MGX 8800 Series Multiservice Wide-Area Switch Product Update

Session 3008
Agenda

- Multiservice Market Dynamics
- IP+ATM Directions
- Cisco MGX™ 8800 Switch Architecture and Applications
- Multiservice Initiatives
- Open House

Where We’ve Been

Stage I: Rapid Expansion of Separate Networks and Introduction of Value-Added Services

SMDS  IP  FR  ATM  Voice  X.25
New Requirements Driving Network Evolution

Stage I: Rapid Expansion of Separate Networks and Introduction of Value-Added Services
- SMDS
- IP
- FR
- ATM
- Voice
- X.25

Stage II: Multiservice Data Networks Integrate IP, FR, ATM, and CE
- Multiservice Data
- Voice

Stage III: PSTN Voice Migrated to Data Networks
- 21st Century Carrier Infrastructure
Changing Dynamics of Global Service Provider Market

Deregulation and Competition

Data Surpassing Voice

Growth of IP Applications

Shift to Multiservice Networks

Service Provider’s Paradox: A New Business Model

Service Provider Profit Mix

Data

Voice

Old World
Force-fit Data onto TDM Network;
Declining TDM Profits

New World
Network Optimized for Packet Data;
Voice Is an Application

By 2010, 80% of service provider profits will come from data services.

Tom Nolle, BCR 7/99
Current Service Provider Environment

- IP driving next generation services
  - VoIP, IP VPNs, video over IP, value-added services (hosting, e-commerce)
- But…the bulk of today’s data revenues are still coming from FR, SNA, leased line services and Internet dial access

Balancing the Service Portfolio

IP User Growth (Millions)  Frame/ATM Service Revenues ($Billions)

Emerging Service Opportunity  Today’s Revenues

Source: Vertical Systems, IDC, Zona Research, Literature Searches, Team Analysis
Solution: IP+ATM

Customers Moving to Include Service Providers in their Network for Outsourcing and New Capabilities

Enterprise Customers

IP

IP+ATM

ATM

Service Providers

Moving to Include IP in their Network, to Interact with Customer Applications

Virtual Private Networking: A $24 Billion Opportunity

IP+ATM Opportunity

Worldwide VPN Service Revenues ($B)

Source: CIMI Corp.
New World Forces Also Change the Voice Model

- Worldwide Deregulation and Competition
- IP Everywhere
- Voice Rides Data Network
- Service Providers
- Exploding Demand for Services and Bandwidth
- Long-Term Profitability

Today’s Voice Infrastructure: Tyranny of the DSO

Traditional Rigid TDM Structure Yields High Cost Per Bit
Packet Voice Infrastructure Enables Investment Shift

- Grow tandem infrastructure with packet technology (VoIP, VToA)
- Leverage statistical multiplexing over packet core
- Enable integrated voice/data access

TDM Networks Limit Growth and Profitability

- High costs
  Unable to expand into new markets
  Reduced profitability
- High complexity
  Longer time to market for new services
  Increased operational costs
- Limited growth
  Uns suited to data transport and value-added services
Delivering the New World Vision

• At the Edge...
  Cisco MGX 8830, 8850, and BPX® 8680 switches
  Full IP+ATM edge feature-set

• ...and in the Core
  Jupiter
  Scalable IP+ATM switching and routing

Agenda

• Multiservice Market Dynamics
• IP+ATM Directions
• Cisco MGX 8800 Switch Architecture and Applications
• Multiservice Initiatives and Roadmaps
Cisco MGX 8800 Switch Platform
Architecture Overview

- Hardware architecture
- Software architecture
- Multiservice Layer 2 data
- Layer 3 data
- Packet voice

Cisco MGX 8850 Switch Universal Chassis

Optimized for Scale and Flexibility

- Midplane architecture designed to cost-optimize for both narrowband and broadband services
- Integrated DCS functionality
- 1:N and 1:1 redundancy options
- Scalable switch fabric options
  - PXM1: 1.2 Gbps non-blocking capacity
  - PXM45: 45 Gbps non-blocking capacity
Cisco MGX 8850 Switch
Mechanicals

Chassis and Slot Configuration

- Up to 24 single-height service modules
- Up to 12 double-height service modules
- Slots 15, 16, 31, 32 are reserved for Service Resource Modules
- Field-removable midrail dividers enable easy upgrade from single- to double-height service modules

