Real World IPv6 Migration Solutions

Asoka De Saram
Sr. Director of Systems Engineering, A10 Networks

Agenda

➤ **Choosing the right solutions**

➤ **Design considerations**

➤ **IPv4 to IPv6 migration road map**

➤ **Consumer side considerations**

➤ **Network Service Provider side considerations**

➤ **Content Provider side considerations**

What do you have to think about?

➤ **Choosing the right technology.**
  - ◆ There are many CGN, NAT64, DS-Lite, SLB-PT, 6rd, …
  - ◆ More possible in the future

➤ **Why so many technologies?**
  - ◆ Every network is different
  - ◆ Application requirements
  - ◆ Service Level Agreements
  - ◆ Comfort level (i.e. stateful vs stateless, maturity of the IPv6 stack)
  - ◆ Subscriber base (mobile vs fixed landline)

➤ **After choosing the right technology**
  - ◆ How will it scale?
  - ◆ What are the performance metrics?
  - ◆ Budget considerations

Design Considerations

- **Choosing the right network topology**
  - Inline mode vs one armed mode
  - Placement of the solution (edge, core vs. aggregation)
  - Security considerations
 - Infrastructure considerations (DNS, DHCP, L2/L3 changes)

- **Proof of Concept**
  - Interoperability testing
  - Application testing
  - Performance testing and high availability testing

- **Field User Trials**
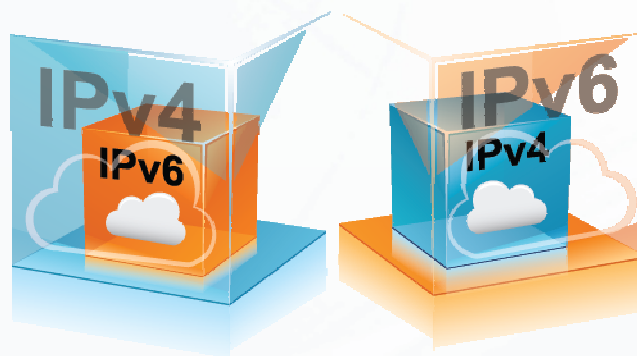 - Partial real world testing with friendly subscribers
  - Security assumptions validations
  - Observing application behavior
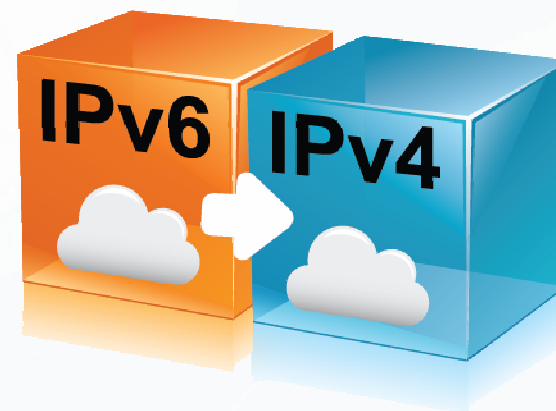 - Verifying application requirements

