



## **ServiceFlex – IP** NGN Carrier Ethernet Service Delivery



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Consulting Systems Engineer

**Session → Metro Ethernet 108**  
**14:30 to 15:15**

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1

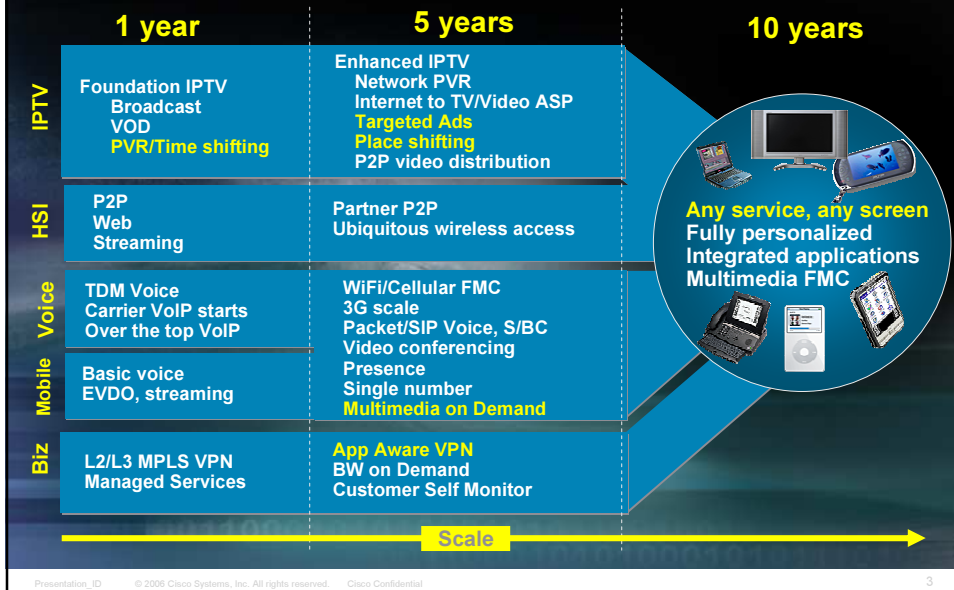
## Agenda

- Market Trends
- Carrier Ethernet
- ServiceFlex Design
- Customers and Commitment
- Q&A

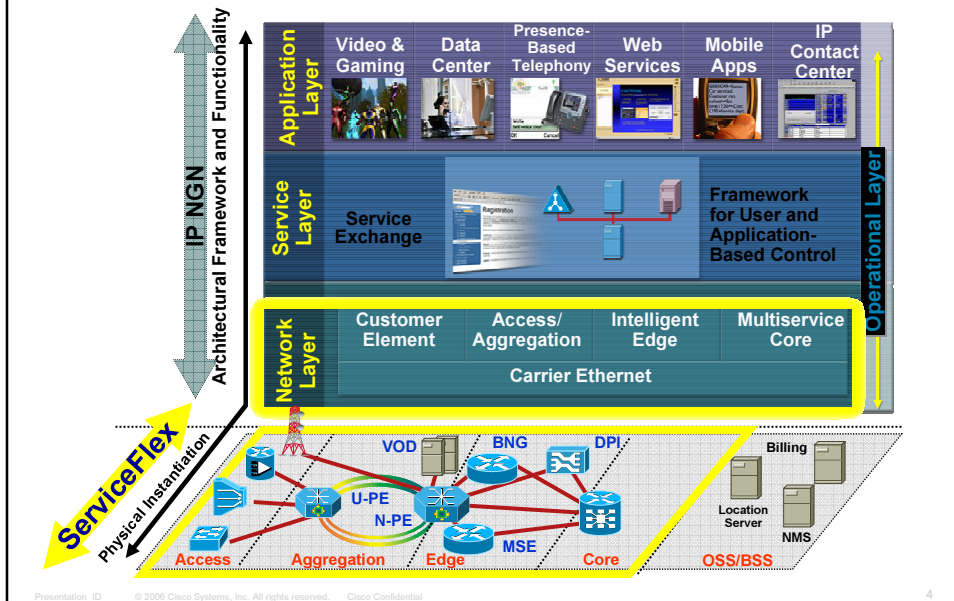
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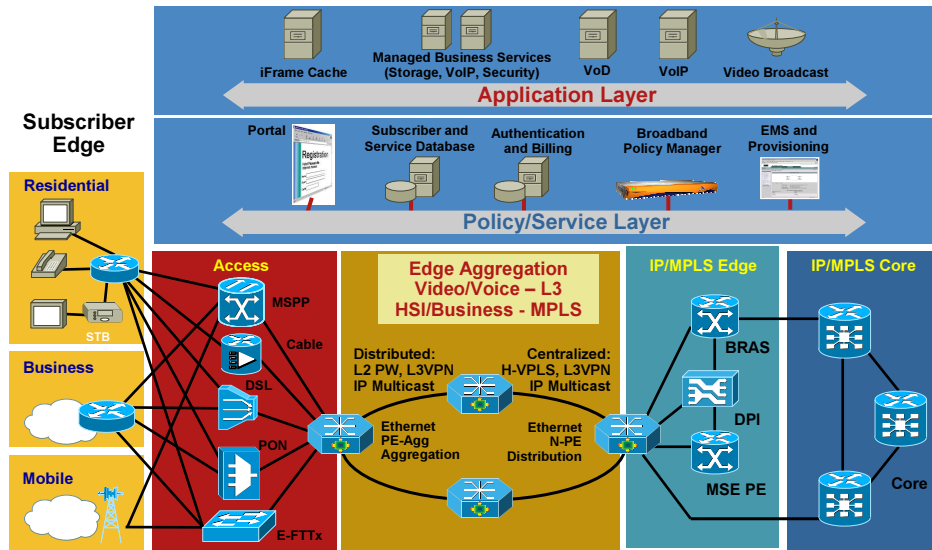
# Services Are Evolving



