IPv6 Deployment Experiences

IPv6 Business Information Exchange

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Terminology

- CM – Cable Modem
- MTA – Media Terminal Adapter (VoIP device)
- STB – Set top Box
- eMTA – Embedded MTA (CM-MTA in one device)
- eSTB – Embedded STB (CM-STB in one device)
- CPE – Customer Premises Equipment
- IGD – Internet Gateway Device
- DOCSIS – Data over cable standard Interface specification
- PacketCable – Specification to provision and support MTAs behind a CM
- Provisioning – Assigning an IP-address and a service tier to device and subscriber

Motivation

- IPv4 address space has almost been exhausted
  - Internet Assigned Numbers Authority (IANA) is expected to run out of IPv4 addresses in 2011
  - American Registry of Internet Numbers (ARIN) recently announced IPv4 scarcity
- To enable growth, service providers need to leverage IPv6 while maintaining IPv4 service
- IPv6 brings additional service possibilities.
  - During planning, consider extra value-added services

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Deployment Considerations and Best Practices

- Migration to IPv6 similar to migration from seven- to ten-digit dialing
  - No predetermined end date
  - Far-reaching
  - Requires careful planning
  - Phased rollout

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Core Concepts

- Deploy IPv6 to enable and support device management, example devices include:
  - Cable modems
  - Media terminal adapters
  - Set top boxes
- IPv6 capable components to achieve this minimally include:
  - Core network
  - Access network
  - Device provisioning and management
- Leverage deployment of common infrastructure to enable IPv6 consumers and drive content and service availability using IPv6

Planning

- Gradual phased deployment
- Proceed sequentially through the following areas
    - Addressing plans
    - Network
    - Back Office
    - DNS
    - Subscriber Services
    - Content and Internet Services

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Addressing

- Consider addressing plans early
- Significant considerations in developing the plan
    - Traffic flow
    - Route aggregation
    - Security
- Poor planning upfront can lead to re-work

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Scope

- Native, dual stack core and access networks
- Backoffice also dual stack, where applicable
- Cable modems (DOCSIS) single stack IPv4 or IPv6
    - eMTAs remain IPv4
    - eSTBs targeted to support IPv4 only or IPv6 only (does not impact content)
    - Support for dual stack CPEs
- Native dual-stack subscriber services
- Leverage well-known transition technologies to enable enterprise desktop IPv6 connectivity, as needed

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Network Core Approach

- Dual Stack preferred, but not always possible
- Consider hardware capabilities
    - IPv6 support in hardware vs. software
        - Impacts throughput, scalability
    - Interior Gateway Routing Protocol
- Upgrade your security infrastructure
    - IPv6 is probably already running on your network, even if you have not enabled the service

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Network Edge Approach

- Plan for gradual migration, not flash cut
- The large volume of subscribers creates scalability and deployment challenges
    - Flash-cuts are not recommended
- DOCSIS® devices support gradual IPv6 deployment
    - Device management
    - Subscriber services
- Best practice is to enable IPv6 granularly

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Network Edge Considerations

- Management and balance of non-IPv6 features relative to IPv6 enablement and deployment
- Large scale testing and interoperability is critical
    - Throughput and performance testing must also be included
- Leverage hardware and software upgrade where possible
    - Coupled with IPv6 enabled firmware for DOCSIS devices enables device migration and management over IPv6

Enterprise Network

- Do not overlook internal enterprise network
- Staff may require IPv6 access to support IPv6 deployment activities
- Multiple deployment methods
    - Native, dual stack preferable
    - Use transition technologies when dual stack is not available
        - ISATAP, static tunnels, others

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Back Office

- Upgrade and migration of back office infrastructure to be IPv6 capable is a significant effort
  - May include operating system and application upgrades as well as data migrations
  - May exceed several hundred servers in some cases
- Includes development, test, and deployment of new applications and systems required to support IPv6
- Includes upgrade and enabling of tools and utility servers for monitoring and management

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Back Office Considerations

- Consider separate vs. combined infrastructure for IPv4 and IPv6
  - Combined more operationally efficient
  - Phased approach - upgrade operating system and network followed by application
- Real deployment efforts will undoubtedly uncover many findings
  - Unexpected issues and bugs with popular operating systems specific to IPv6
  - Many components (not just operating systems) have never been used outside of a lab or controlled environment

