



**AiR
SUPERiORITY**

Wireless Access and Backhaul for SmartGrid: How to make the Right Choices

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Narrowband

Wideband

Broadband

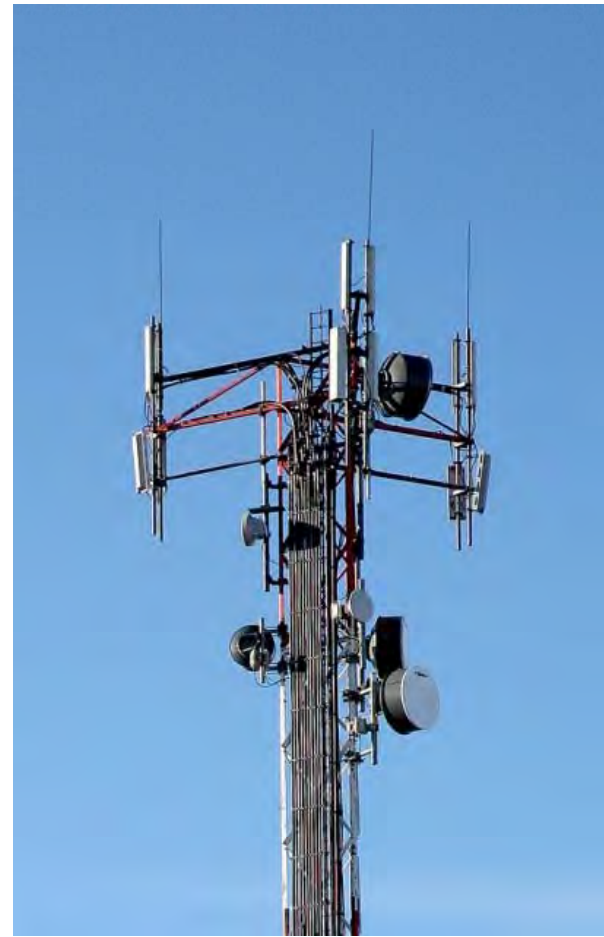
Private

Public

Converged

Wireless Connectivity

- Public Networks
 - Convenient
 - Almost ubiquitous
 - Availability
- Private Networks
 - Ownership
 - Exclusivity
 - Availability



Spectrum



- The “Road” for Wireless
- Regulated by the FCC (USA)
- Often referred to as the “most expensive Real Estate in the world”

Spectrum Options

- Licensed Spectrum
 - “Toll Road” for Wireless
 - Private and exclusive
 - Limited Availability

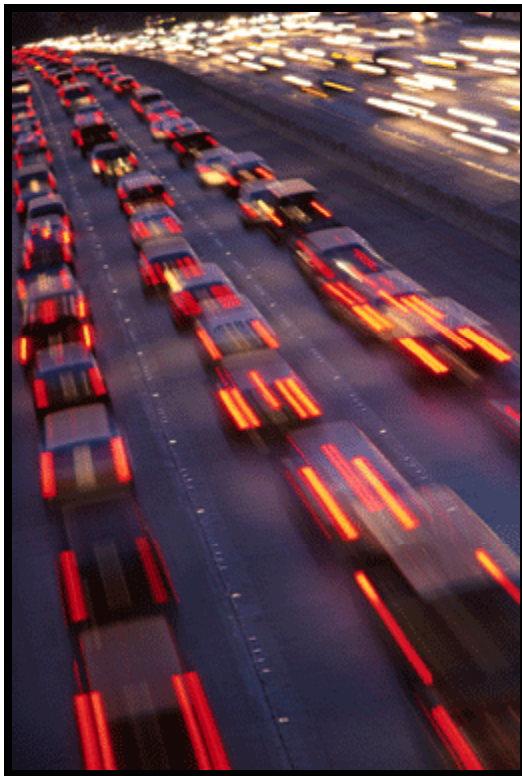
- Unlicensed Spectrum
 - “Public Highway” for Wireless
 - Shared and non-exclusive
 - Can get crowded
 - Collisions happen



Access Network Technologies

- Access Network Considerations
 - Distance to endpoint
 - Bandwidth required
- Typical Terms
 - WAN (Wide Area Network)
 - LAN (Local Area Network)
 - HAN (Home Area Network)