IPv6 Migration Techniques
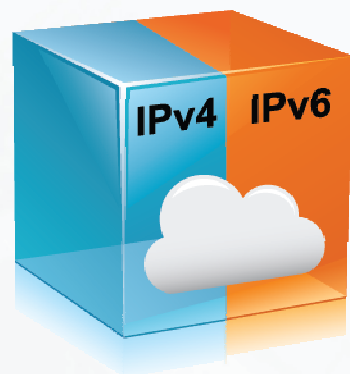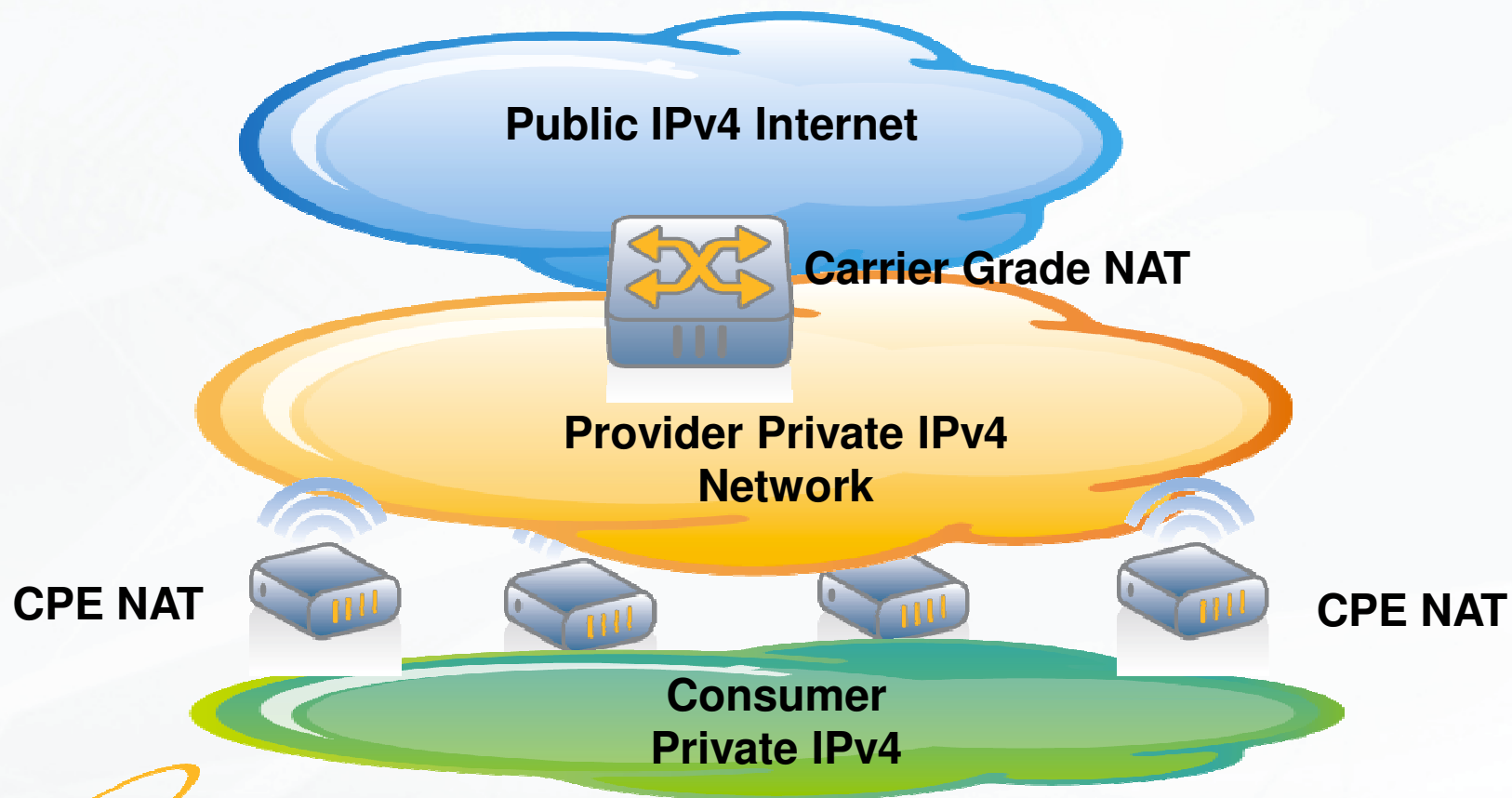
Dual-Stack **Encapsulation** **Translation**

Carrier Grade NAT Topology (NAT444)

➤ **Two Layers of NAT**
- ◆ Customer Premise Equipment NAT (Traditional NAT)
- ◆ Service Provider NAT (CGN)

Public IPv4 Internet

Carrier Grade NAT

Provider Private IPv4 Network

CPE NAT

CPE NAT

Consumer Private IPv4

Carrier Grade NAT Topology (NAT44)

> **Single Layer of NAT**
> - ◆ Provider provisioned end devices
> - ◆ Ideal for mobile handsets