Cisco MGX 8800 Switch
Architecture

Optimizing Cost-Performance Curve
Cisco MGX 8850 Switch Midplane Architecture

Technology-Optimized for Narrowband and Broadband

**Narrowband**
- 2.2 Gbps optimized for aggregating narrowband services
- 8 Cell Buses
- Investment protection for MGX 8220 SMs

**Broadband**
- 90 Gbps optimized for aggregating broadband services
- 72 serial lines
- Fully synchronized
Cell Bus Architecture

- 2.2 Gbps cell bus capacity
  - Upper shelf: 6 x ATM OC-6c
  - Lower shelf: 2 x ATM OC-3c
- Cell buses are Cisco MGX 8220 Switch compatible
- The top-bay cell bus delivers up to 160 Mbps in 2x mode
- The upper bay is engineered for high-capacity cards

Cisco MGX 8800 Switch
Narrowband Technology

- Midplane supports 2.2 Gbps of full duplex Cell Bus capacity
- Top bay
  - 6x Cell Bus, OC-6 per Cell Bus
  - 155 Mbps per slot
- Lower bay
  - 2x Cell Bus, OC-3 per Cell Bus
  - 25 Mbps per slot
- Any single-height service module can use any slot
High-Speed Serial Lines Architecture

- 45 Gbps total non-blocking switching capacity
- 12 x 3.75 Gbps serial crosspoint links
  - 3 x 1.25 Gbps lines per slot to SMs
  - 12 double-height slots
- 1:1 redundancy for serial crosspoint links
- Non-blocking, sustained throughput per slot > OC-48
- Q1 CY ’00

Cisco MGX 8800 Switch Broadband Technology

- Midplane supports 45 Gbps of full duplex, fully redundant serial line capacity
- Three serial line traces to each double-height slot => 36 total
- Serial line throughput = 1.25 Gbps per line
- Synchronized to deliver > OC-48c sustained throughput per slot
Cisco MGX 8800 Switch
Distribution and Redundancy Buses

- **T1 distribution bus** to facilitate SRM breakout of Channelized T3 into DS1s (M1-3 DCS function)
- **T3 distribution bus** to facilitate SRM break-out of channelized OC-12 into T3 streams (DCS function)
- **T1/E1 redundancy bus** provides 1:N redundancy to service modules

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Cisco MGX 8850 Switch
Chassis and Slot Configuration

- Up to 24 single-height SM service modules
- Up to 12 double-height service modules
- Slots 15, 16, 31, and 32 are reserved for service resource modules
- Field removable midrail dividers enable easy upgrade from single height to double height service modules
PXM1 Architectural Overview

- Three port device:
  - One port to up-links via a line module on the backcard
  - Two ports connected to the cell bus on the mid-plane
- Maximum uplink is full-duplex 622 Mbps
- Each cell bus has 160 Mbps to support 2x mode
- 6 x ATM OC-6c (upper shelf)
- 2 x ATM OC-3c (lower shelf)
- New SM can run at 2x mode to exploit the available mid-plane bandwidth

Cisco MGX 8800 Switch Architecture PXM45

- 45 Gbps non-blocking Crosspoint switch
  - Virtual output buffering
  - R5000 series MIPS CPU
  - Cell bus control and arbitration
  - Crosspoint control and arbitration
  - Bridging between Cell bus and serial lines
  - 1:1 Hot Standby redundancy
  - 4 GB hard disk
  - Stratum 3 clocking
Cisco MGX 8800 Switch Platform
Architecture Overview

- Hardware Architecture
- Software Architecture
- Multiservice Layer 2 Data
- Layer 3 Data
- Packet Voice

Cisco MGX 8800 Switch
Software Architecture

Designed for Flexibility and Scalability

To Network Management System

Network Management Control Point Software

AutoRoute SW
PNNI SW
IP/MPLS SW
SS7 SW

Virtual Switch Interface (VSI)*

Cisco MGX Switch Platform Software

MGCP

*VSI: Architectural flexibility
Cisco MGX 8800 Switch
PNNI Implementation

- **Phased approach**
  - Single peer group—up to 200 switches
  - Full hierarchy mechanisms—subsequent release
- **Optimized connection admission control and route selection algorithms**
- **Value-add capabilities**
  - Access lists for security
  - Redundant links for load balancing and reliability
  - Plug-and-play with open standards
Cisco MGX 8800 Switch Platform
Architecture Overview