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DNS

- DNS importance grows with IPv6
  - Up to 39-character addresses are difficult to remember and type
- Two upgrade issues
  - IPv6 transport - low risk
  - IPv6 address records - higher risk
    - Need to ensure end-to-end IPv6 connectivity first
- DNS can be leveraged as gatekeeper and or enabler for IPv6
  - Separate domain name for IPv6 service
  - “White list” and related approaches for popular Internet presences

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Security

- Support for IPv6 remains a gap for various security components
    - These need to be addressed to ensure IPv6 can be extended and offered to subscribers
- Gaps in IPv6 security may impact various aspects of IPv6 enablement and deployment
    - IDS, IDP, and Vulnerability Assessment

Subscriber Services

- Directly-connected device (CPE) or home gateway (IGD)
- Directly-connected CPE require IPv6 stack, stateful DHCPv6 client, DNS resolver (if single stack IPv6)
- Home gateways serve as single point of attachment
    - Receive an IPv6 prefix (address block) from provider
    - Provision subscriber devices using Stateless Address Autoconfiguration (SLAAC) or stateful Dynamic Host Configuration Protocol (DHCPv6)
    - If using SLAAC, DNS and other device-specific information is delivered via stateless DHCPv6 or Recursive DNS Server option

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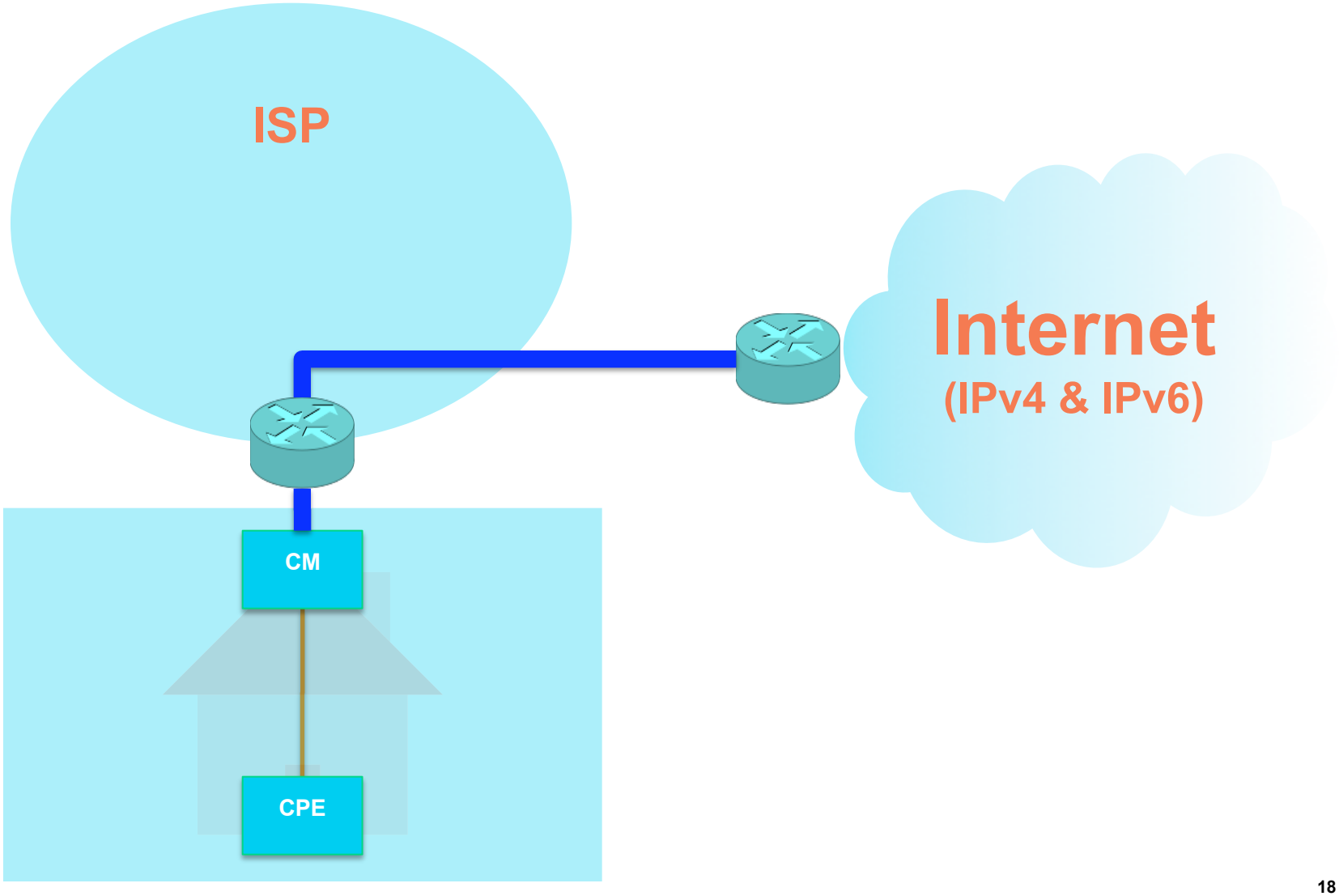
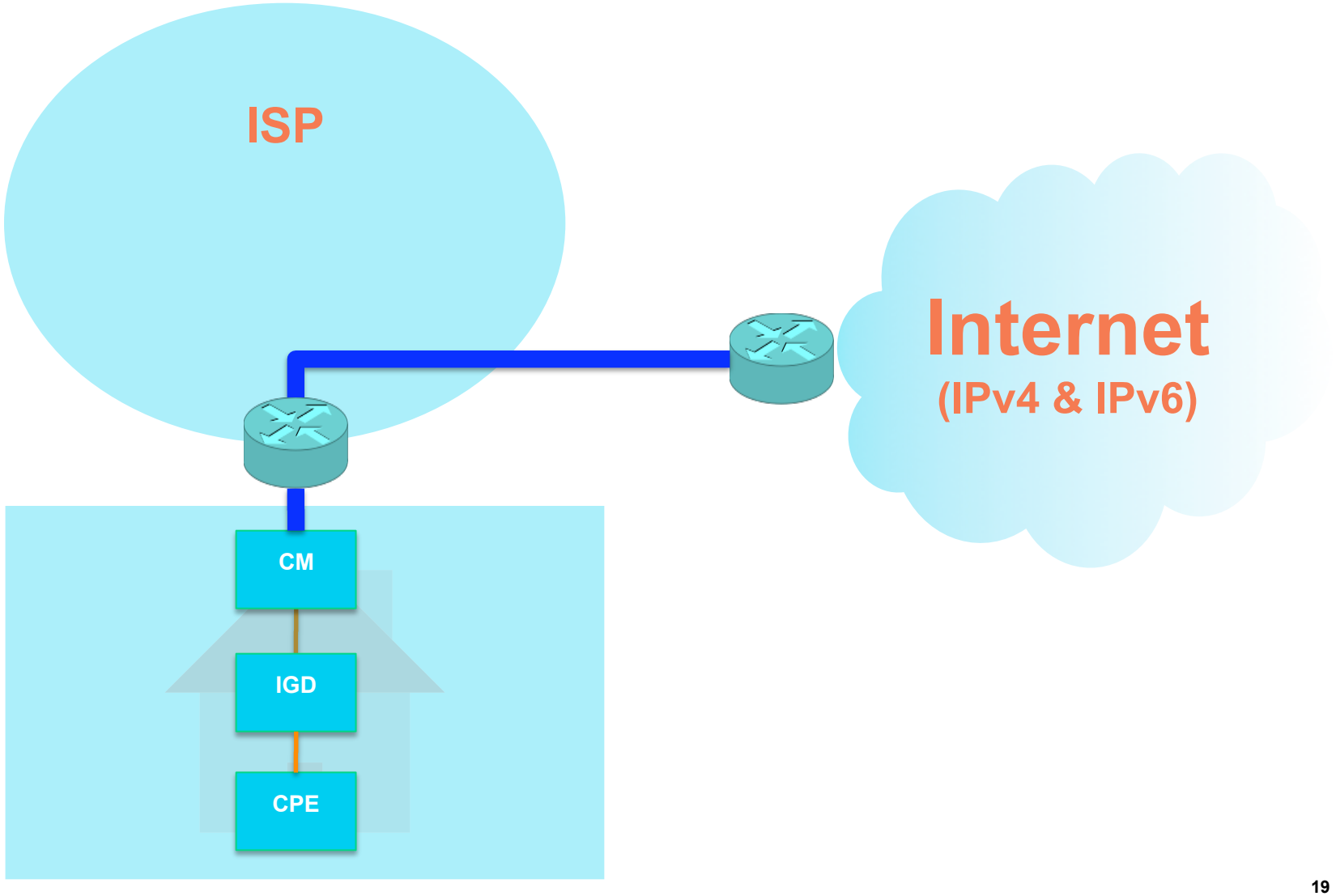
Directly-connected CPE