# ServiceFlex – IP NGN Converged Network Design



# Cisco ServiceFlex Design Transforming Consumer and Business Services



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5

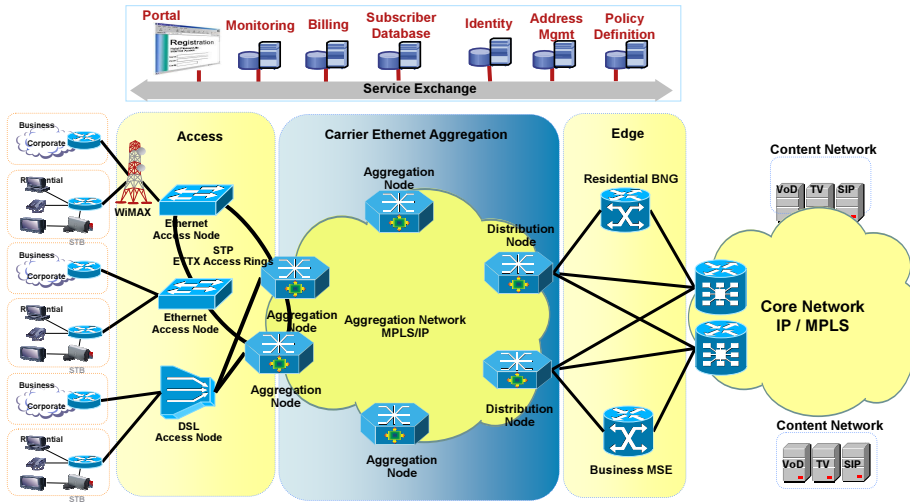
## Metro Ethernet Architecture



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6

# Carrier Ethernet Aggregation System

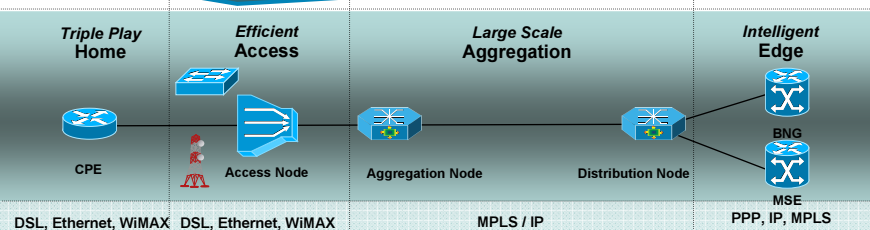


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7

# System Components Overview

CPEs	Access Nodes	Aggregation Node	Distribution Node	Edge Nodes
<b>DSL</b> • Linksys WAG54Gv3, WAG54GP2v2 • Cisco 1800, 2800, 3800 <b>Ethernet:</b> • Telsey CPV, CPL, Tlgin, Voad 200 • Cisco 1800, 2800, 3800, 3400 <b>WIMAX</b> • Redmax SU-O	<b>ADSL2+, VDSL, G.SHDSL</b> • EDA 1200 • ISAM 7302/7330 • UTS AN-2000 IB • ZTE FSAP 9800 <b>Ethernet</b> • ME-3400 • 4924, 6524, 6500 <b>WIMAX</b> • Redmax AN-100U+3400	<b>Cisco 7604, 7609S</b> • RSP-720 • ESM 20xGE, 2x10GE, SIP-400/10xGE • Software: 12.2.33SRB EVC 1.5 infrastructure	<b>Cisco 7609S</b> • RSP-720 • ESM 20xGE, 2x10GE, SIP-400 / • Software: 12.2.33SRB EVC 1.5 infrastructure	<b>Cisco 10008</b> • PRE3, 12.2.31SB R4 <b>Cisco GSR</b> • SIP-601, 12.0.32SY3