Backhaul Network Technologies



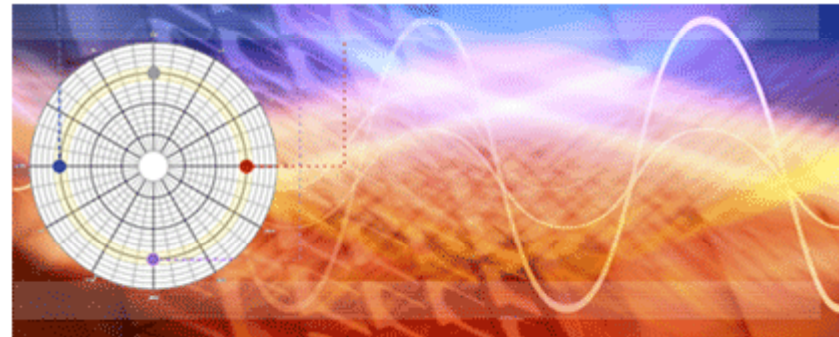
- Multi-Lane highway or Interstate
 - Capacity (“Big Pipe”)
 - SONET
 - MPLS
- Backhaul Network Considerations
 - Bandwidth requirements
 - Future Growth
 - Mission Critical (Redundancy)

Network Architecture Criteria

- Applications
 - Network Overlays
 - Shared Infrastructure
- RF Coverage Analysis
- Capacity Planning (Scalability)
 - Number of end points
 - Bandwidth required today and tomorrow
- Cost (CAPEX/OPEX)

Technology Requirements

- Built on Open Standards
 - IEC-61850, IEEE-1613, WiMax
 - 802.16e, Cellular, Ethernet, Serial
- Open Protocols
 - MPLS, IEC-61850, DNP-3, Modbus, SNMP
- World Class Security
 - Encryption, Authentication, Accounting, Management
- Simple to Use
 - Web and Menu Configuration
 - Diagnostic tools
- Standards Based Gateways
- Advanced Narrowband Radio
- WiMax
- Mesh
- Wireless Sensing
- Frequencies 150 MHz to 60 GHz
- Bandwidths from 300 bps to 800 Mbps
- Licensed and Unlicensed Solutions
- Global Certifications

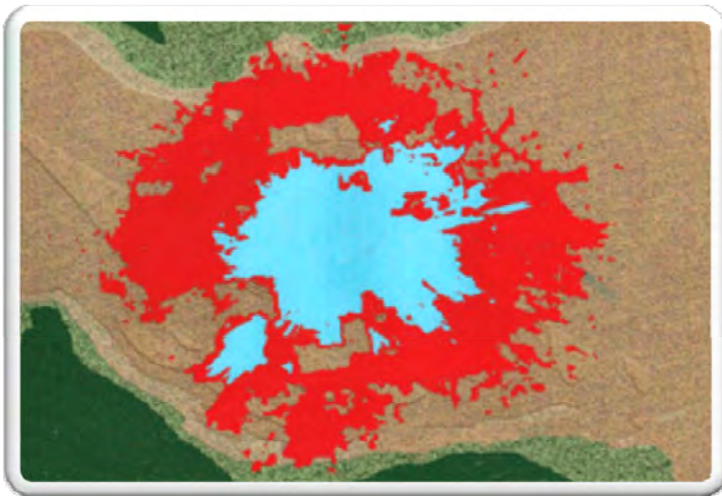


Bandwidth

- Multiple Applications: AMR/AMI, Outage Notification/Restoration, Protection and Control, Distribution Automation, and SCADA, Video
- Real-Time Performance to Support Advanced Analytical Requirements
- Scalable
- Facilitates Demand Response Applications
- Support for Core Backbones and Redundant Rings



RF Coverage



- WiMax 802.16e Technologies
 - Reliable High Speed connectivity with low Fade Margins
 - Immune to Multi-Path and Frequency Selective Fading
 - Supports Fixed and Mobile Applications
- Narrowband Licensed Technologies
 - High output power, extended range
 - Modulations Optimized for Narrow Channels
 - Support for Bridging and Routing
 - IP Connectivity to Remote Sites
 - Reuse of Current Licenses
 - Supports both fixed and mobile

Advanced IP Networking

- Applications that benefit by using QoS
 - Protection and Control
 - Real time fault location and Outage Restoration
 - AMR/AMI
 - Distribution Automation
 - SCADA
 - Distributed Generation,
- QoS Guarantees Priority
 - By Physical Port
 - By Application
 - By Address
 - By IP Port

