Wide Area Networks (WANs)
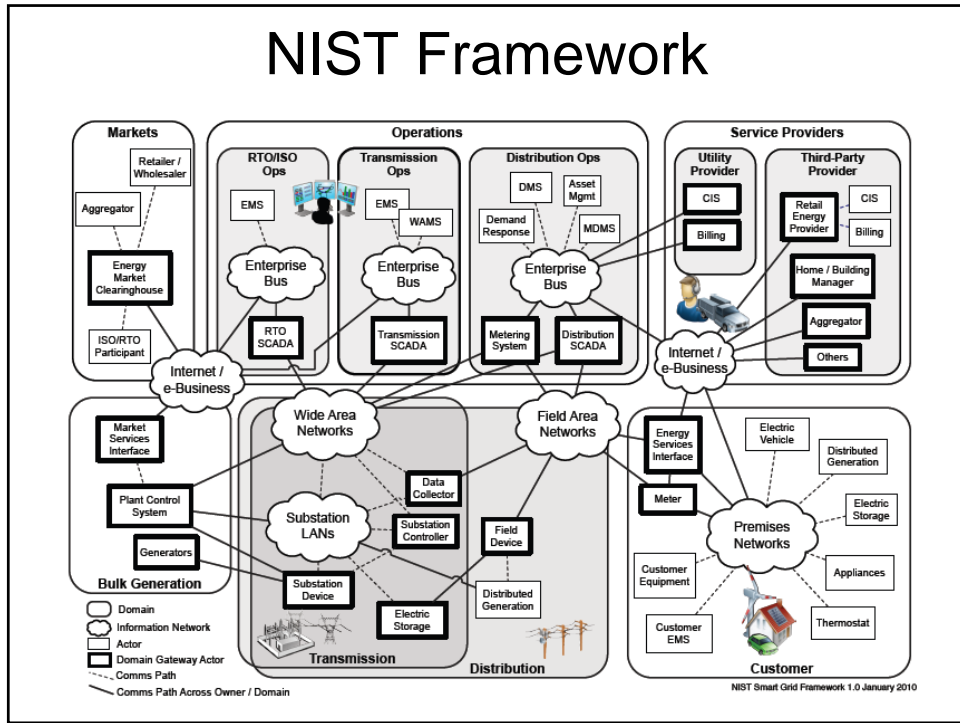
CS 687

University of Kentucky

Fall 2015

Outline

- WAN
- Fiber Optical Network
- SONET
- WiMAX

NIST Framework

NIST Smart Grid Framework 1.0 January 2010

End-to-End Smart Grid (High-Level Taxonomy)
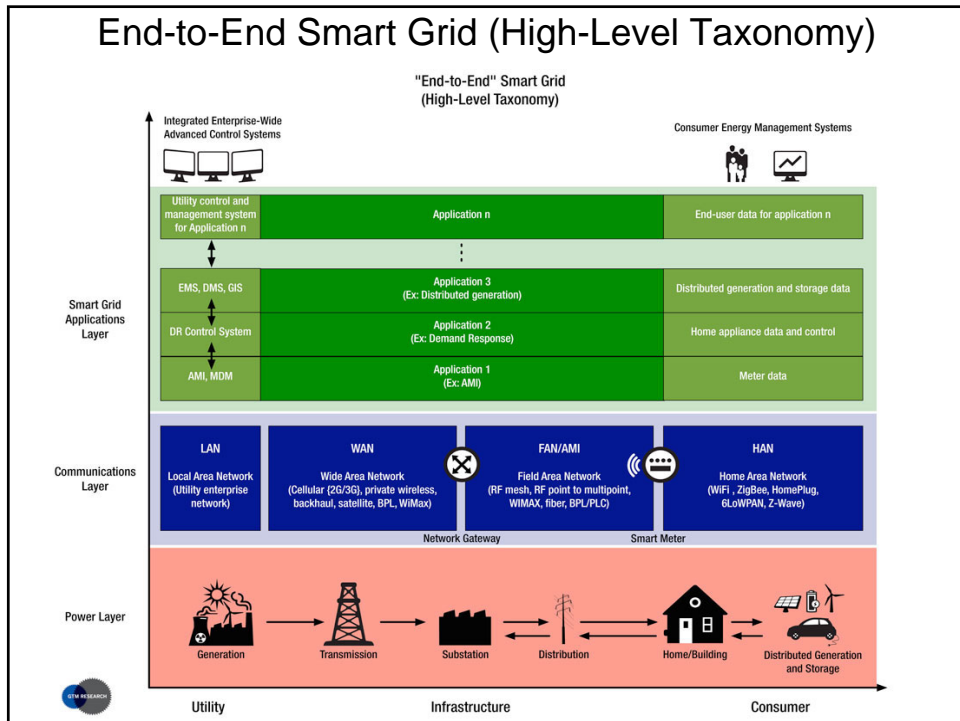
Wide Area Networks