IGD



Subscriber Services Considerations

- Not all subscriber CPEs support the necessary IPv6 pre-requisites for use in some broadband deployments
- Availability and widespread deployment of IPv6 capable IGDs is lacking
- Challenges associated with routing for delegated IPv6 prefixes should be uniformly addressed

Content Delivery Networks

- Significant content and services delivered by Content Delivery Network (CDN)
  - Internal
  - Third party
- CDN technology must support IPv6
  - Some CDN providers only support IPv4
  - Delaying IPv6 adoption
- If CDN supports IPv6, it can deliver content sourced by IPv4 servers
  - Reduces the upgrade rush for content providers
  - Offers IPv6 access to many sites
  - Accelerates IPv6 adoption

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Content and Services Considerations

- Availability of content and services over IPv6 to date appears to be lacking
- Simply having IPv6 connectivity available is not sufficient
- Availability of content and services over IPv6 must align with availability of the consumers to encourage adoption

Goals and Objectives

- Ensure that underlying infrastructure can support content and service parity over IPv4 and IPv6
    - Native IPv6 is *preferred* versus the use of tunnels and other techniques
- Understand and identify issues, challenges, and gaps associated with offering content and services over IPv6
- To broaden the adoption of IPv6 among consumers and those who provide content and services.
    - Availability of IPv6 should be transparent to subscribers

Conclusion

- Prepare for an iterative strategy
  - Expand IPv6 service in phases
- Deploying IPv6 must not impact existing services
- IPv6 must become business as usual for staff from every area of the business
  - Lack of attention here will continue to be problematic for the deployment of IPv6
  - Deferring or avoiding IPv6 will be problematic and complicate the deployment of IPv6
  - Training and education is essential

Conclusion

- Support for IPv6 is still evolving and is deployable in most cases
- Testing and interoperability are critical for a successful deployment
- IPv6 deployments have been increasing in recent years
- We still have a long road ahead
    - Transition is critical and non-trivial
- A great deal has been learned, more lessons ahead

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Q&A

- Contact information

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Backup

Pre-requisite Highlights for CPE

- For subscriber CPE directly connected to cable modem
  - Support for dual stack CPE by underlying network which includes provisioning
  - IPv6 stack and stateful DHCPv6
  - Applications that support the use of IPv6 transport

Pre-requisite Highlights for IGD

- For subscriber IGD connected to cable modem
  - Support for dual stack CPE by underlying network which includes provisioning
  - IPv6 stack and stateful DHCPv6 (WAN) including prefix delegation
  - Configuration and addressing on subscriber LAN
  - IPv6 routing (and firewall)
  - Subscriber CPE must also support IPv6 including applications

Prefix Delegation and Prefix Stability

- Subscriber IPv4 addresses change during network maintenance
    - Impact mitigated through NAT, Dynamic DNS
- In IPv6, the entire prefix may change
    - Requires different operational behavior from customer
        - Customer network addresses change, too
- Some customers (commercial) demand prefix stability
- Best practice
    - Allocate a dedicated block of stable prefixes
    - Leverage back office to enable renewals
    - Leverage the dynamic routing protocol in the network
    - Consider aggregation point for stable prefixes
- Stable prefixes increase the size of the regional routing table

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Content and Internet Services

- Content available over IPv6 drives adoption
- Similar to back office upgrade process
    - Common infrastructure for IPv4 and IPv6
    - Enable IPv6 on server before announcing service
- DNS serves as the gatekeeper/enabler for IPv6
    - Offers transparent migration to subscribers
    - Can be enabled gradually, area by area

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