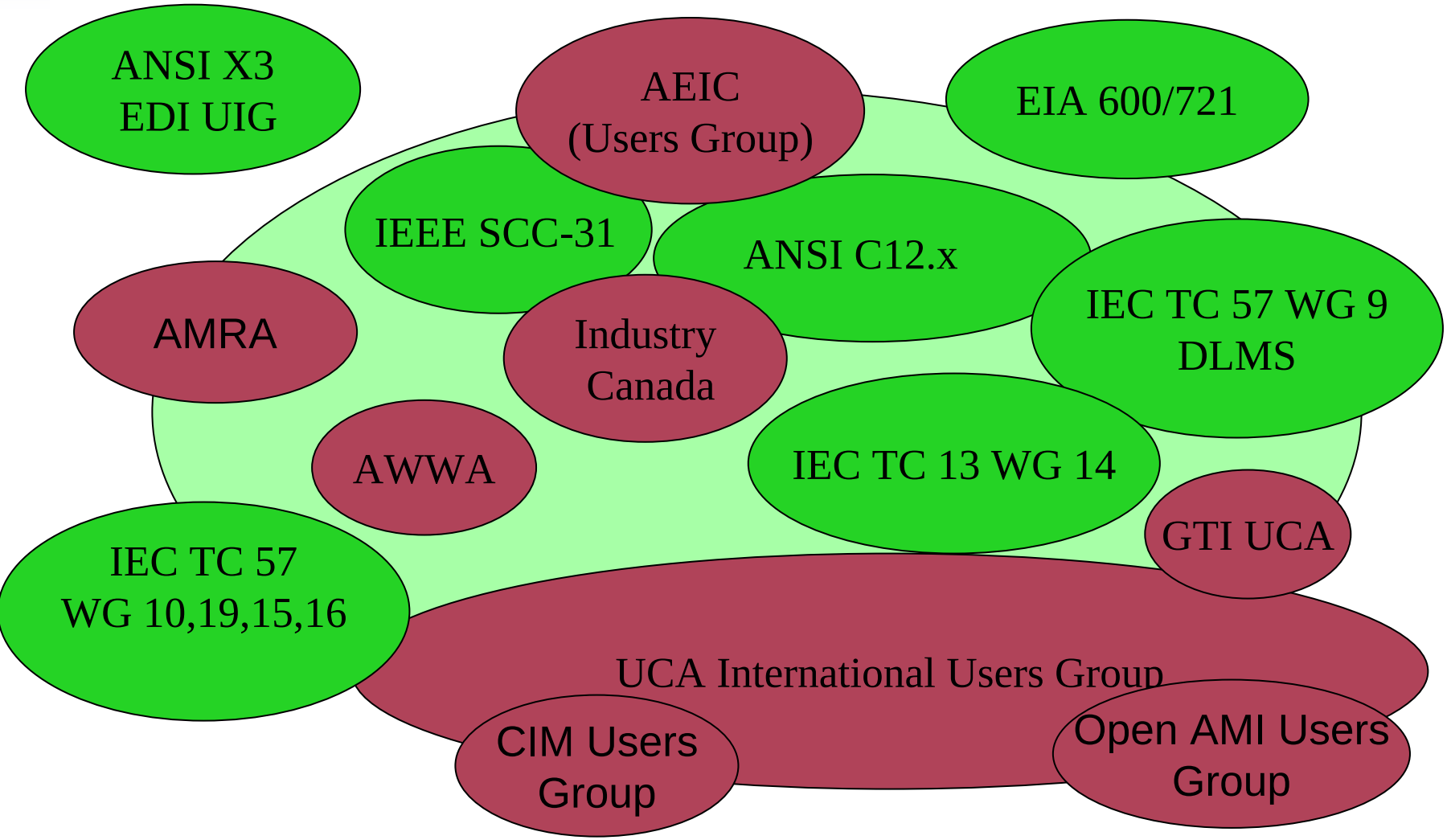
Sample of Key Standards Development Organizations and Consortia



IEC TC57 Working Groups

- WG 3: Telecontrol protocols
- WG 10: Power system IED communication and associated data models
- WG 13: Energy management system application program interface (EMS - API)
- WG 14: System interfaces for distribution management (SIDM)
- WG 15: Data and communication security
- WG 16: Deregulated energy market communications
- WG 17: Communications Systems for Distributed Energy Resources (DER)
- WG 18: Hydroelectric power plants - Communication for monitoring and control
- WG 19: Interoperability within TC57 for the Long Term
- WG20: Planning of (single band) power line carrier systems (IEC 60495), Planning of (single sideband) power line carrier systems (IEC 60663)

Revenue Metering Standards Development Initiatives: “The Radar Screen”



Home “Automation” Standards...