• Hardware Architecture
• Software Architecture
• Multiservice Layer 2 Data
• Layer 3 Data
• Packet Voice

Frame Service Module (FRSM)

• High port density
  8 x T1/E1 (channelized/unchannelized)
  4 x X.21
  2 x T3/E3 unchannelized
  2 x T3 channelized
  2 x HSSI

• Frame Relay functionality
  Frame Relay UNI, NNI
  Simple frame-based ATM UNI (FUNI)
  Frame Relay-to-ATM network interworking
  Frame Relay-to-ATM service interworking
  Frame forwarding for HDLC, PPP transport
  Enhanced LMI to Cisco routers
  CoS support on HSSI and T3/E3 modules
  BERT

• 1:N redundancy through SRM
Frame Relay Price Leadership

- **Delivering market-leading port prices across Cisco’s Edge Platforms:**
  - < $85 per DS0 port
  - nx $36 per nxDS0 port
  - < $860 per DS1 port
  - $8500 per DS3 port

- **Common equipment prices as low as half the competition...**

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ATM User Service Module (AUSM/B)

- **Full ATM functionality**
  - T1/E1 ATM UNI, NNI
  - n x T1/E1 ATM UNI (IMA)
  - Multiple IMA groups per module
  - All ATM service categories, including CBR, VBR, UBR, and ABR_FST
  - ILMI, OAM cells
  - BERT

- **High port and connection density**
  - Eight T1/E1 ports per module
  - 1,000 connections per card

- **1:N redundancy**
Cisco MGX 8850 Switch Broadband Ports
ATM Switch Service Module (AXSM)

- Full ATM functionality
  All ATM service categories, including CBR, VBR-RT, VBR-NRT, UBR, and ABR
  PVC, SVC, S-PVC
  1M+ cells of buffering, 128K connections
  ILMI, I.610 support (OAM flows), ATM UNI 3.0, 3.1, 4.0
  Virtual output queues

- High port density
  16x T3/E3 ports: 192/node
  16x OC-3/STM-1 ports: 192/node
  4x OC-12/STM-4 ports: 48/node
  1x OC-48/STM-16 port 12/node

- 1:1 redundancy

Circuit Emulation Service Module (CESM)

- High port and connection density
  8x T1/E1 ports per module
  1x T3/E3 ports per module

- Full ATM functionality
  AAL1-based T1/E1, T3/E3 circuit emulation
  Structured and unstructured T1/E1
  Unstructured T3/E3
  Clock recovery mechanisms include SRTS and adaptive timing
  On-hook/off-hook detection
  Silence suppression

- 1:N redundancy
Cisco MGX 8800 Switch Delivers Circuit Emulation Services for Leased Line Replacement

- Replace leased lines for enabling video applications and interconnecting TDM muxes, PBX’s
- Leverage ATM Infrastructure

T3 Service Resource Module (SRM)

Bulk Distribution and 1:N Redundancy Reduces Costs and Minimizes Operations Expenses

- High-density bulk distribution
  - Up to three T3s per SRM
  - T1s extracted via C-bit parity or M-frame format
- N:1 service module redundancy
- BERT and loopback commands
- 1:1 redundancy of SRM
Service Resource Module (SRM) Provides TDM Interface Support

• 1999 availability
  Single-height card
  Up to three T3s per SRM
  DS1s extracted
  Up to eight DS1s distributed to each single-height service module

• Planned CY ’00 availability
  Double-height card
  Up to two OC-3/STM-1s per SRM
  VT1.5/VT2.0 extracted
  Up to eight VT1.5/VT2.0 distributed to each single-height service module

• Radar for CY ’00
  Double-height card
  Up to four OC-12s per SRM
  DS3s extracted
  Up to eight DS3s distributed to each double-height service module
Cisco MGX 8800 Switch Platform
Architecture Overview

- Hardware Architecture
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- Multiservice Layer 2 Data
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- Packet Voice

Route Processor Module (RPM)

- Cisco 7200-based hardware
- Double-height card fits into any service module slot
- 140k pps via Cisco 7200 NPE 150 routing engine
- ATM deluxe dual SAR: one ingress, one egress to SAR
- Same Cisco IOS® image as Cisco 7200
- Up to 12 RPM per Cisco MGX Switch
- Cisco MGX Switch ATM deluxe port-adapter backcards
  - 1x FDDI
  - 1x FE
  - 4x Ethernet 10BaseT
- Cisco MGX Switch port adapter supports:
  - Full 24-bit VPI/VCI
  - F4/F5 OAM support
  - AAL 5
- Switched connections cannot terminate on these ports
Modular Layer 3 Architecture Scales with Service Demands