Public IPv4 Internet

Carrier Grade NAT

Provider Private IPv4 Network
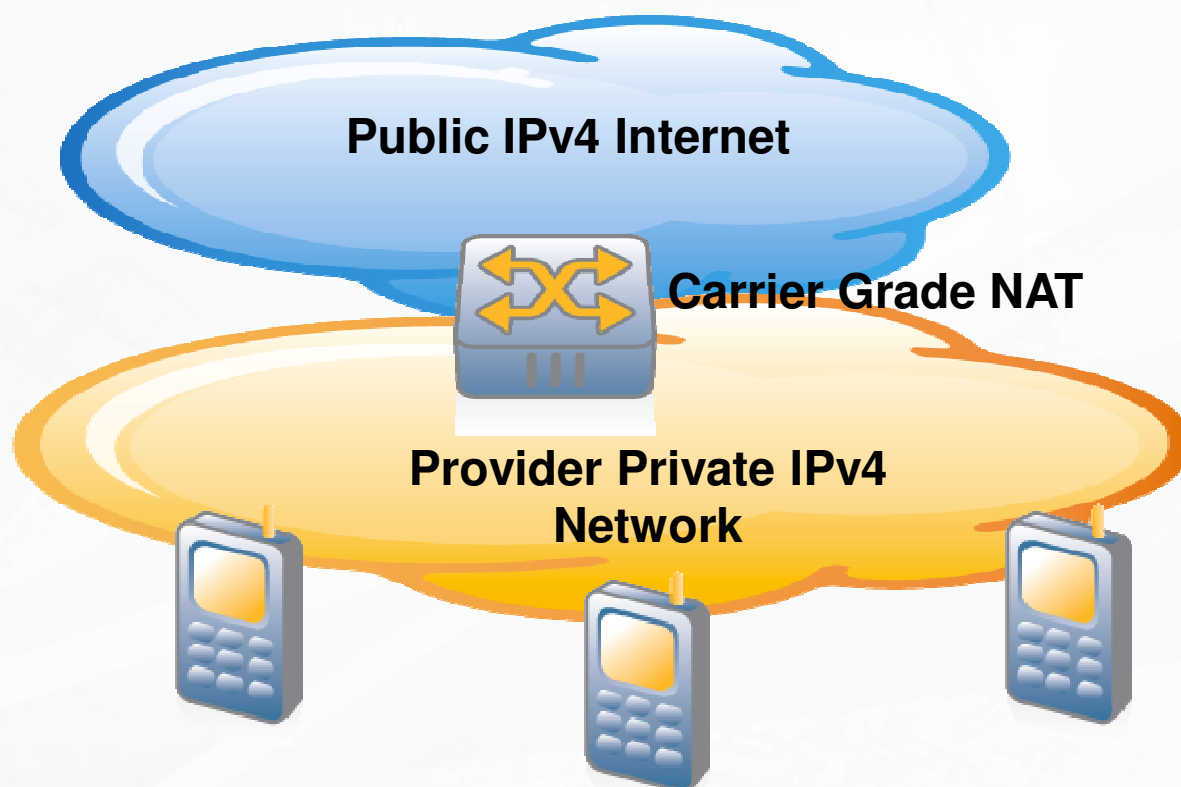
CGN Deployment Topology – Inline Mode

Public IPv4 Internet

Carrier Grade NAT

Carrier Grade NAT

Internal Network Private IPv4
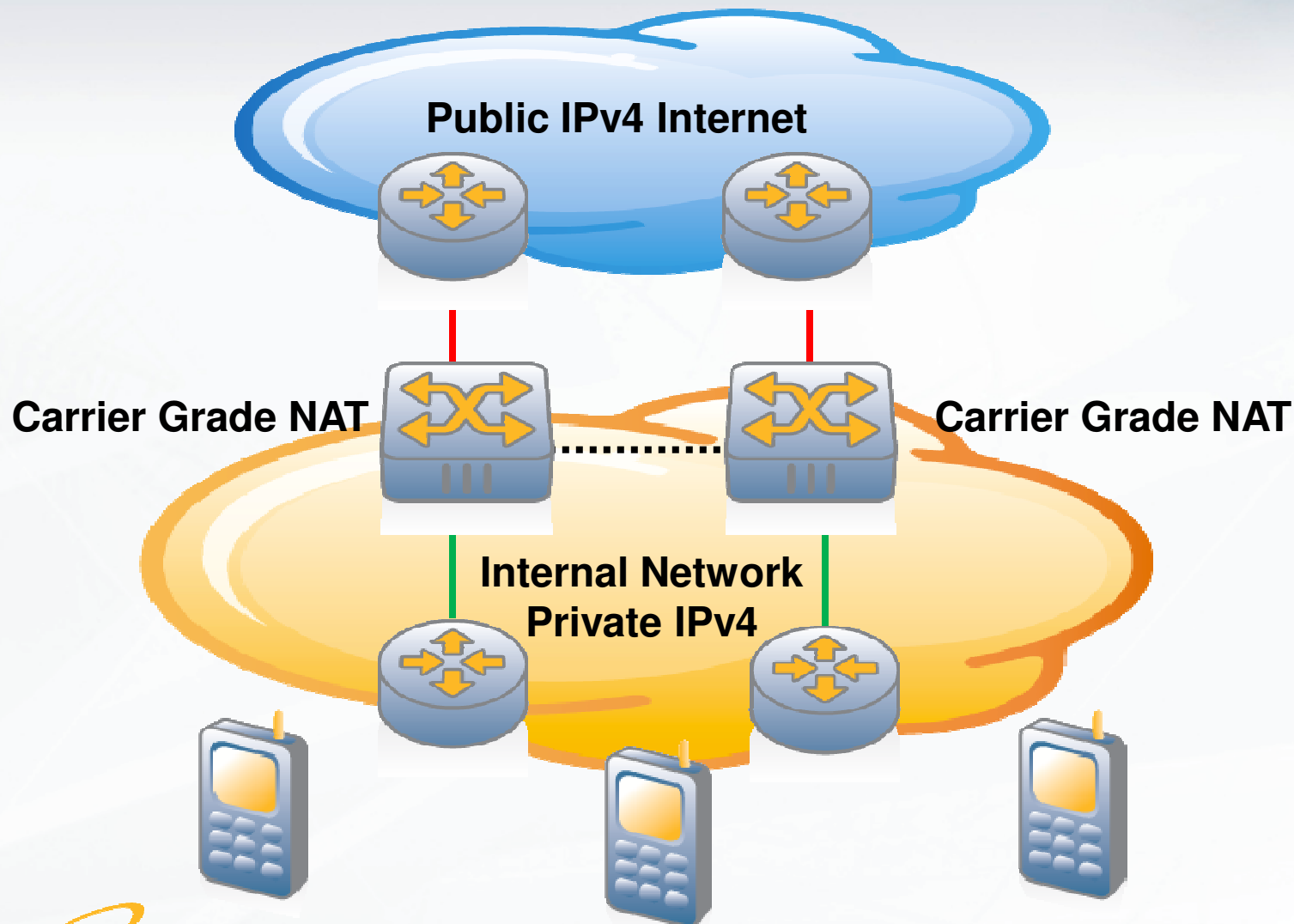
CGN Deployment Topology – One Armed Mode