1985 → 2007

X-10™
CEBus©
LonWorks™
Smarthouse™

“Digital Convergence”

- X-10™
- CEBus©
- Lonworks™
- Smarthouse
- Firewire
- CAL/HPnP
- Home RF
- Bluetooth
- SWAP
- WLIF
- Home PNA
- Home API
- HES
- SNAP
- HOP
- UPnP
- ATM RBB
- Jini/Java
- HAVi
- OSGi
- IRDA
- VESA
- WLIF
- SOAP

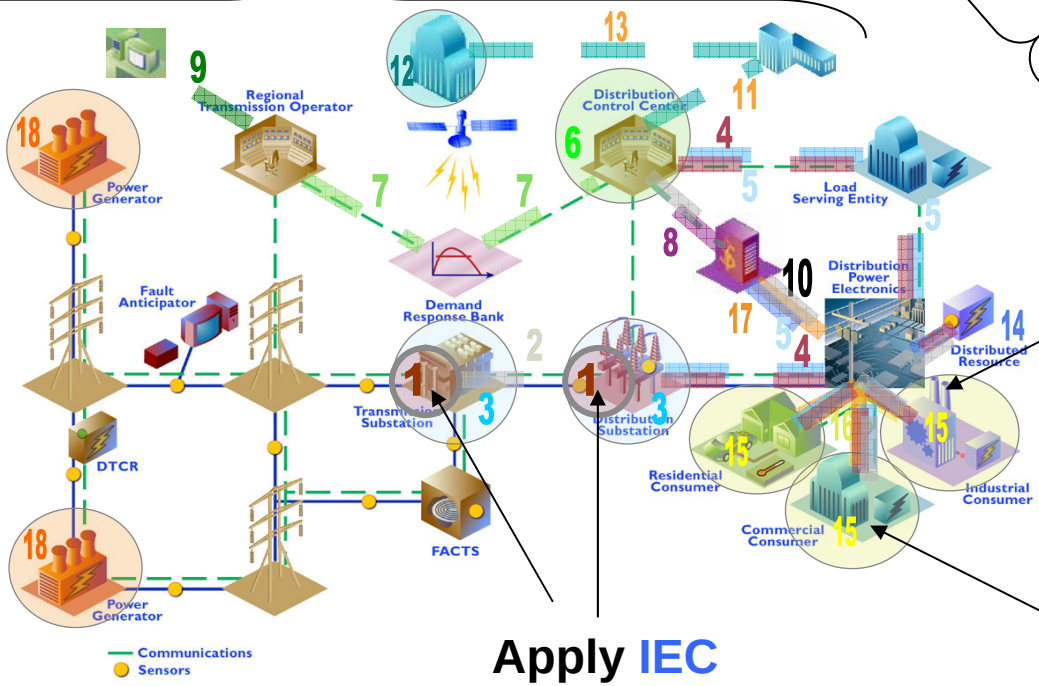
HomePlug
Zigbee
UWB
AHAM
CHA
Ethernet
IPvX
WSDL
UDDI
XML
EIB
Konnex
BACnet
HomeGate

