Satellite Solutions for Smart Grid Modernization
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Satellite Network Components and Architectures
Satellite Network Technology - Overview

- **Satellite data networks are IP based**
  - “Packet-switched” as opposed to “circuit-switched”
  - Interfaces standards based – easily interconnect to other standard based networks

- **Support high speed fixed and mobile endpoints**

- **Architectures include both star-based topology and mesh**

- **Widely deployed globally for mission critical applications**

- **Domestically there are four key Satellite Service and Technology Providers**
  - Market share 2008 - Hughes(50.3%), Gilat-Spacenet(24.9%), ViaSat (9.5%) & iDirect (3.9%)

Source: Comsys
Network Operation Center (NOC) based private satellite network

Secure Satellite Service Provider
Network Operation Center (NOC)

Backhaul

DATA CENTER or HEADQUARTERS

Remote Sites
Satellite Network Architectures - Mesh

Direct remote to data center communication via satellite

DATA CENTER or HEADQUARTERS

Remote Sites
Satellite Network Components – The Satellite Terminal

- **Antenna**
  - .74m to 1.8m

- **Radio (Transmit), LNB (Receive) & Feed Horn**

- **InterFacility Link – IFL cables**

- **Satellite Modem/Router**

- **Antenna Mounts**
  - Non-penetrating mounts
  - Wall mounts
  - Pole mounts
  - Can mount on:
    - Roofs, walls, ground, poles and other structures
Satellite Network Architectures - Comparison to other private networks

Remote Site
- Router
- CSU/DSU

Remote Site
- Router
- DSL modem

Remote Site
- Satellite Router
- Satellite Antenna

Satellite Network
- Satellite Link
- Satellite Network

Data Center
- T1, DS3, etc.

NOC
- Private or VPN
- T1, DS3, etc.

Internet
- DSL, T1, DS3, etc.

MPLS
- T1, DS3, etc.

T1

DSL
Attributes and Capabilities of Satellite Networks
## Next Generation High Throughput Satellites

Capacity in North America is positioned to double in next 3 years, with the industry launching two next generation satellites.

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>Gen. 1 HTS</th>
<th>Gen. 2 HTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Capacity</td>
<td>1 Gbps</td>
<td>10 Gbps</td>
<td>100 Gbps</td>
</tr>
<tr>
<td>Downstream (per site)</td>
<td>Up to 3000 Kbps</td>
<td>Up to 8 Mbps</td>
<td>Up to 10’s Mbps</td>
</tr>
<tr>
<td>Upstream (per site)</td>
<td>Up to 300 Kbps</td>
<td>Up to 2000 Kbps</td>
<td>Up to multi-Mbps</td>
</tr>
</tbody>
</table>
Satellite Network Performance - Speeds

- **Speed/Throughput**
  - Downstream – Remote receive capability
    - 128kbps to 10mbps
      - 128k, 256k, 512k, 1m, 1.5m, 2m-10mbps, up to 24mbps application dependent
    - Note: Carrier size can be misleading. Outbound carrier sizes range from 1Mbps to 440Mbps.
  - Upstream – Remote transmit capability
    - 64kbps to 6mbps
      - 64k, 128k, 256k, 512k, 1m, 1.5m, 2m, 3m, 4m, 5m, 6m
    - Note: Inbound carrier sizes range from 64kbps to 6mbps
Satellite Network Attributes and Characteristics

• **Network Availability**
  - Satellite links sizeable to 99.9% link availability or higher
  - NOC and satellite availability at 99.999%

• **Redundancy**
  - Satellite Router
    - Built-in dial-up modem
    - Alternative path (wireless or wireline) for automatic failover and back
  - Hub
    - Redundant NOC or DataCenter architecture for no loss networks; deployed for oil & gas SCADA solutions today

• **Latency**
  - Roundtrip latency is 600-800ms

• **Coverage**
  - Entire U.S.
Satellite Network Attributes and Characteristics

- **Scalability**
  - Sizeable on a per site basis
  - Same equipment can support all levels of service to accommodate future growth without forklift upgrade

- **Application Optimization**
  - Support to optimize application performance over wide area networks

- **Pricing**
  - Satellite equipment and installation
    - $2000-$4000 for .98m to 1.2m 2watt
    - $5000-$20000 for 1.8m 4watt to 10watt
  - **Service pricing**
    - Plans as low as $30/mo/site for 64kbps/1mbps level of service, up to $500/mo/site for 1mbps/5mbps service
  - **Dedicated Bandwidth**
    - Outroute - $8k-$12k/mbps/month
    - Inroute - $12k-$16k/mbps/month
Satellite Network Attributes and Characteristics

- **Network Management**
  - Proactive Monitoring and Fault Resolution
  - 24x7 support
  - Network performance monitoring and reporting

- **Service Level Agreements (SLAs)**
  - Availability
  - Latency
  - MTTR
  - Installation