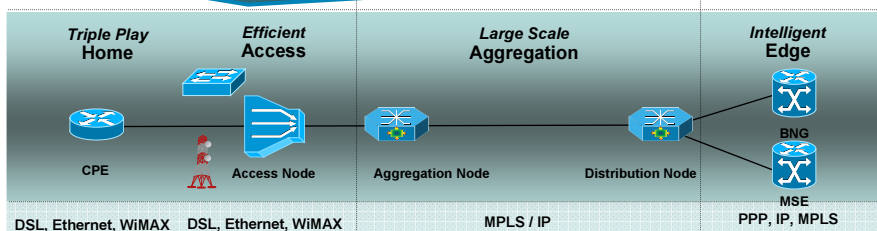


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8

# System Functional Overview

Access Network Functions	Aggregation Network Functions	Edge Nodes Functions
<ul style="list-style-type: none"> <li>DSL, Ethernet and Fixed WiMAX Access</li> <li>DSL Forum TR-101 functions</li> <li>MEF Ethernet services models</li> <li>N:1 and 1:1 VLAN Multiplexing Models</li> <li>Multi VC, Trunk and Non Trunk UNI options</li> <li>ETTX STP Access Rings and Hub and Spoke</li> <li>WiMAX nodes integrated in the ETTX Access</li> <li>DSL Access Nodes with redundant connectivity</li> </ul> <p>Residential, Business, Ethernet Bitstream services</p>	<ul style="list-style-type: none"> <li>Transport Functions between Access and Edge</li> <li>Intelligent Access Multiplexing</li> <li>MPLS/IP Layer 2 and Layer 3 transport services                             <ul style="list-style-type: none"> <li>Transparent virtualized Ethernet P2P and MP transport (EoMPLS and H-VPLS) for services with IP/L3/VPN/L2/VPN Edge in BNG and MSE</li> <li>Service aware IP transport for 3play (IPTV, VoD, Voice) services.</li> </ul> </li> <li>The L2/L3 MPLS/IP transport layer provides flexibility scalability, transparency, virtualization and service awareness when required</li> <li>The Aggregation Network provides the option for implementing L2/L3 Business VPN Services</li> </ul>	<ul style="list-style-type: none"> <li>Subscriber and Service Edge</li> <li>Residential HSI in BNG</li> <li>Business L2/3VPNs in MSE</li> </ul> <p>This network layer may be already present</p>

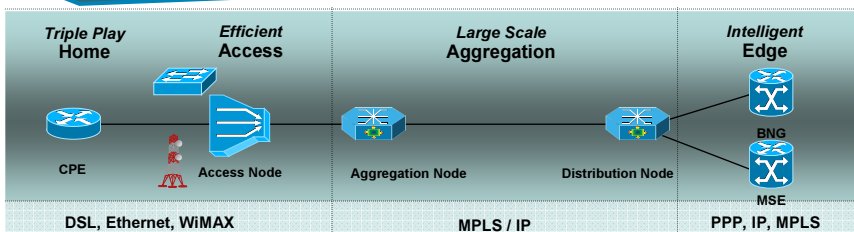


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9

# Residential CPE Functions

Routed CPE	Bridged CPE
<ul style="list-style-type: none"> <li>CPE interfaces:                             <ul style="list-style-type: none"> <li>802.3, 802.11a/b/g LAN interface</li> <li>ADSL/2+, VDSL, 802.3 WAN interface with Non Trunk UNI (single VC), Trunk UNI (multi VC)</li> </ul> </li> <li>Forwarding function based on NAT/PAT:                             <ul style="list-style-type: none"> <li>Local DHCP server for the LAN interface</li> <li>PPPoE and DHCP clients on the WAN interface</li> <li>Forwarding decision based on service destination (routing with different service routes) or home device mapping (home device mapped to different WAN interface/VC). Mapping functions configured by GUI, DHCP Op121 or TR-69</li> <li>Triple Play Service Support Functions: IGMP proxy routing, SIP and RSTP ALG (NAT traversal)</li> </ul> </li> <li>QoS support on the WAN interface                             <ul style="list-style-type: none"> <li>ATM COS (multiple VCs), Home Device Classification (MAC, 802.1P COS, DSCP, Op 60) and scheduling</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>CPE interfaces:                             <ul style="list-style-type: none"> <li>802.3, 802.11a/b/g LAN interface</li> <li>ADSL/2+, VDSL, 802.3, WiMAX WAN interface with Non Trunk UNI (single VC), Trunk UNI (multi VC)</li> </ul> </li> <li>Forwarding function based on 802.1D bridging:                             <ul style="list-style-type: none"> <li>DHCP snooping</li> <li>PPPoE and DHCP clients on the home devices</li> <li>Forwarding decision based on service destination (bridging to different service routers) or home device mapping (home device mapped to different WAN interface/VC). Mapping functions configured by GUI, DHCP snooping or TR-69</li> <li>Triple Play Service Support Functions: IGMP snooping</li> </ul> </li> <li>QoS support on the WAN DSL interface                             <ul style="list-style-type: none"> <li>ATM COS (multiple VCs), Home Device Classification (MAC, 802.1P COS, DSCP, Op 60) and scheduling</li> </ul> </li> </ul>