Examples of Intelligrid Architecture Recommendations

Develop and implement consistent systems management and security policies

Apply IEC 61970 and 61968 (CIM, GID) for Enterprise Data Sharing

R&D: Harmonize IEC 61850 and 61970 Standards



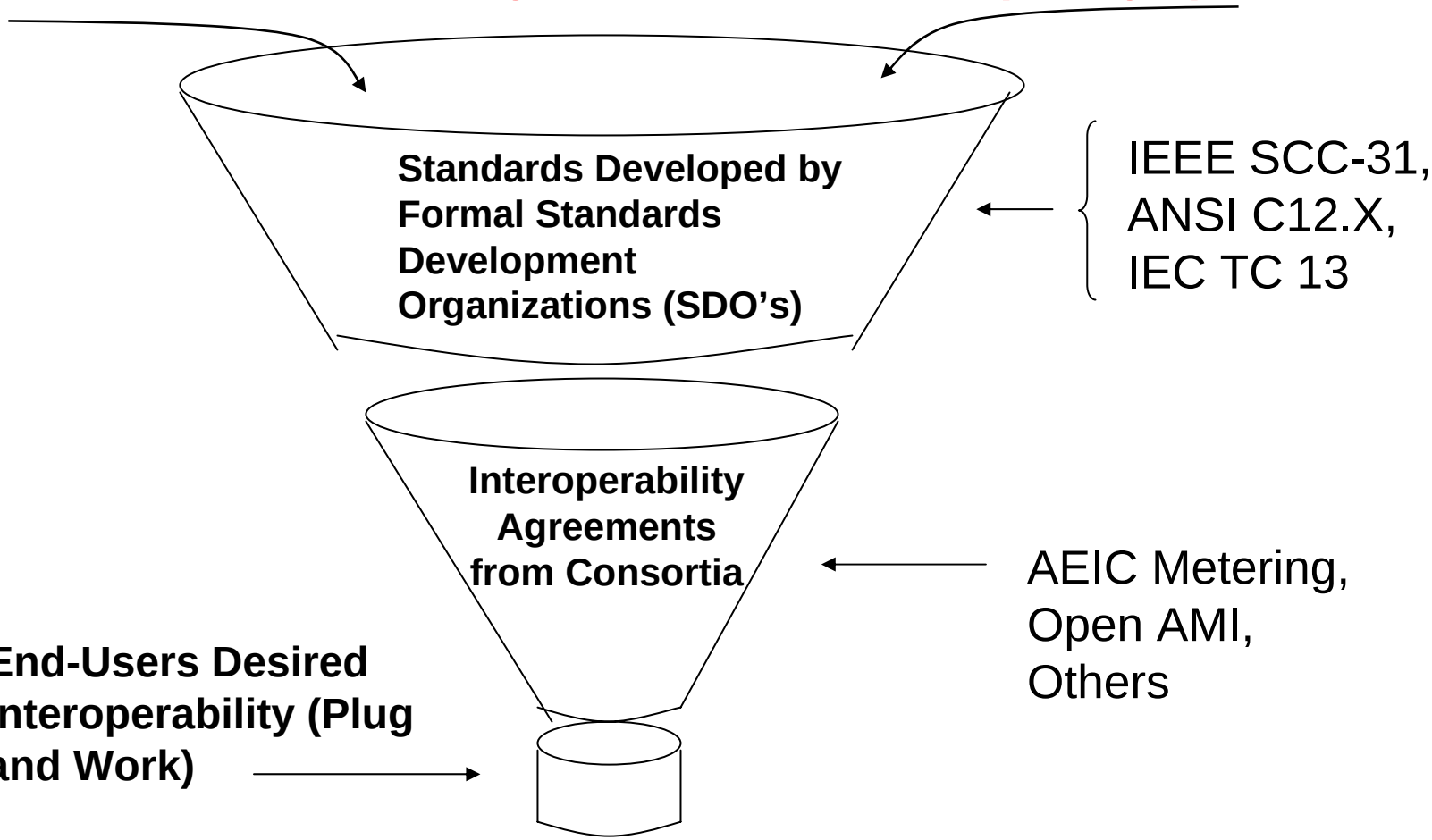
Apply ANSI C12/COSEM for Revenue Metering