DS-Lite - Topology

IPv4 Content

IPv6 Content

IPv4 Core Network / Internet

DS-Lite ISP Device (AFTR)

IPv6 Network / Internet

Native IPv4 Packets

IPv4-in-IPv6 Tunneled Packets

Native IPv6 Packets

Provider Network – IPv6

IPv6 Address

Native IPv4 Packets

IPv4 Clients

IPv6 Clients

SLB-PT – Topology

IPv4 and IPv6
Servers

AX SLB-PT
IPv4 VIP

AX SLB-PT
IPv6 VIP

IPv4
Internet

IPv6
Internet

IPv4
Clients

IPv6
Clients
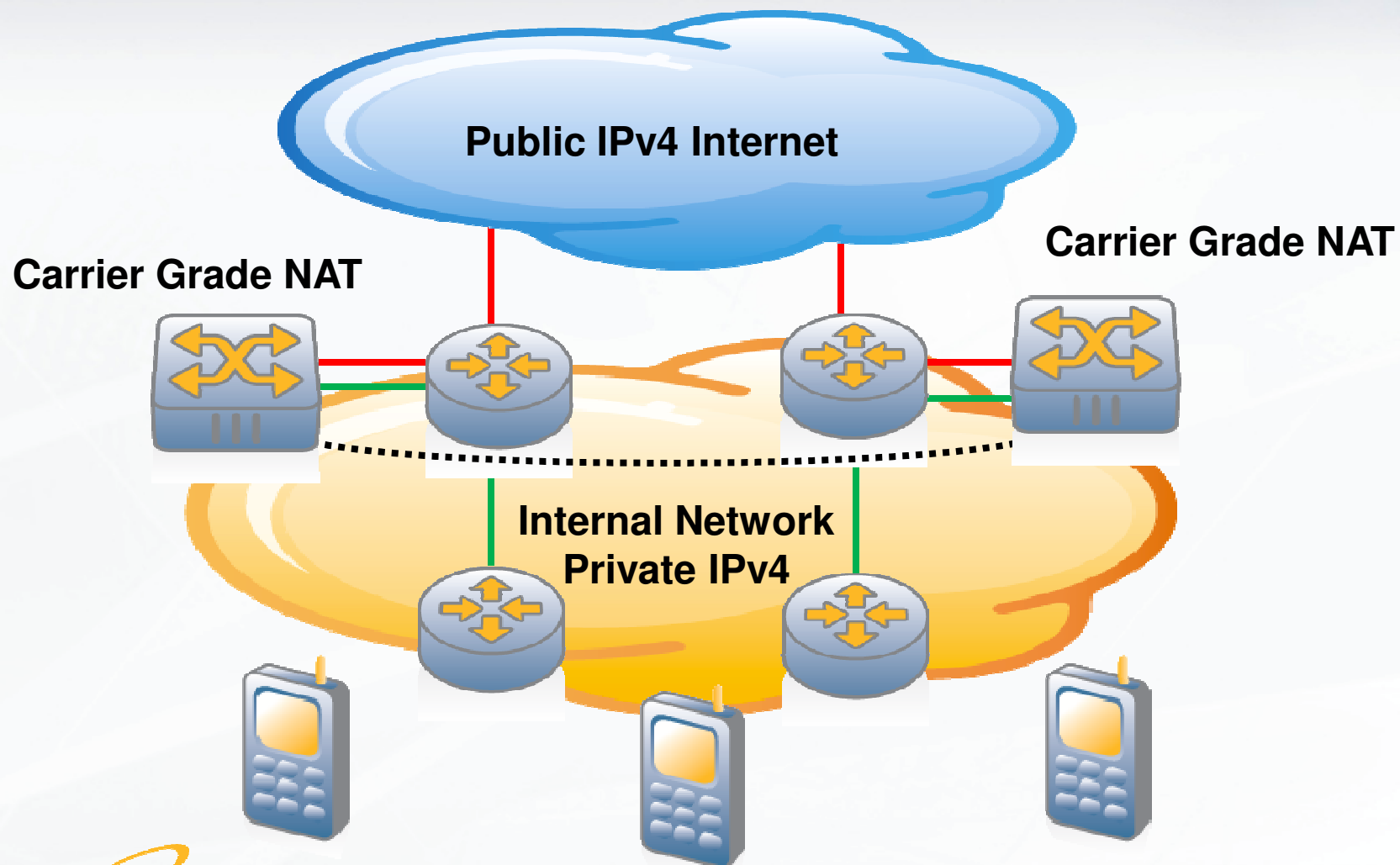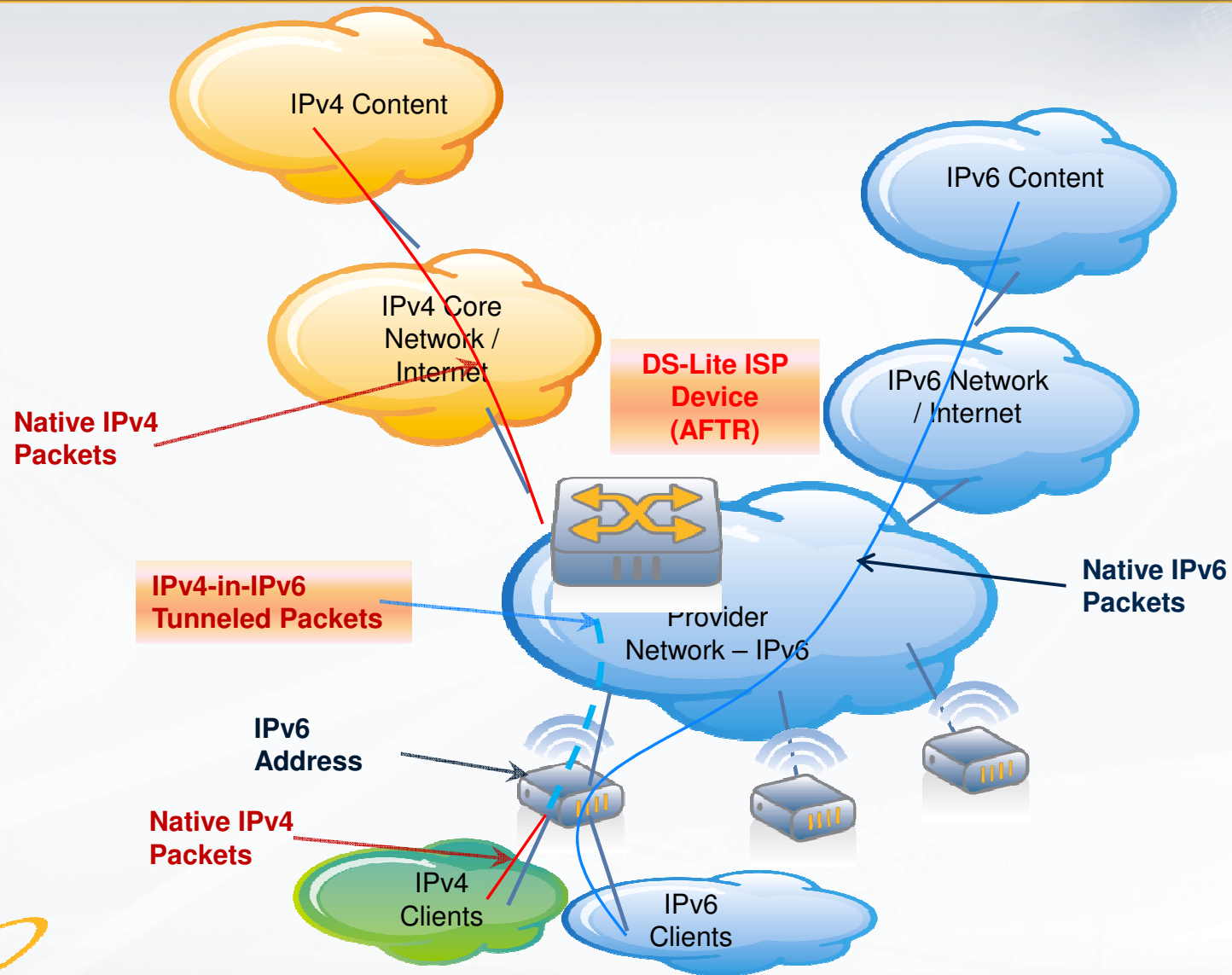
NAT64/DNS64 Deployment Topology