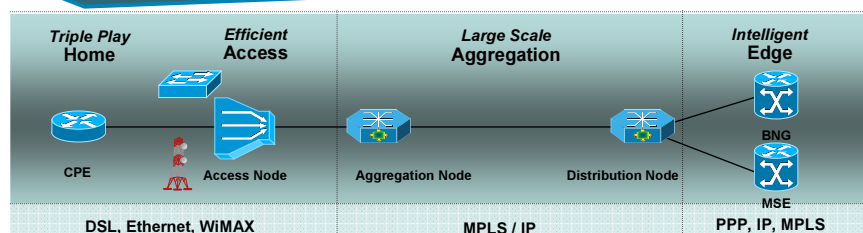


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10

# Business CPE Functions

Routed CPE	Bridged CPE
<ul style="list-style-type: none"> <li>• CPE interfaces:                             <ul style="list-style-type: none"> <li>• LAN: 802.3, 802.11a/b/g, others</li> <li>• WAN: ADS/2+, SHDSL, 802.3 interface with Non Trunk UNI (single VC) or multiple Non Trunk UNI interfaces</li> </ul> </li> <li>• IP Routing Forwarding function:                             <ul style="list-style-type: none"> <li>• IP unicast and multicast</li> <li>• PPPoE, IPoE encapsulations on the WAN</li> <li>• Dynamic routing RIP, OSPF, E-BGP and PIM</li> </ul> </li> <li>• QoS support on the WAN interface                             <ul style="list-style-type: none"> <li>• DSCP classification and scheduling, 802.1p marking</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• CPE interfaces:                             <ul style="list-style-type: none"> <li>• LAN: 802.3, with 802.1Q support</li> <li>• WAN: 802.3, WiMAX with 802.1Q support</li> </ul> </li> <li>• 802.1Q Bridging Forwarding function:                             <ul style="list-style-type: none"> <li>• Spanning Tree Protocol (not on WiMAX)</li> </ul> </li> <li>• QoS support on the WAN DSL/Ethernet interface                             <ul style="list-style-type: none"> <li>• 802.1p classification and scheduling</li> </ul> </li> </ul>

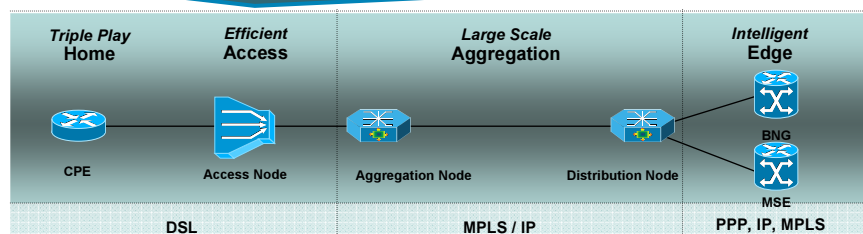


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11

# DSL Access Node Functions

Residential Services	Business Services
<ul style="list-style-type: none"> <li>• Access Node interfaces                             <ul style="list-style-type: none"> <li>• NNI: 802.1q (uplink and subbanding)</li> <li>• UNI: ADSL/2+, VDSL with Non Trunk UNI (single VC or priority tagged UNI), Trunk UNI (multi VC or 802.1Q)</li> </ul> </li> <li>• Access Node Functions with Residential Services support                             <ul style="list-style-type: none"> <li>• 1:1 and N:1 VLAN connectivity</li> <li>• Subscriber isolation function in N:1 VLANs</li> <li>• DHCP OP82 and PPPoE Line ID tag support</li> <li>• ARP, MAC and IP spoofing prevention on Access UNI ports</li> <li>• IGMP snooping, w/ proxy reporting IGMP filters, IGMP fast leave</li> <li>• MAC limit on port and broadcast rate limit on upstream direction</li> <li>• STP(MST) and Active/Backup u support for redundant uplink connectivity</li> <li>• ATM COS and IEEE 802.1p classification and prioritization on UNI interface, policing upstream</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Access Node interfaces                             <ul style="list-style-type: none"> <li>• NNI: 802.1q (uplink and subbanding)</li> <li>• UNI: ADS/2+, VDSL, G.SHDSL with Non Trunk UNI (single VC or priority tagged UNI), Trunk UNI (multi VC or 802.1Q)</li> </ul> </li> <li>• Access Node Functions with Business services support                             <ul style="list-style-type: none"> <li>• 1:1, N:1 VLAN connectivity</li> <li>• MAC limits, ACLs, BPDU filters on Access UNI ports (bridge domain)</li> <li>• STP(MST) and Active/Backup support for redundant uplink connectivity</li> <li>• IEEE 802.1p classification, marking and prioritization on the UNI interface, policing upstream</li> </ul> </li> </ul>