Apply IEC 61850 for Real-Time Controls

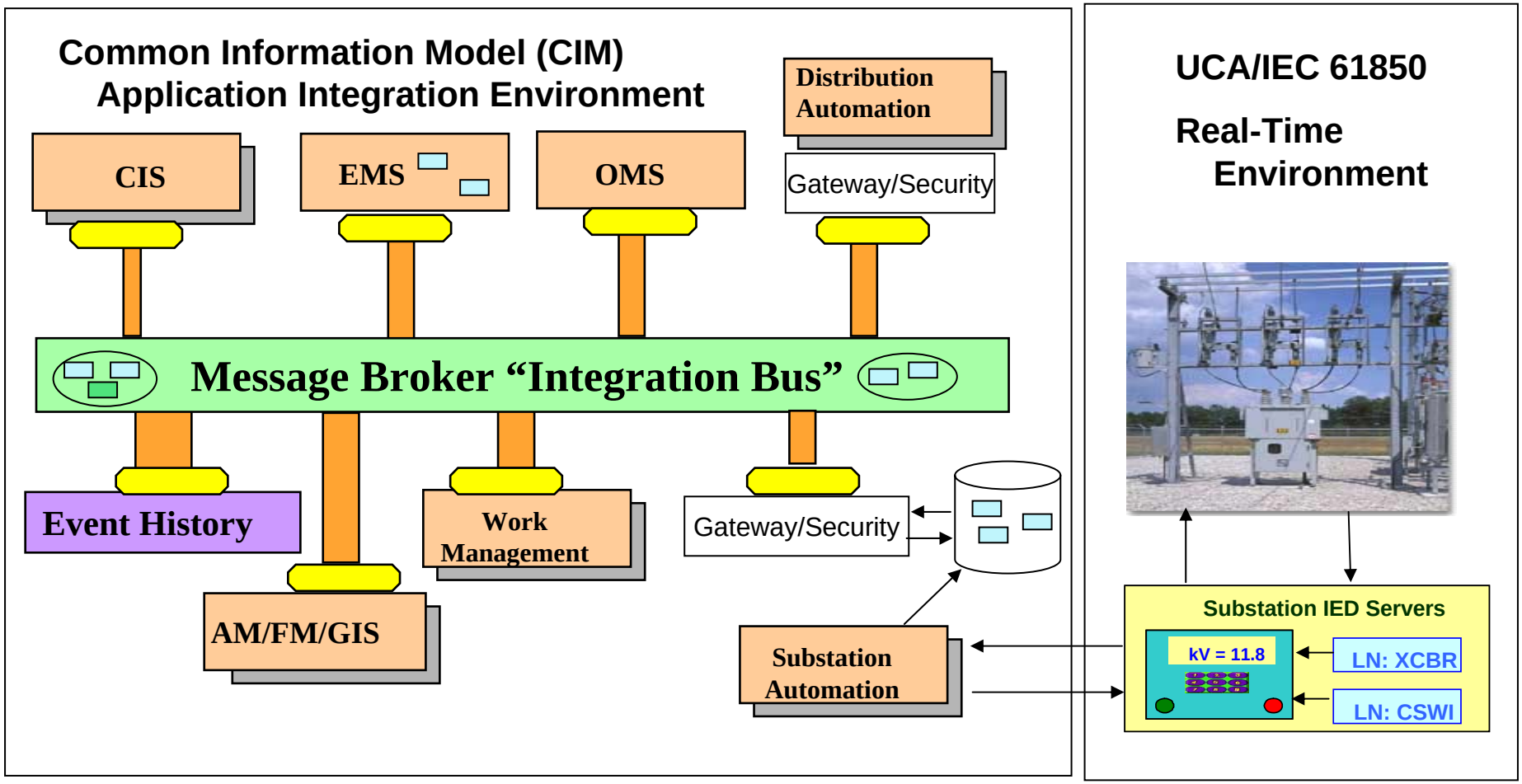
Apply ASHRAE BACnet™ for Building Automation