- Cisco 7200-based hardware
  Based on NPE 150
  ATM deluxe SAR to cell bus
- Double-height front card
  Up to 12 RPMs per chassis
- Single-height back cards
  4x Ethernet
  1x Fast Ethernet
  1x FDDI

Cisco MGX 8800 Switch Integrates MPLS Label Edge Routing and Label Switching

- Integrated IP and ATM-based services
- Integrated aggregation for PPP/Frame Relay
- Integrated MPLS enabling IP VPNs
**IP VPNs and ATM-Based Services**

**Provider Multiservice Network**

- Deliver multiple services over a single pipe
- Leverage common ATM infrastructure
- Scalable IP VPNs with MPLS
- Enable ATM-based services with PNNI
- ATM, Frame Relay, voice, CES

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**Cisco MGX 8800 Switch Platform Architecture Overview**

- Hardware Architecture
- Software Architecture
- Multiservice Layer 2 Data
- Layer 3 Data
- Packet Voice
Enabling Full-Featured Voice Transport
Voice Interworking Service Module (VISM)

- PCM to packet voice conversion
- Full-featured voice processing
  - 32-K ADPCM, 16-K LDCELP, 8-K CS-ACELP
  - VAD and comfort noise generation
  - Programmable 16, 32, 64, 128 ms echo cancellation
  - DTMF/MF detection/generation
- Full voice transport and interworking
  - VoIP and VoATM
  - Voice gateway
- Multiple packetization format
  - Circuit emulation (AAL1)
  - VToA (AAL2)
  - VoIP (RTP in AAL5)
  - VoFR (FR in AAL5)

Cisco MGX Switch With VISM
Scalable Packet Voice Solution

- Dynamic DSP allocation
  - Basic functionality (ECAN, nxDS0, G.711, tone detection
    and generation) for all channels
  - High functionality (ADPCM, CELP) negotiated on demand
    for a fair proportion of channels
- High-density aggregation
  - Eight T1/E1s of PCM Voice
  - 192(256) DS0/card
  - 4608(6144) DS0/shelf
  - N x DS0
- Carrier-class reliability
  - 1: N redundancy
  - BERT support via SRM
Cisco MGX 8850 Switch with VISMs as a Packet Voice Gateway

- Virtual class-4 tandem implementation
- Cisco SS7, PRI and CAS signaling protocols
- VoIP and VoATM transport

Cisco MGX 8850 as a Universal Packet Voice Edge Switch

- Universal voice switching and signaling architecture
- Voice Gateway function provides interworking between PSTN and VoATM, VoIP
- Support for Cisco SS7, PRI and CAS signaling protocols
- T3 grooming of DS0 circuits to PSTN
Cisco MGX 8850 Switch Competitive Differentiators

**Services Breadth**
- Industry’s leading IP and MPLS implementation
- FR, PPP, ATM, and CE
- VoIP and VoATM

**Scalability/Port Density**
- DSO to OC-48c
- Narrowband: 1344 DS1’s; 6144 DS0’s; 192 E1’s
- Broadband: 12x OC-48c/STM16, 48x OC-12c/STM4, 192x OC-3c/STM1, 192x T3/E3

**Price/Cost Leadership**
- Integrated broadband uplinks = low-cost entry
- High density service modules = lowest cost/port
- Common operations and sparing

**Carrier Class Reliability**
- Hot standby common logic; graceful upgrades/downgrades
- SONET/SDH automatic protection switching
- 1:N service port redundancy

What About All those 9s?

<table>
<thead>
<tr>
<th>Availability</th>
<th>Unavailable Minutes/Year</th>
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<tr>
<td>99.99%</td>
<td>52.6 Minutes</td>
</tr>
<tr>
<td>99.999%</td>
<td>5.26 Minutes</td>
</tr>
<tr>
<td>99.9999%</td>
<td>0.526 Minutes; 31.6 Seconds</td>
</tr>
<tr>
<td>99.99999%</td>
<td>0.0526 Minutes; 3.16 Seconds</td>
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<td>PSTN</td>
<td>Less than a few Minutes per Year</td>
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Minutes in a Year = 525,600
# Cisco MGX 8800 Switch Software Release Matrix