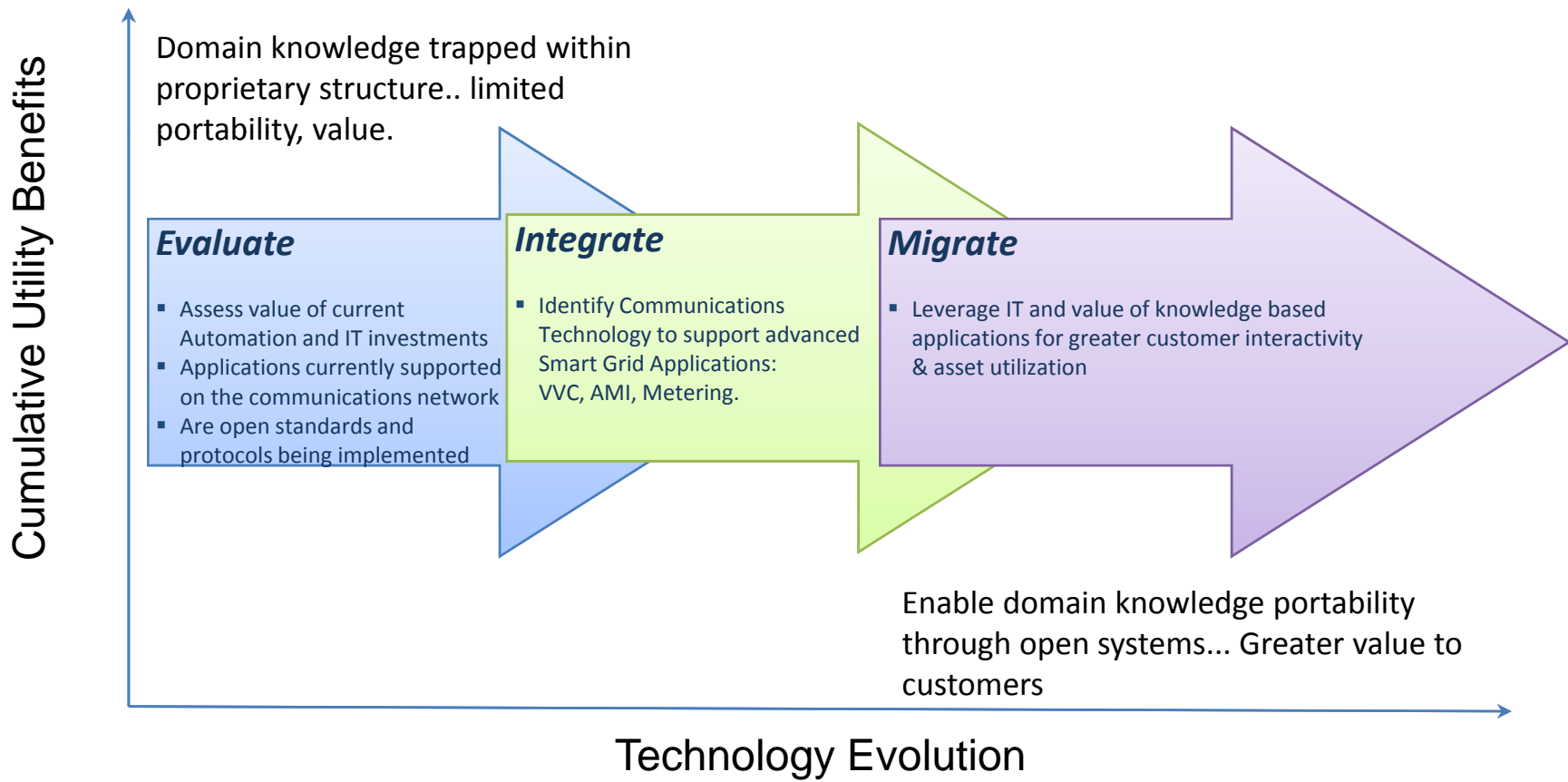
Network Security



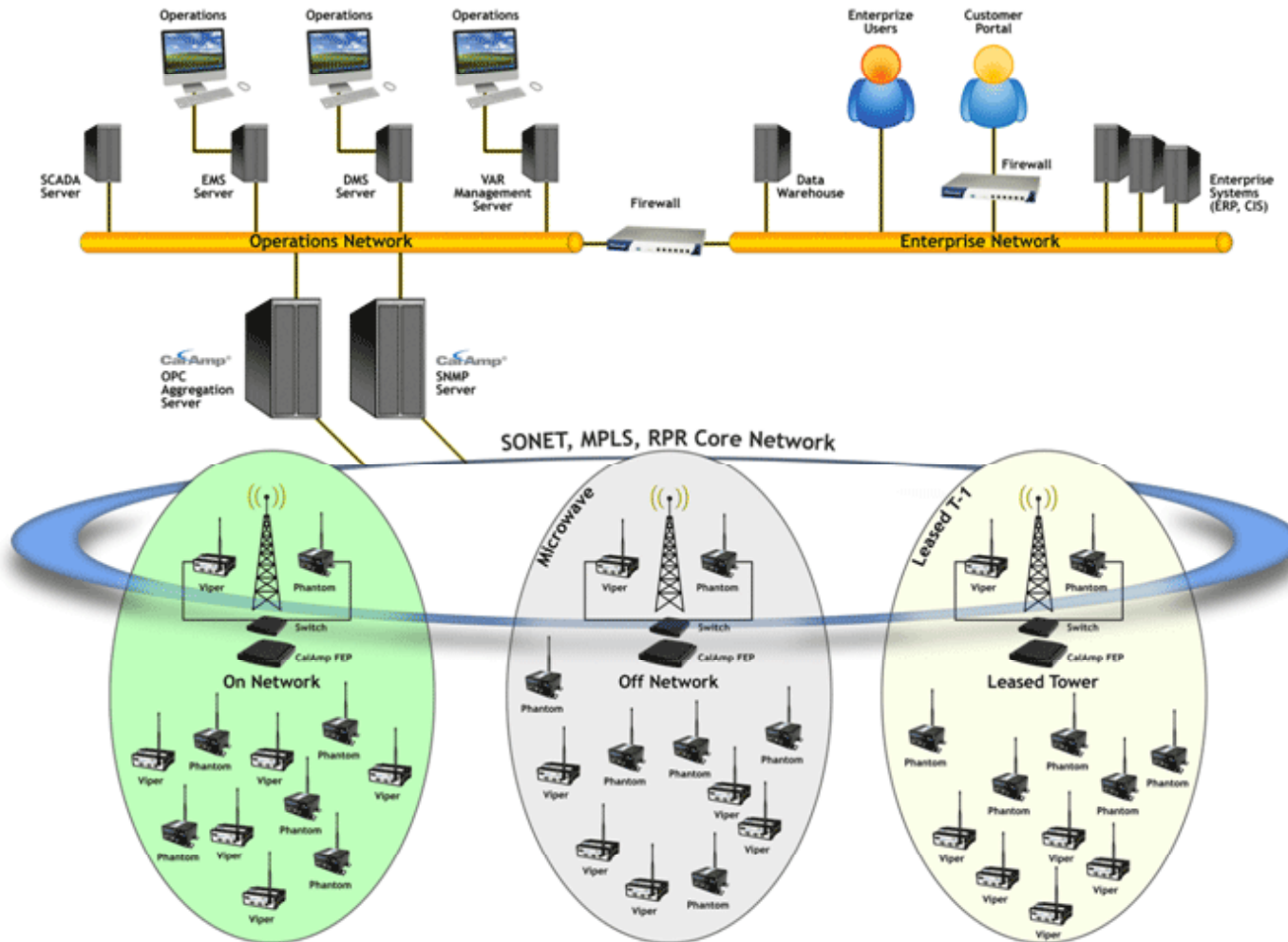
- Encryption
 - AES 128/256 meets FIPS-140-2 & FIPS- 197
- Authentication
 - Local Authentication
 - Radius Authentication
 - 802.1x EAP/TTLS
- Traffic Segregation
- VLAN Support
- Secure remote Management
 - SNMP HTTPS,SSH
- NIST &NERC – CIP Requirements
 - Meets Security Audit requirements