A Standards Development Model

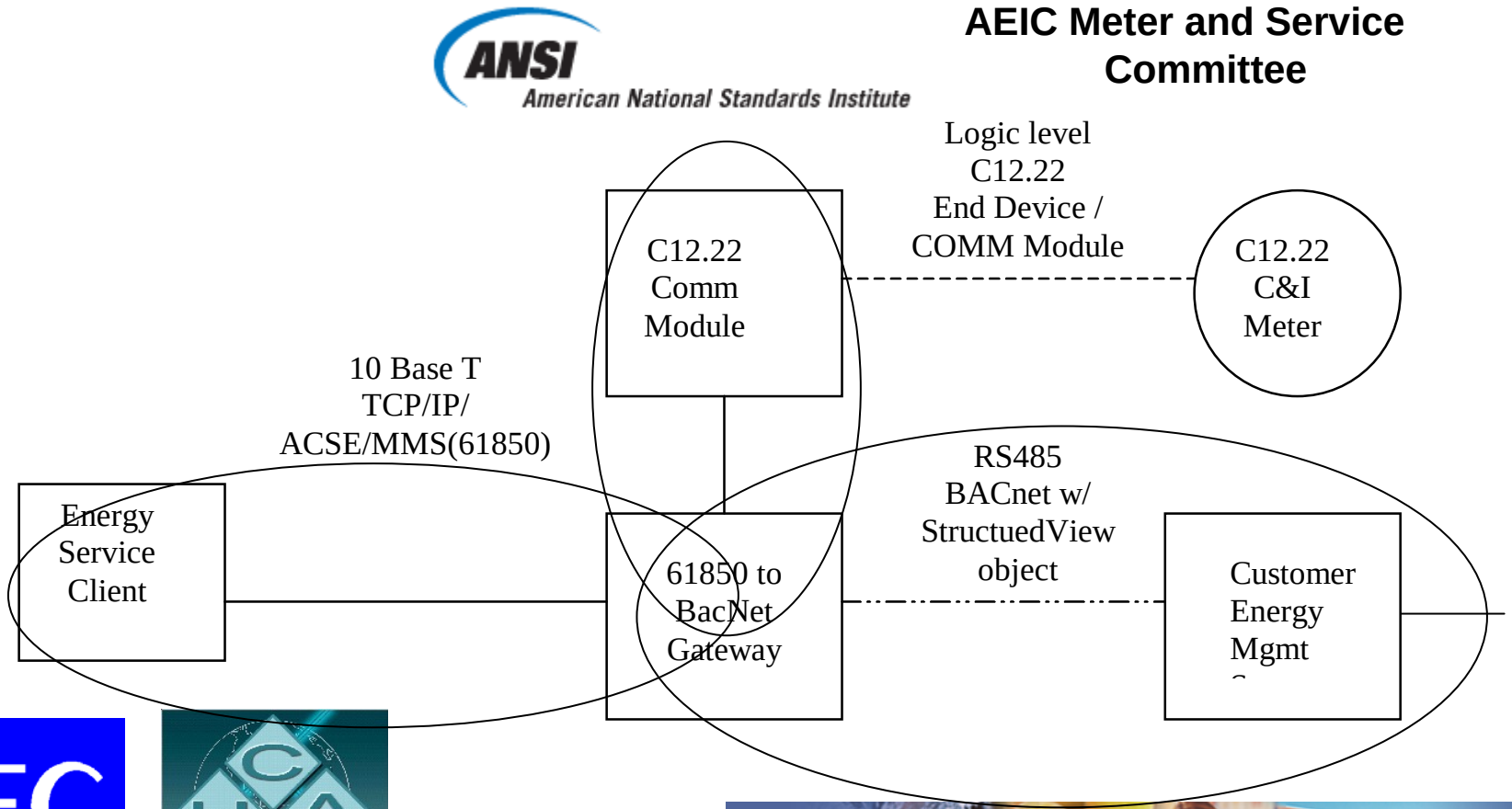
Universe of networking and distributed computing options



Example 1: EPRI P 137.018 Project: Enable integration between Advanced Automation and Information Technology Environments

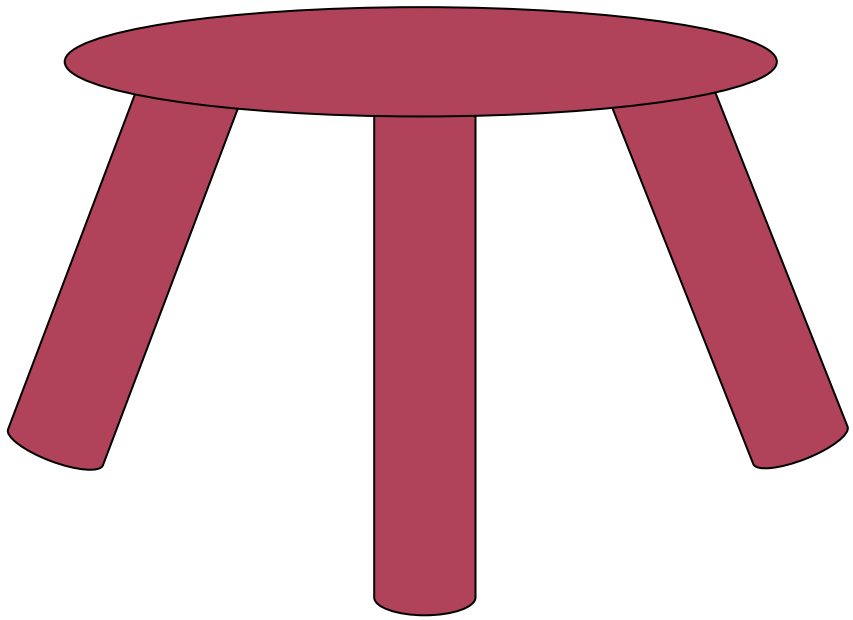


Example Project (2002) "Gateway" Implementation: Integrating Major Metering, Utility and Building Automation