DNS Server Farm

IPv6/v4

IPv6 Internet

IPv6 Servers

IPv6 Provider

IPv6 Client

IPv4 Internet

IPv4 Servers

NAT64 + DNS64 Synthesis
Address Family Translation
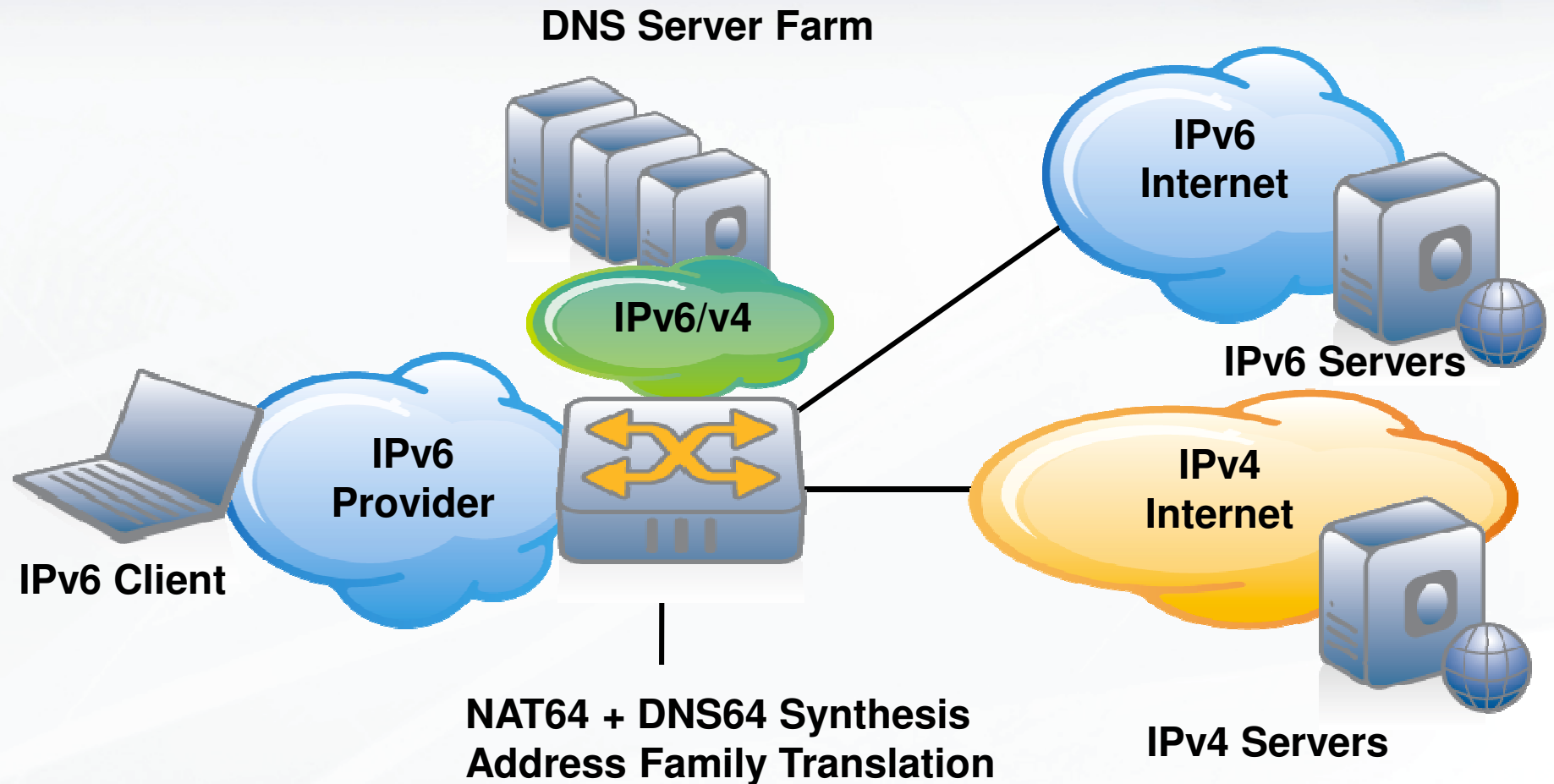
Networking Considerations