EVOLUTION OF COMMUNICATIONS SYSTEMS FOR SMART GRID: A DISTRIBUTED COMMUNICATION ARCHITECTURE

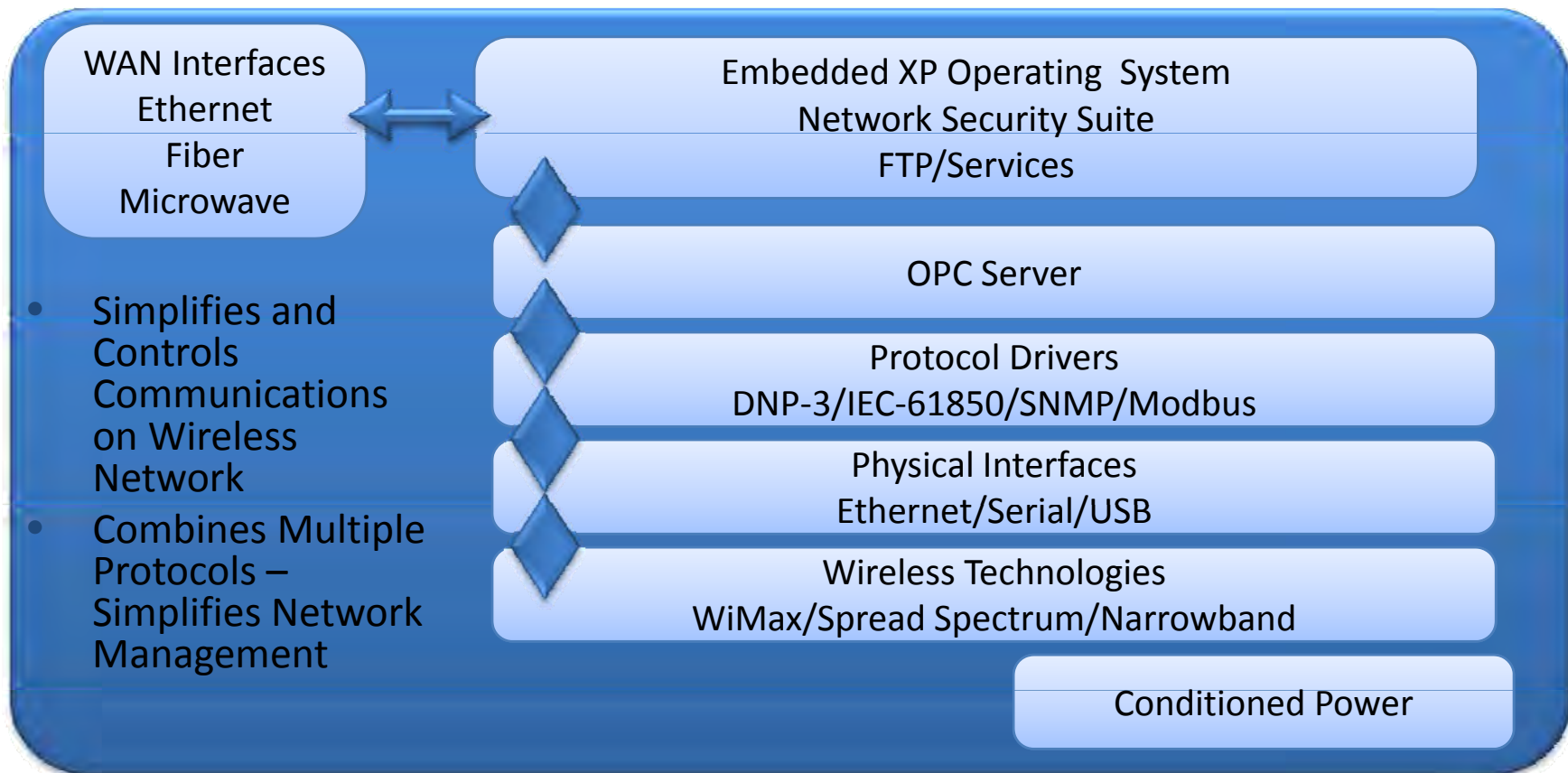
Evolution of Communications Systems for Smart Grid