Three Necessary Ingredients for Successful Interoperable Systems Development

Three Legged Stool: For Interoperable Products



1) Open standards: Protocols, test schemas, object models

IEC TC57, ANSI C12, ASHRAE SPC135, Other

2) Involved User Group: Interoperability Agreements, Labeling, Testing, Marketing

UCA International, BACnet Mfgs. Assoc. Assoc. of Edison Illuminating Cos

3) Reference implementations and Designs: Developer Tools, Standards Implementations and test implementations

AMRTools, openAMI, …

Examples of Intelligrid Architecture Recommendations

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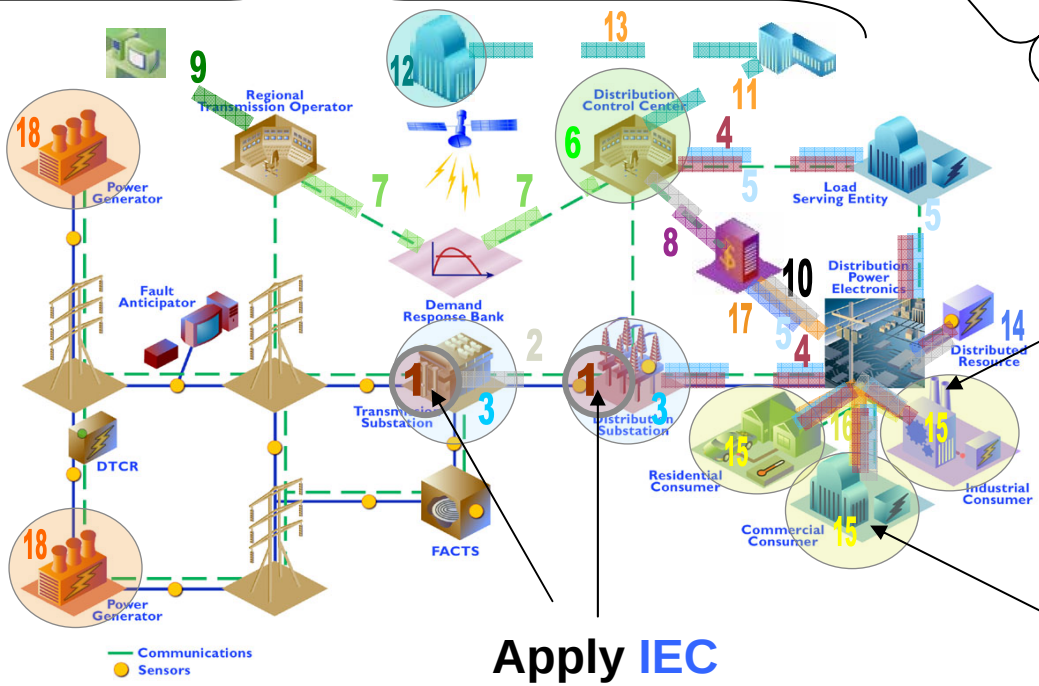