- A wide area network (WAN) is a telecommunication network that spans a large geographical area (i.e., any network that links across metropolitan, regional, or national boundaries).
- Examples of WANs
  - ISDN
  - X.25
  - Frame Relay
  - ATM
  - SONET (Synchronous Optical Network)
  - WiMAX

Fiber Optical Networks

Fiber Optics

- Fiber Optics are cables that are made of optical fibers that can transmit large amounts of information at the speed of light.
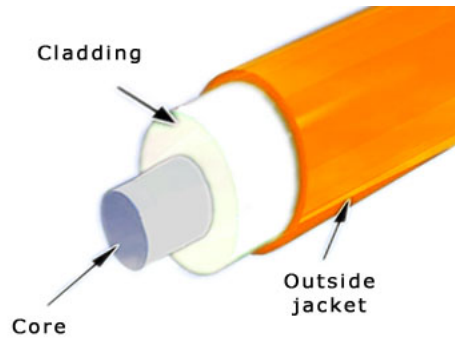

The Cable

- Fiber Optic have three major characteristics
  - Composed of fibers either glass or plastic and sometimes both

  - Are very flexible

  - Have different tips

Components

- Outside Jacket
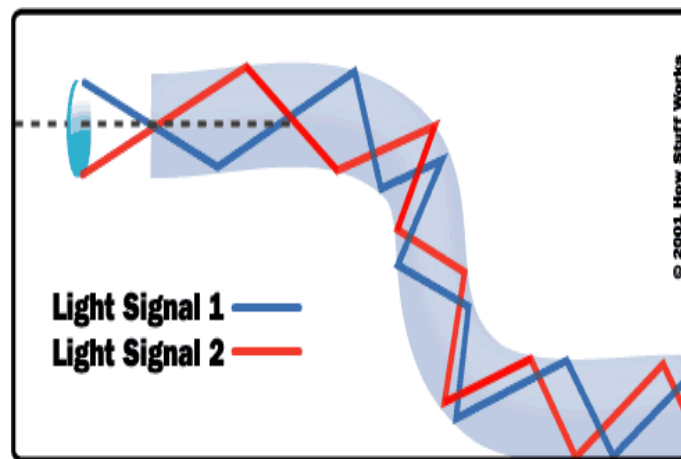
- Cladding

- Core

Glass Fibers

Characteristics

- Glass Core

- Glass Cladding

- Ultra Pure Ultra Transparent Glass

- Made Of Silicon Dioxide

- Low Attenuation

- Popular among industries

Total Internal Reflection in Fiber

Light Signal 1 ——
Light Signal 2 ——

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Advantages of Optical Transmission

- Large bandwidth permits high data transmission, which also supports the aggregation of voice, video, and data
- Technological improvements are occurring rapidly, often permitting increased capacity over existing optical fiber
- Immunity to electromagnetic interference reduces bit error rate and eliminates the need for shielding within or outside a building
- Glass fiber has low attenuation, which permits extended cable transmission distance
- Light as a transmission medium provides the ability for the use of optical fiber in dangerous environments
- Optical fiber is difficult to tap, thus providing a higher degree of security than possible with copper wire
- Light weight and small diameter of fiber permit high capacity through existing conduits

Disadvantages of Optical Transmission

– Cable splicing:
  - Welding or fusing: you must clean each fiber end, then align and carefully fuse the ends using an electric arc.
    - Time consuming
    - Least amount of signal loss between joined elements.
  - Gluing
    - Bonding material that matches the refractive index of the core of the fiber.
    - Time consuming
    - Higher loss of signal power than fusing.
  - mechanical connectors
    - Considerably facilitate the joining of fibers,
    - More signal loss than do the other two methods
    - Can reduce the span of the fiber to a smaller distance.

Cost

- On a (bit/s)/km basis, the fiber cost will always be less than that for copper cable.

- Some organizations may require only a fraction of the capacity of the optical fiber.
  - It is often difficult to justify fiber to the desktop and similar applications where the cost of copper cable may be half or less than the cost of fiber.

SONET/SDH

- Current transmission and multiplexing standard for high speed signals
  - North America: Synchronous Optical Network (SONET)
  - Europe, Japan and rest of the world: Synchronous Digital Hierarchy (SDH)