- **Field Maintenance**
  - Next day to same-day 24x7 field maintenance support

- **Installation**
  - Up to 2000 sites per month during a planned enterprise deployment
  - Option to train customer personnel to install and perform maintenance
Satellite Router Capabilities

<table>
<thead>
<tr>
<th>Indoor Unit</th>
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</thead>
<tbody>
<tr>
<td><strong>Transmission capabilities</strong></td>
</tr>
<tr>
<td>• Receive Outroute up to 110 Mbps (DVB-S2)</td>
</tr>
<tr>
<td>• Transmit Inroutes up to 6 Mbps</td>
</tr>
<tr>
<td><strong>Connectivity</strong></td>
</tr>
<tr>
<td>• Two 10/100 Ethernet Ports</td>
</tr>
<tr>
<td>• Serial Port</td>
</tr>
<tr>
<td>• Integrated Dial Backup Modem</td>
</tr>
<tr>
<td><strong>Performance Features</strong></td>
</tr>
<tr>
<td>• Data Prioritization</td>
</tr>
<tr>
<td>• Integrated TCP Acceleration</td>
</tr>
<tr>
<td>• Web Page Acceleration</td>
</tr>
<tr>
<td>• Data Compression</td>
</tr>
<tr>
<td><strong>Router functionality</strong></td>
</tr>
<tr>
<td>• DHCP Server/Relay</td>
</tr>
<tr>
<td>• Network Address Translation</td>
</tr>
<tr>
<td>• RIP v1, RIP v2, VRRP</td>
</tr>
<tr>
<td>• Policy Based Routing support</td>
</tr>
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Quality of Service Capabilities

Prioritize applications for the best performance possible

Mission-critical applications set to high-priority

Voice and video conferencing applications set to Constant-Bit-Rate

Regular Web, email, and intranet traffic set to normal priority

Very small file traffic set to low latency setting
Satellite Solutions for Smart Grid Modernization
Role for Satellite Solutions in Smart Grid

- **Emergency Response**
- **Employee Training**
- **Mobile Based Work Flow**
- **Field Ops**
- **Home Area Network**
- **Neighborhood Area Network**
- **WAN (PTP μwave MPLS, fiber, leased lines)**
- **Distribution**
- **Transmission**
- **Generation**
- **Substation Connectivity – Primary & backup**
- **Distributed/Remote/Off shore Generation**
- **SCADA – Monitoring/Control**

- **Smart Meter Collection Point**

**Home Area Network**
- Devices

**Neighborhood Area Network**
- Smart Meter Collection Point

**Transmission**
- WAN (PTP μwave MPLS, fiber, leased lines)

**Distribution**
- Primary & backup

**Generation**
- Distributed/Remote/Off shore Generation
Current Environment

9/24/2009

Hughes

Connect to the future:
Applying Satellite Solutions

- **AMI – Advanced Metering Infrastructure – Collection Point Backhaul**

  - **Solution:**
    - Private Mesh Satellite Network
    - Optional wireless backup

  - **Strengths:**
    - Non-internet-based, private network
    - Network management, monitoring and reporting tools
    - Universal coverage – no dark spots
    - High Performance and availability
    - Scalable data rates

  - **Unique requirements and considerations:**
    - Utility pole mounting
    - Environmentally protected enclosures
Applying Satellite Solutions

• Substation Connectivity

  • Solution:
    • Private Mesh Satellite Network
    • Backup to terrestrial primary
    • Primary access with the option for wireless or dial-up for backup at “hard-to-reach” locations
    • Supports VoIP and video surveillance requirements
    • Can carry business and operations traffic in a segmented fashion

  • Strengths:
    • Non-internet-based, private network
    • Network management, monitoring and reporting tools and capabilities
    • VSAT Reliability is better compared to 3G; also no usage-based pricing

  • Unique requirements and considerations:
    • Environmentally protected enclosures where required
    • Versatile installation options
Summary – Satellite Solutions
Where, When and Why?

• Where and When?
  – AMI/AMR collection points
  – Substations
  – Mobile units

• Why?
  – Performance supports utility applications (PQM, RM, SCADA, …)
  – Ubiquity - single provider coverage everywhere
  – Fast, wide-scale network deployments
  – Private networks facilitate security compliance
  – Optimum path diverse high network availability solution
  – Excellent first response and disaster recovery
  – Advanced proactive network monitoring and management tools
  – Multicast capability to all locations simultaneously
  – Support of high-quality VoIP and video on demand (voice communication at unmanned locations and video surveillance)
Suggestions for Satellite Solution Evaluation

• **Approach providers to discuss solutions for specific needs**
  – Take into account all applications and the broad range of needs
  – Discuss specific applications and traffic patterns

• **Test the technology**
  – Request pilots from providers
  – Test the applications and solutions
    • Consider application performance as a whole not just transmission characteristic performance

• **Evaluate economics of specific solutions**
  – Each provider may have different ways of solving the same problem – evaluate all options
Questions?

Thank you!

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