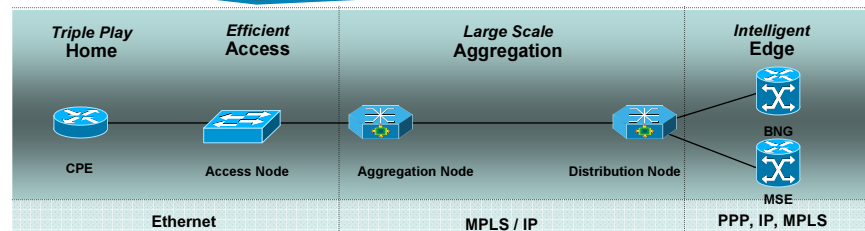


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12

# Ethernet Access Node Functions

Residential Services	Business Services
<ul style="list-style-type: none"> <li>• Access Node interfaces                             <ul style="list-style-type: none"> <li>• NNI: 802.1q (uplink and subtyping)</li> <li>• UNI: Ethernet, Non Trunk UNI and Trunks UNI</li> </ul> </li> <li>• Access Node Functions with Residential Services support                             <ul style="list-style-type: none"> <li>• 802.1Q with STP support</li> <li>• 1:1 and N:1 VLAN connectivity</li> <li>• DHCP snooping OP82 Line Identity</li> <li>• ARP, MAC and IP spoofing prevention (DAI, IPSG)</li> <li>• Port Security (MAC limit and unicast/multicast flood limit)</li> <li>• IGMP snooping, w/ proxy reporting, IGMP filters, fast leave</li> <li>• STP security (BPDU guard, Root guard), fast convergence (RST)</li> <li>• Private VLAN (with community and isolated VLAN support) and MVR</li> <li>• IEEE 802.1p/DSCP classification, marking and prioritization on the UNI interface, policing per service class upstream</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Access Node interfaces                             <ul style="list-style-type: none"> <li>• NNI: 802.1q (uplink and subtyping)</li> <li>• UNI: Ethernet, Non Trunk UNI and Trunks UNI</li> </ul> </li> <li>• Access Node Functions with Residential and Business services support                             <ul style="list-style-type: none"> <li>• 802.1Q with STP support</li> <li>• 802.1Q tunneling per port or access node</li> <li>• L2PT (Layer 2 Protocol Tunneling) and COS mutation</li> <li>• MAC limits, ACLs, BPDU filters on UNI ports and bridge domain)</li> <li>• IEEE 802.1p/DSCP classification, marking and prioritization on the UNI interface, policing upstream</li> <li>• STP security (BPDU guard, Root guard), fast convergence (RST), control plane policing</li> </ul> </li> </ul>

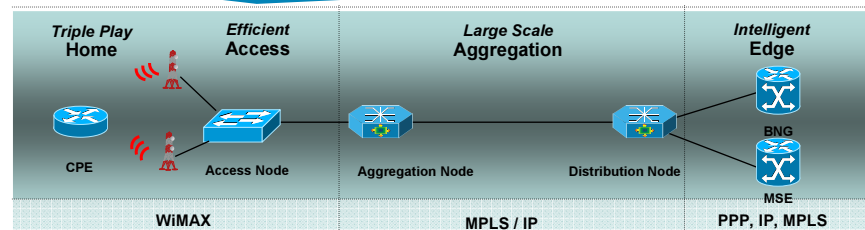


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13

# WiMAX Access Node Functions

Residential Services	Business Services
<ul style="list-style-type: none"> <li>• Access Node interfaces                             <ul style="list-style-type: none"> <li>• NNI: Ethernet 802.1Q transparent bridge</li> <li>• UNI: Fixed WiMAX 802.16-2004 P2P and P2MP</li> </ul> </li> <li>• Access Node Functions with Residential Services support                             <ul style="list-style-type: none"> <li>• DHCP OP82 Line Identity support</li> <li>• Multipoint bridging with split horizon</li> <li>• IEEE 802.1p classification and mapping to the WiMAX service flows, which provides per subscriber endpoint per service class scheduling</li> </ul> </li> <li>• Usually there are 6WiMAX sector controllers deployed per site that will be connected in an Ethernet Access Node that complements the functions required for residential and business services support</li> </ul> <p>Note the VLAN tags are initiated by the CPE</p>	<ul style="list-style-type: none"> <li>• Access Node interfaces                             <ul style="list-style-type: none"> <li>• NNI: Ethernet 802.1Q transparent bridge</li> <li>• UNI: Fixed WiMAX 802.16-2004 P2P and P2MP</li> </ul> </li> <li>• Access Node Functions with Residential Services support                             <ul style="list-style-type: none"> <li>• P2P and MP bridging with no split horizon</li> <li>• IEEE 802.1p classification and mapping to the WiMAX service flows, which provides per subscriber endpoint per service class scheduling</li> </ul> </li> <li>• Usually there are 6WiMAX sector controllers deployed per site that will be connected in an Ethernet Access Node that complements the functions required for residential and business services support</li> </ul> <p>Note the VLAN tags are initiated by the CPE</p>

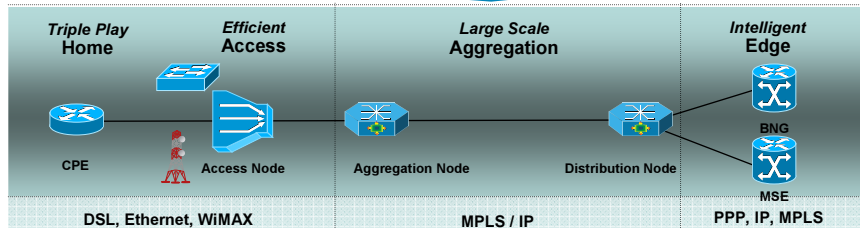


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14

# Aggregation Network Functions

Aggregation Node	Distribution Node
<ul style="list-style-type: none"> <li>• May provide Access Node for business Ethernet services</li> <li>• Flexible Ethernet UNI functions (Access Node interface):                             <ul style="list-style-type: none"> <li>• Classification: port, 1Q, range 1Q, QinQ, untagged traffic</li> <li>• Translation and Rewrites: push and pop tags</li> <li>• H-QOS (parent shaper child queuing)</li> </ul> </li> <li>• Carrier Ethernet Forwarding functions (also concurrent):                             <ul style="list-style-type: none"> <li>• EoMPLS Pseudowire and VPLS VFI x-connect</li> <li>• Bridge domains with split horizon, IGMP snooping</li> <li>• IP unicast and multicast routing with Multicast CAC and RSVP receiver proxy; MPLS(IP over MPLS and IP multicast over EoMPLS PW) and Multicast VPN support</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• May include Aggregation Node function</li> <li>• Flexible Ethernet UNI functions (BNG/MSE interface):                             <ul style="list-style-type: none"> <li>• Classification: QinQ</li> <li>• Translation and Rewrites: push and pop tags</li> </ul> </li> <li>• Carrier Ethernet Forwarding functions (also concurrent):                             <ul style="list-style-type: none"> <li>• H-VPLS</li> <li>• EoMPLS Pseudowire aggregation</li> <li>• EoMPLS Pseudowire switch function</li> <li>• IP unicast and multicast routing: MPLS (IP over MPLS and IP multicast over EoMPLS PWs) and MPLS/Multicast VPN</li> <li>• MPLS NNI function between Aggregation Network and Core</li> </ul> </li> </ul>