- **Fixed Networks (Cable, DSL, Ethernet Networks)**
  - Two layers of NAT (Home NAT + Provider NAT)
  - Choice of provider specific private IPv4 addressing critical
  - More subscribers with IPv6 ready devices
  - Higher bandwidth consumption per subscriber
  - More concurrent connections per subscriber

- **Mobile Networks (3G/4G, WiFi Networks)**
  - One layer of NAT
  - Choice of Provider specific private IPv4 addressing not as critical
  - Fewer subscribers with IPv6 ready devices
  - Lower bandwidth requirements
  - Low concurrent connections per subscriber

Application Considerations

➤ **Client Server Applications**

   ◆ Web

   ◆ Email

   ◆ DNS

➤ **Application that require special handling**

   ◆ Streaming Media (RTSP)

   ◆ File Services (FTP)

   ◆ Voice over IP (SIP)

   ◆ Virtual Private Networking (PPTP, IPSec)

➤ **Peer to Peer Applications**

   ◆ Gaming

   ◆ Instant messaging

   ◆ File sharing

Security Considerations

➤ **Mandating and maintaining the existing security policies**

➤ **How does the migration technology effect security?**

➤ **Standards based approaches**

- ◆ IETF Behave TCP
- ◆ IETF Behave UDP

➤ **How flexible and adaptable is my implementation?**

- ◆ What options are available to adjust parameters, for example:
  - ◇ End Point Independent Filtering
  - ◇ End Point Independent Mapping
  - ◇ User quota
  - ◇ Address selection mechanisms
- ◆ Various application timers and behaviors
  - ◇ Long lived vs short lived (Ex. VPN vs DNS)
  - ◇ Peer to peer applications vs client server applications

Logging Considerations

- ## Required by law enforcement agencies
  - Service Provider Considerations
    - Dynamic vs. Deterministic port allocation
  - Content Provider Considerations
    - Log port number and IPv4 address

- ## Consider Logging Impact
  - Performance impact to CGN
  - Storage requirements
  - Data retention requirements
  - Cost of the logging infrastructure (CPU, Disk, Memory)

- ## Log Reduction Techniques
  - Hex Logging, and Binary Logging (String size reduction)
  - Batch Logging, Fixed NAT, and Deterministic NAT (Volume reduction)

IPv6 Migration Road Map

➤ **Roadmaps are specific to type of deployments**
  - ◆ Consumer space
    - ◇ Home networks
    - ◇ Mobile subscribers
  - ◆ Network Service Providers
    - ◇ Dual Stack (IPv4 and IPv6)
    - ◇ NAT64/DNS64
    - ◇ Tunneling
  - ◆ Content Providers and Enterprises
    - ◇ SLB-PT

IPv4	IPv4 6to4	IPv4 CGN 6rd SLB-PT	IPv4 IPv6 CGN DS-Lite SLB-PT NAT64 6rd	IPv6 IPv4 NAT64	IPv6

Migration Considerations

➢ **Home Networks**

   ◆ Organic upgrades to IPv6 capable systems

      ◇ Wireless Routers, set-top boxes, handsets, laptops, gaming consoles

   ◆ Application availability

   ◆ Customer-premises equipment (DSL, Cable Routers)

➢ **Service Provider Networks**

   ◆ Upgrading the plumbing to support IPv6

   ◆ Service Provider support infrastructure (provisioning tools)

   ◆ Scalability and performance

   ◆ Dedicated translation technologies

➢ **Content Provider and Enterprise Side Considerations**

   ◆ Number of administrative domains

   ◆ Production grade IPv6 content

   ◆ Service Level Agreements

IPv6 in the Enterprise

➤ **Infrastructure Costs**

- ◆ Servers, firewall, routers, switches, and load balancer upgrades
- ◆ Application accessibility and vendor readiness
- ◆ End user requirements – new laptops, handsets

➤ **Business Continuity**

- ◆ Seamless migration strategies
- ◆ Minimizing downtime

➤ **Economics**

- ◆ Additional Expenses
- ◆ Return on investment

➤ **Migration Technologies**

- ◆ Dual Stack
- ◆ SLB-PT
- ◆ NAT64 with DNS64

Summary

➤ **Moving to IPv6 is no longer an option**

➤ **Many challenges**

➤ **Many approaches**

➤ **Many different technologies and considerations**

➤ **Progress is happening on many fronts**

- ◆ Infrastructure Vendors
- ◆ Service Providers
- ◆ Content Providers
- ◆ Application Vendors

➤ **Need more commitment and coordination**

How is A10 involved?