<table>
<thead>
<tr>
<th>Software Release</th>
<th>1.1.1x 8850</th>
<th>1.1.2x 8850/8830</th>
<th>2.0.0x 8850</th>
<th>2.1.0x 8850</th>
<th>2.2.0x 8850</th>
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<tbody>
<tr>
<td>Key Features</td>
<td>PXM1 45 Gbps Back plane MPLS LER</td>
<td>8850 45 Gbps Back plane MPLS LER</td>
<td>8830 20Gbps Back plane PNNI 50k conns</td>
<td>PXM45 45 Gbps Back plane PNNI 100k conns</td>
<td>PXM1 45 Gbps Back plane MPLS LER</td>
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<tr>
<td>Interfaces</td>
<td>NarrowBand FRSM CESM RPM AUSM SRM VISM (VoIP)</td>
<td>NarrowBand FRSM CESM RPM AUSM SRM VISM (VoIP)</td>
<td>NarrowBand FRSM CESM AUSM</td>
<td>BroadBand only AXSM AXSM-E NarrowBand RPM VISM VoIP/VoATM FRSM-8 SRM</td>
<td>BroadBandB AXSM AXSM-E NarrowBand FRSM CESM RPM AUSM SRM VISM (VoIP)</td>
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<tr>
<td>Switching Fabric</td>
<td>1.2 Gbps</td>
<td>1.2 Gbps</td>
<td>1.2 Gbps</td>
<td>45 Gbps</td>
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# Cisco MGX 8800 Switch Release 1 Report Card

<table>
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<th>MGX</th>
<th>FCS Commit</th>
<th>Actual</th>
<th>Key Features</th>
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<tr>
<td>1.0</td>
<td>4/30/99</td>
<td>3/31/99</td>
<td>• Platform</td>
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<td></td>
<td>• PXM</td>
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<td>• FRSMs</td>
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<td>• CESMs</td>
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<td>• SRM</td>
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<tr>
<td>1.1.00*</td>
<td>6/15/99</td>
<td>5/17/99</td>
<td>• PXM1 Redundancy</td>
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<td></td>
<td>• AUSM/B</td>
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<tr>
<td>1.1.10*</td>
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<td>8/15/99</td>
<td>• SONET APS</td>
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<td>• PXM UNI</td>
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<td>• BPX 9.2 endpts</td>
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<td>1.1.11</td>
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<td>• MPLS ELSR</td>
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<td>1.1.20</td>
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<td>• MGX 8830</td>
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<td>• FRSM X.21</td>
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* GA

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## MGX 8800 Series Multiservice Wide-Area Switch Product Update

### Session 3008

**Roadmap—Voice/Data Access**

<table>
<thead>
<tr>
<th>Q2 CY '99</th>
<th>Q3 CY '99</th>
<th>Q4 CY '99</th>
<th>Q1 CY '00</th>
<th>Q2 CY '00</th>
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<tr>
<td><strong>Cisco MGX Switch—R1.0, 1.1</strong></td>
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<td><strong>MGX</strong></td>
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<tr>
<td>- PXM1, BB Uplinks</td>
<td>- VISM—VoIP</td>
<td>- VISM—AAL1 (CES)</td>
<td>- VISM—AAL2 (VTOA)</td>
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<td>- CESM-8T1/E1 N x DS0 On-hook/off-hook detection</td>
<td>- SRCP/MGCP</td>
<td>- xGCPATM extensions</td>
<td>- ATMF SVCs</td>
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<tr>
<td>- AUSM-T1/E1/B, IMA</td>
<td>- Red. PVC for bearer/SGCP</td>
<td>- Full COT</td>
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<td>- G.729a, G.729b, G.723, G.726, G.725.1</td>
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<td></td>
<td>- Auto Disable ECAN and Comp.</td>
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<td>- CAS, PRI</td>
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<td>- A/Mu-lawConv</td>
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<td>- CRTP</td>
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<td>- DTMF/MF Tone Detect. and Gen.</td>
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### Key

- **Committed:** Project is funded, staffed, and scheduled
- **Planned:** Project is funded, but not fully staffed or scheduled
- **Radar:** Project is under investigation and subject to change

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**Radar:**
- VISM: Backhaul SS7, ann./tone playback, fax relay, line test access, NFAS, BERT
- MGX: MGX 8820; PXM1-IMA, 8x T3/E3 uplink, SRM-OC-3, STS1

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Please Complete Your Evaluation Form

Session 3008