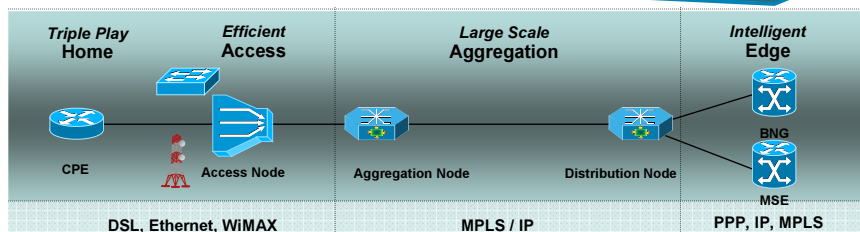


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15

# BNG and MSE Functions

BNG	MSE
<ul style="list-style-type: none"> <li>• 802.1Q and QinQ Access Interfaces</li> <li>• IPoE and PPPoE subscriber sessions</li> <li>• Intelligent Service Gateway session management and control                             <ul style="list-style-type: none"> <li>• Session AAA (RADIUS COA)</li> <li>• Dynamic policy control (RADIUS COA) for: network access policies (QoS, ACLs, L4 redirect), session control policies (session/idle timeouts, service authorization, prepaid), network forwarding policies (L2TP and MPLS VPN mapping)</li> </ul> </li> <li>• IP, L2TP and MPLS (multicast) VPN ISG session forwarding</li> </ul>	<ul style="list-style-type: none"> <li>• 802.1Q and QinQ Access Interfaces</li> <li>• Business Service MPLS PE function:                             <ul style="list-style-type: none"> <li>• MPLS (multicast) VPN</li> <li>• VPLS support for E-LAN services</li> <li>• EoMPLS pseudowire support for E-Line services</li> </ul> </li> <li>• Advanced network access control on the access interfaces:                             <ul style="list-style-type: none"> <li>• ACLs</li> <li>• MAC Limits</li> <li>• BPDU filters and L2TP</li> <li>• Ingress and Egress H-QOS</li> </ul> </li> </ul>



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16



# Cisco Carrier Ethernet Portfolio

Award Winning – Excellence in Innovation



SONET/SDH/Ethernet	DWDM	IP/MPLS and Ethernet
ONS 15454 ONS 15600 ONS 15454 ONS 15327 ONS 15310-MA ONS 15302/305 ONS 15310-CL	ONS 15454 ONS 15216	CRS-1 12000 / XR 12000 Cisco 7600 Catalyst 6500 ME 3400 / ME 2400 ME 4924 ME 6524 Catalyst 3750 Metro Catalyst 4500 Integrated Services Router Cisco 10700

- Cisco Carrier Ethernet Solutions Deliver :**
- Architectural Flexibility - Network Convergence
  - Service Richness - Complete Solutions
  - MEF9 and MEF 14 Certified
  - Portfolio Breadth – End to End Manageability (Ethernet OAM)



## ServiceFlex Design



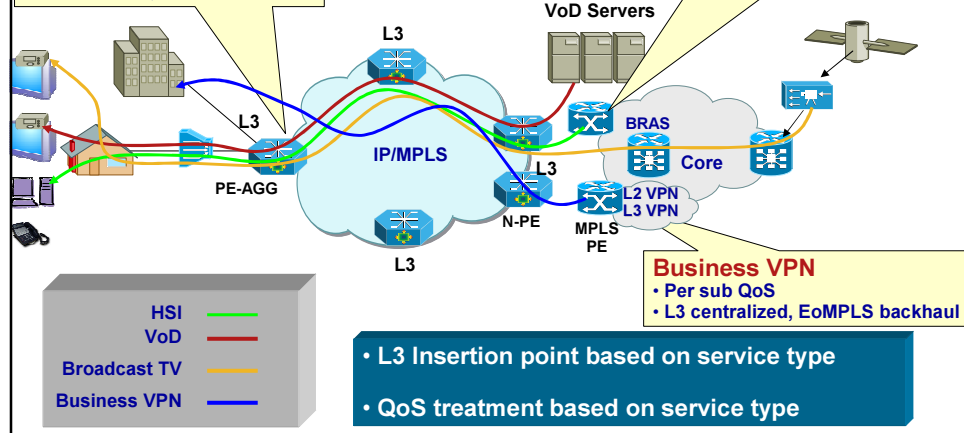
# From Design Principles to Implementation One ServiceFlex Design