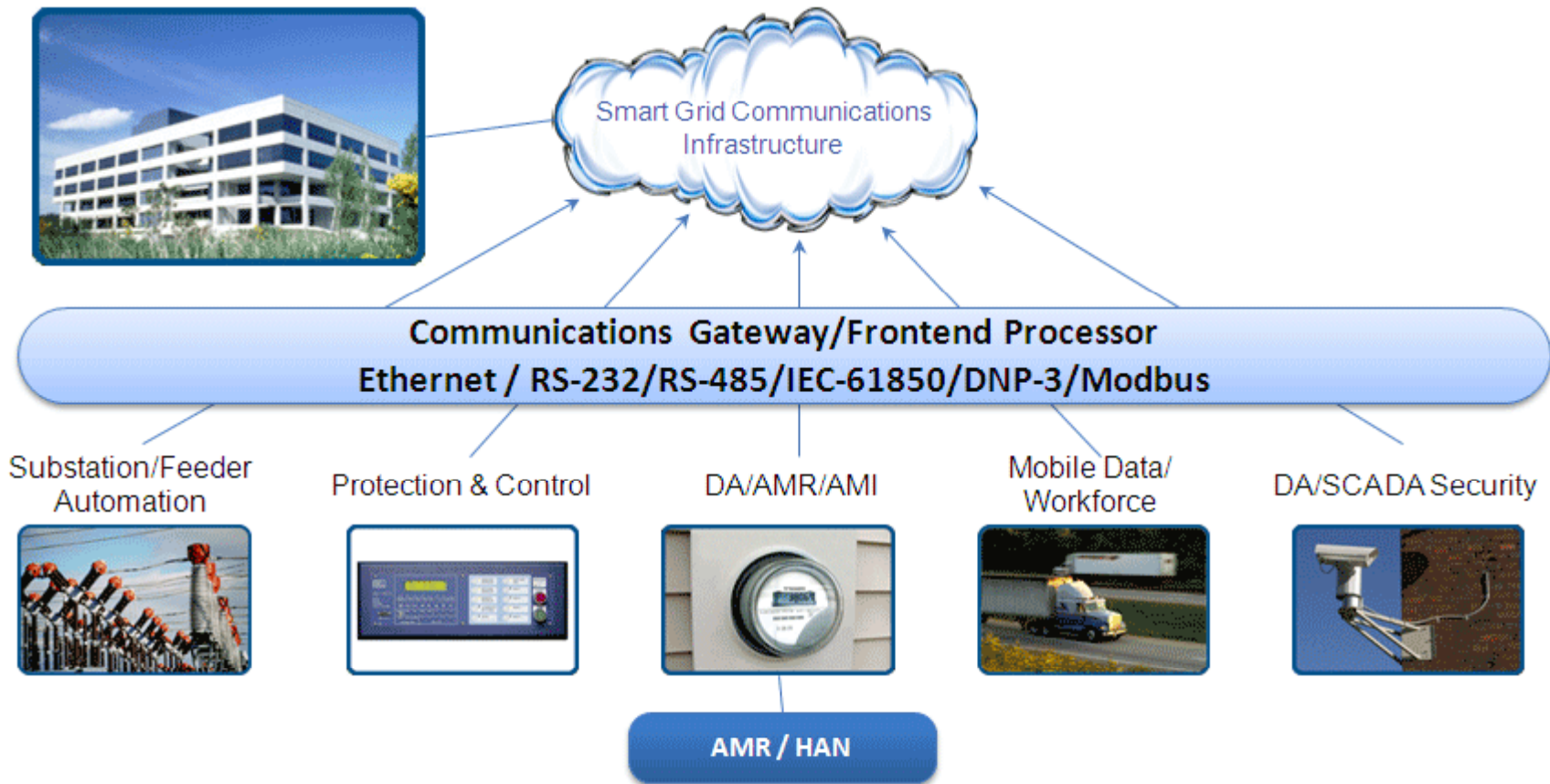
Distributed Communications Architecture



Communications Gateway



Multiple Technologies for Multiple Applications

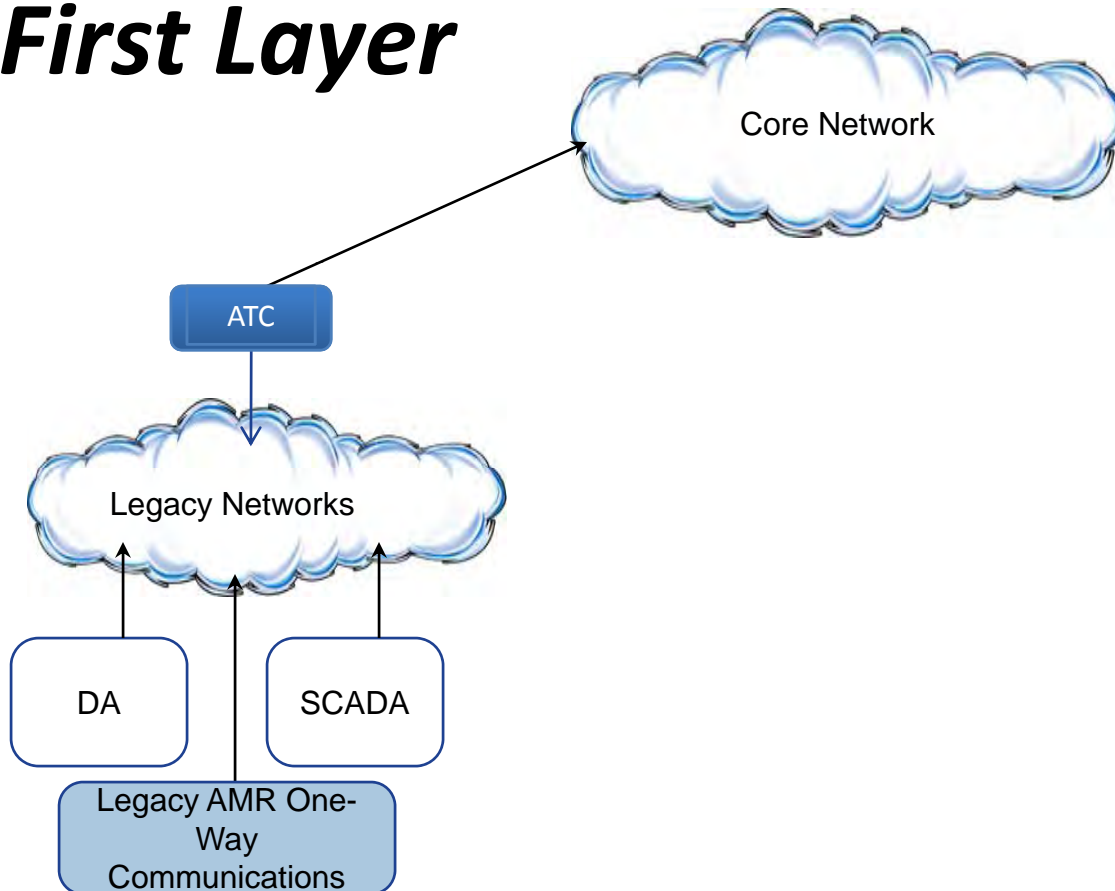


Multi-Layer Approach

- Optimum performance achieved by use of multiple technologies
- Separate RF Networks for Different Applications Improves Reliability
- Critical Applications can be designed for Highest Availability
- Non-Critical Application can be designed more Economically
- Legacy Systems can still be utilized (no fork lift upgrade)