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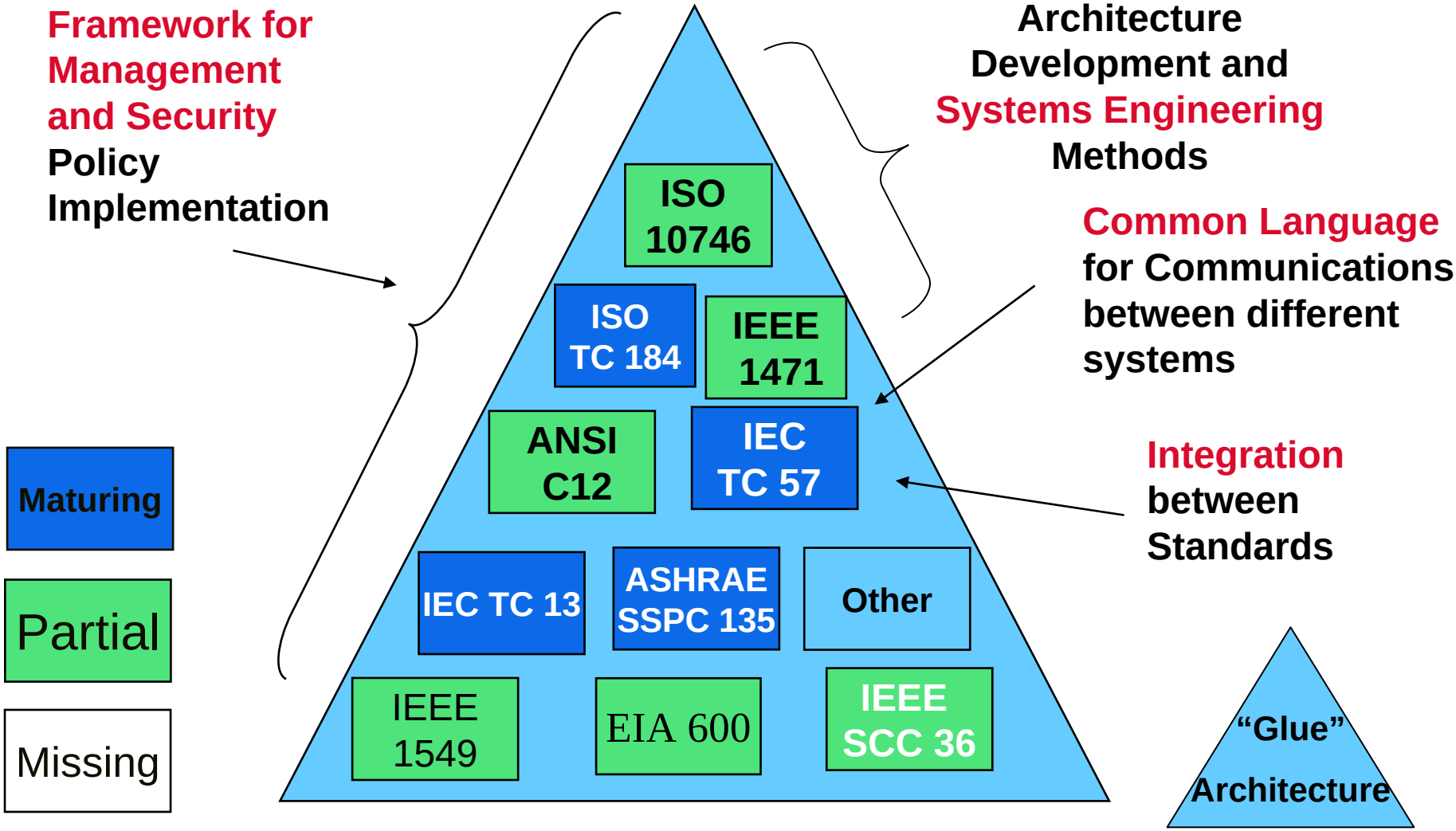
Industry-Level Architecture Seeks to Integrate Standards



Several Disciplines Need to Come Together

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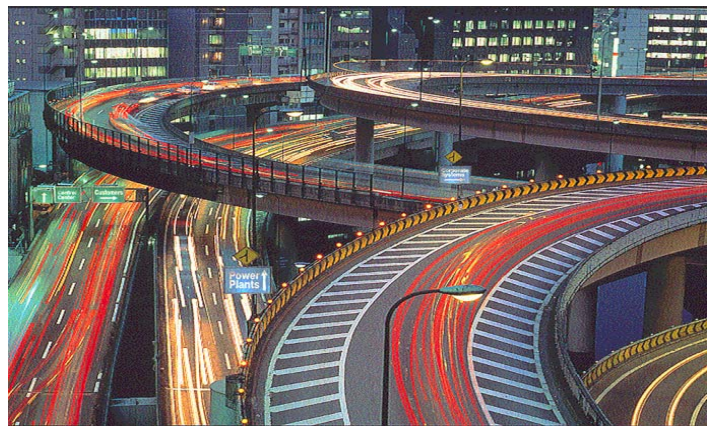

Work is needed in key areas:

- System Operation and Protection Applications: Necessary to operate closer to limits, need to integrate data and applications across Gen,T&D, Consumer Comm
- Need to integrate Dynamic Consumer Energy and Demand Response
- Need for a robust application level common language that can cut across the major technical domains
- Need advanced Systems Engineering Methods that are capable of massively scaled and robust systems
- Need a Roadmap
- Need to work Cooperatively