**Video and Voice**

- L3 edge distributed for efficient multicast and resiliency
- Per service QoS

**High Speed Internet (HSI)**

- PPPoE & DHCP
- L3 Centralized, EoMPLS Transport
- Per sub QoS

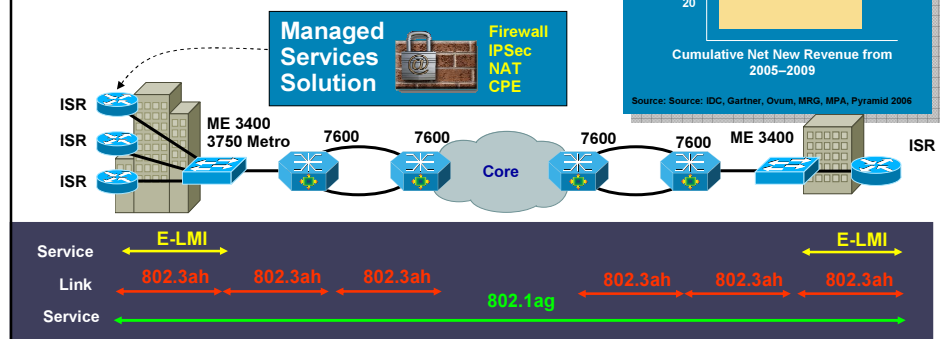
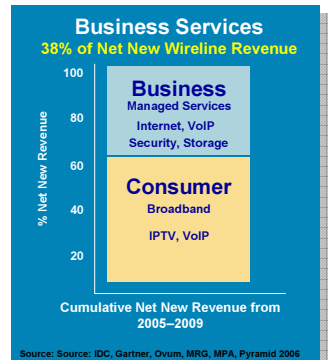


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19

# Business Services: Profitability via Business Ethernet and Managed Services

- Business Ethernet + Triple Play
  - End-to-end Ethernet solution, including ISR
  - 802.1ag, 802.3ah for Ethernet SLAs
  - Auto-provision w/E-LMI for time to service
  - OAM supports ATM/FR to Carrier Ethernet migration
- Layer on Managed Services
  - Increase customer loyalty and revenue
  - Managed Services Solution (NMS + Adv. Services)
  - Managed CPE, Firewall/NAT, IPSec



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20

# FTTH Standards



Technology	Standards	Framing	# Subs per Fiber	Upstream Rates	Mbps per Sub	Downstream Rates	Mbps per Sub	Reach
Ethernet FTTH	IEEE 802.3	Ethernet	1	10 Gbps	1000+	10Gbps	1000+	100Km
BPON	ITU-T G.983.x	ATM	32	155 Mbps	19.4	622 Mbps	19.4	20Km
GPON	ITU-T G.984.x	ATM GFP	32 64	622 Mbps 622 Mbps	19.4 9.7	1.2 Gbps 2.5 Gbps	37.5 37.5	20Km
EPON	IEEE 802.3ah	Ethernet	32	1.25 Gbps	38.4	1.25 Gbps	38.4	20Km

### Ethernet FTTH

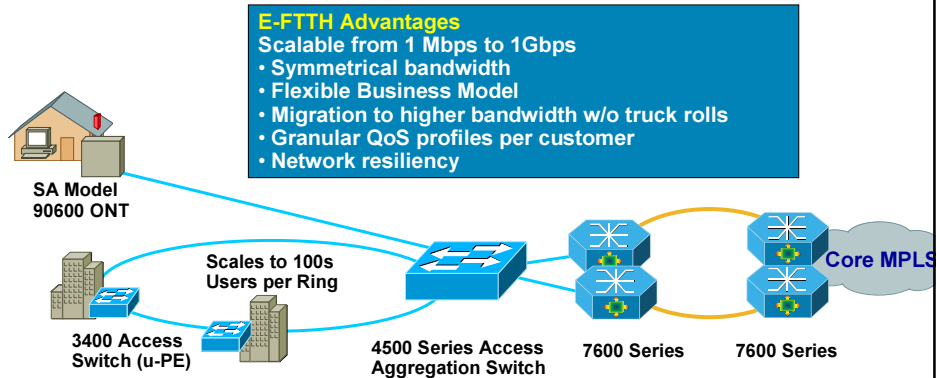
- Bidirectional Scalable Bandwidth
- Granular Traffic Profiles
- Flexible Network Topologies
- Network Resiliency
- Service and Link Layer OAM

### xPON FTTH

- Shares Bandwidth among Subscribers
- Fixed Network Topology
- Specialized Optical Distribution
- Link Layer OAM