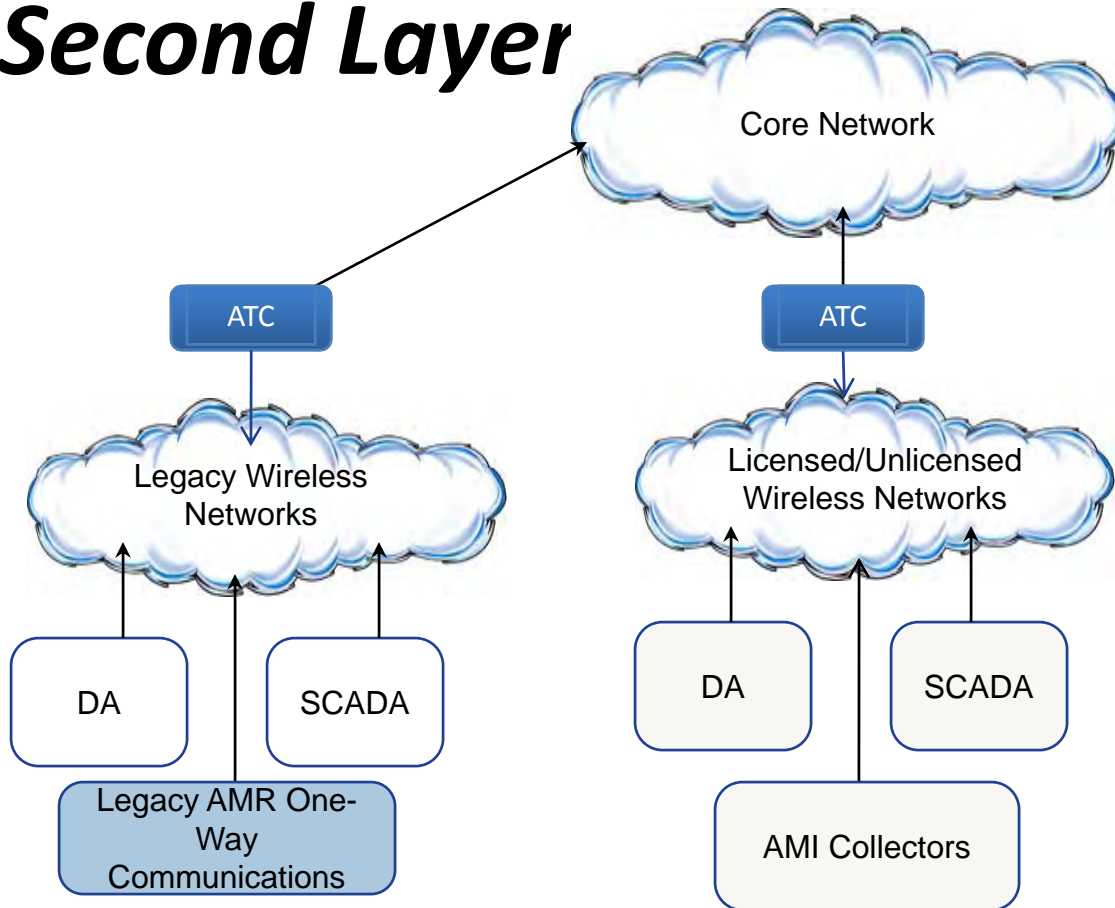
Legacy Communication Network

First Layer



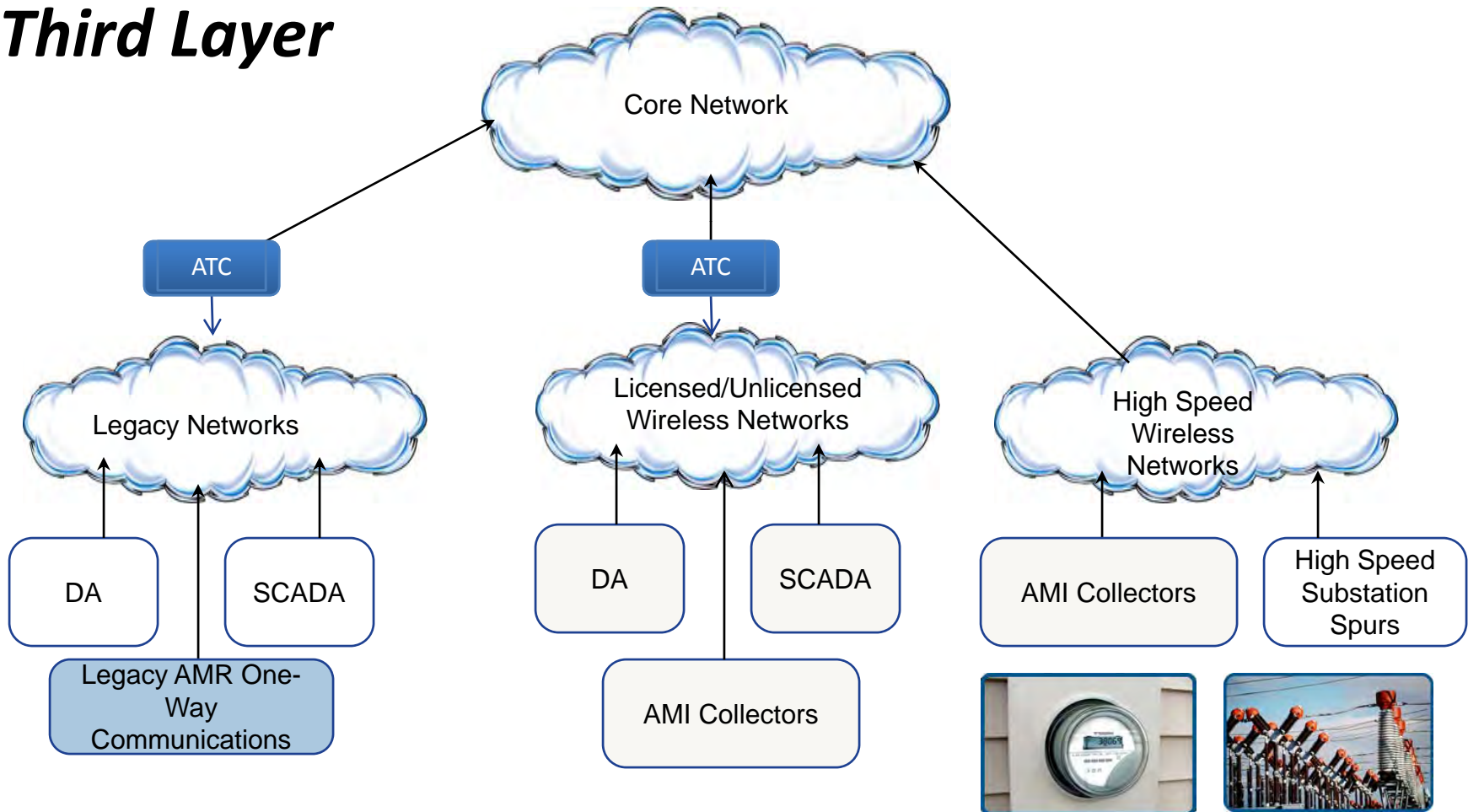
Broadband Communications Network

Second Layer



High Speed Communication Network

Third Layer



Considerations

- Every Design and corresponding Network are unique
 - There is not one technology that will support all applications
- Create your Roadmap
 - Define your Applications
 - Define your Technology Roadmap
- Don't get caught in the Single Technology Trap
 - Consider your options
 - Right Technology for the job
 - Flexibility
 - Scalability

Avoid Headaches!



- Set Realistic Expectations
- Chose Utility Grade Products
- Interoperability
 - Standards based
 - Common Management
 - Common Security
- Plan for the Long haul
- Infrastructure Sharing
 - Converged Fixed / Mobile
 - Scalability



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QUESTIONS?