# Cisco End-to-End Ethernet FTTH for Enhanced Customer Experience

## New Revenue and Customer Loyalty

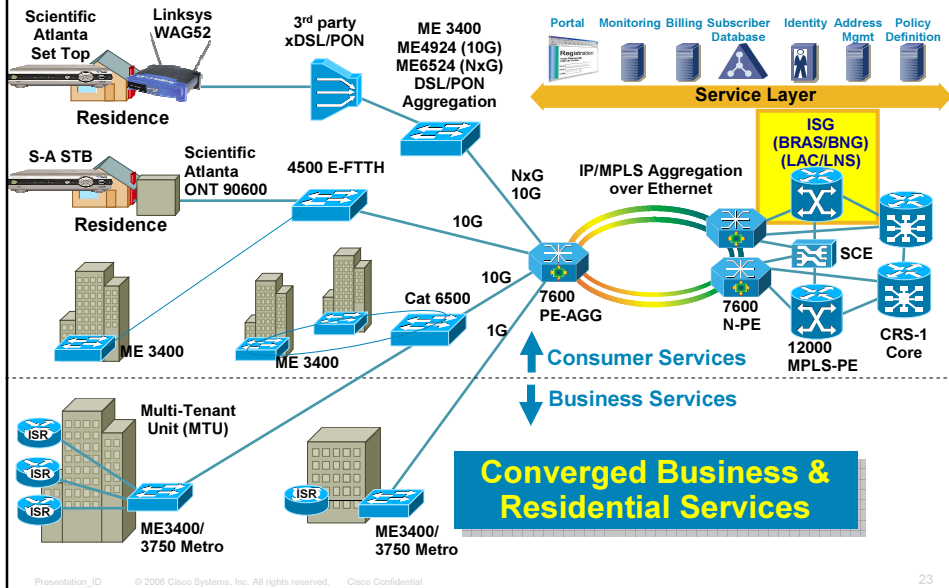


Over 100 FTTH Networks Deployed Globally  
2M+ Subscribers on Cisco E-FTTH Aggregation Networks



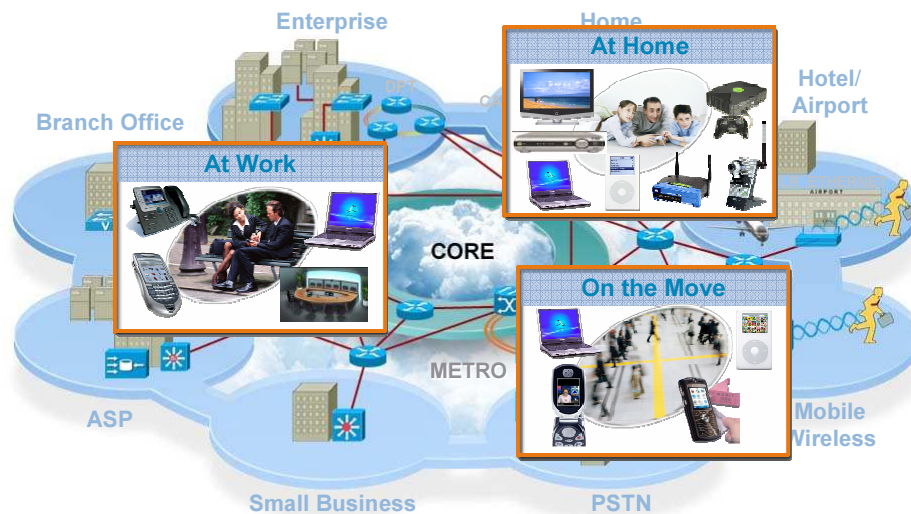
# Cisco ServiceFlex Design

## End-to-End Carrier Ethernet



# Personalized “Any Play” Experiences

## Any Content to Any Device—Anywhere in the Cisco IP NGN



## Cisco 7600 Ethernet Service Edge



Cisco 7600 Series

### Intelligent Services Gateway (ISG)

- **Broadband & Ethernet Aggregation**
- **Consistent session management**  
PPPoE, PPPoEoA, IP, DHCP sessions
- **Greater subscriber awareness**  
AAA, Single Sign-On, User & Service Profiles
- **Integrated policy decision functions**  
Cisco policy language, timers, triggers
- **Greater application awareness**  
Direct Policy Control Bus to Cisco SCE

### Session Border Control (SBC)

- **Delivers video and voice traffic for better QoS/QoE**
- **Supports both SIP and non-SIP apps effectively**
- **Lawful intercept**

## Driving Network Convergence

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25

## Experiences on the Human Network Delivered by Experience Providers, Enabled by Cisco

Connected  
Life



At  
Home



At  
Work



On  
the Move

Personalizes experiences for individual preferences

Experience  
Providers

Delivers unique, integrated experiences



More...



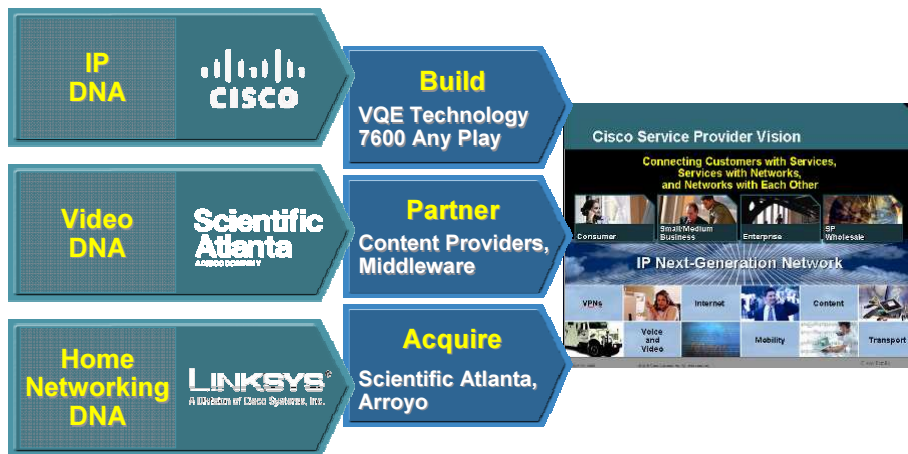
Provides the enabling IP NGN foundation

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26

# Cisco IP NGN Vision and Architecture

## Expanding IP NGN Value Proposition



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27

# Learning from Carrier Ethernet Consumer and Business Deployments