› **Working with many different parties in the transition process**

› **Support for many different technologies**

  ◆ CGN
  ◆ DS-Lite
  ◆ NAT64/DNS64
  ◆ NAT46
  ◆ SLB-PT
  ◆ 6rd
  ◆ Full IPv6 feature parity with IPv4 SLB features

› **Capability to support all these technologies concurrently**

› **Flexible, feature-rich, scalable, high performing and adaptable implementation**
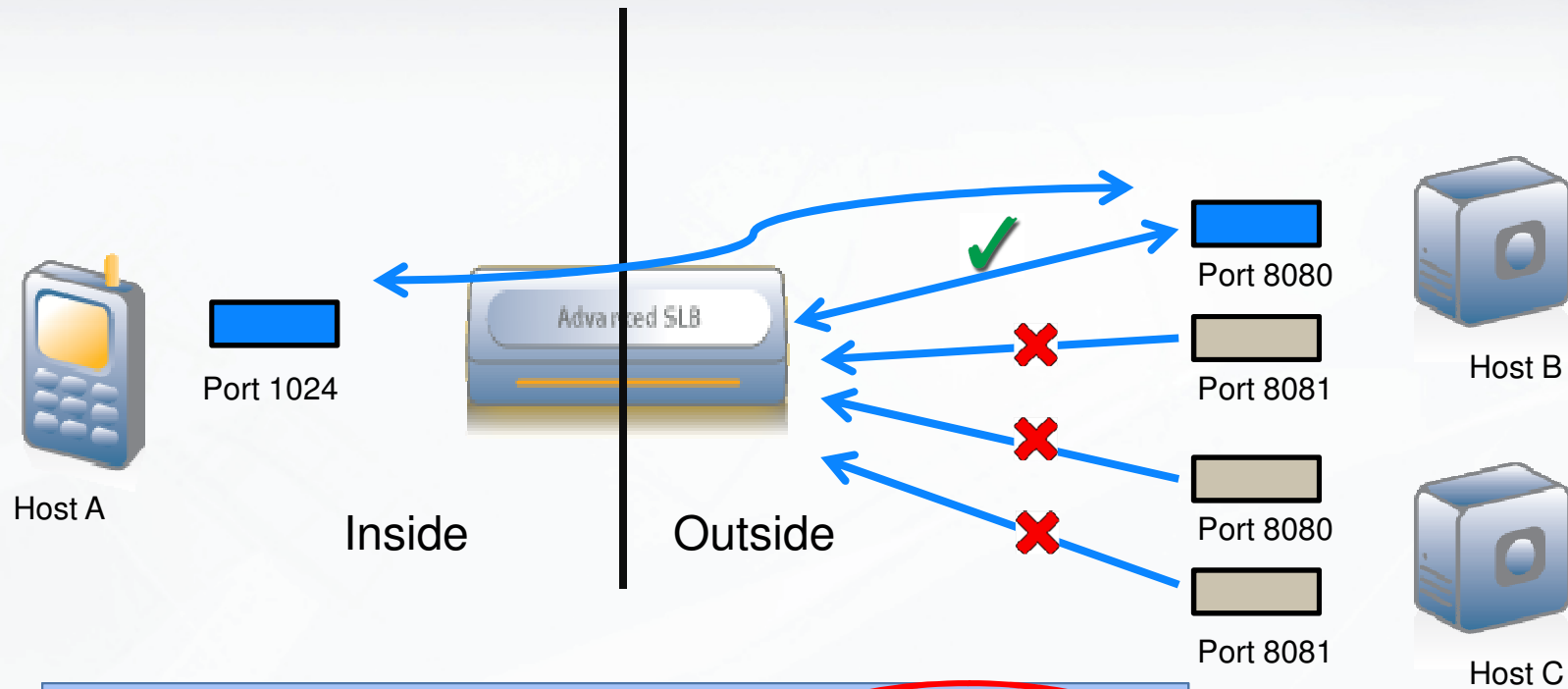
Questions ?

End Point Independent Filtering

Internal	External	Filter
A:1024/B:8080	X:9001/B:8080	*:*/X:9001
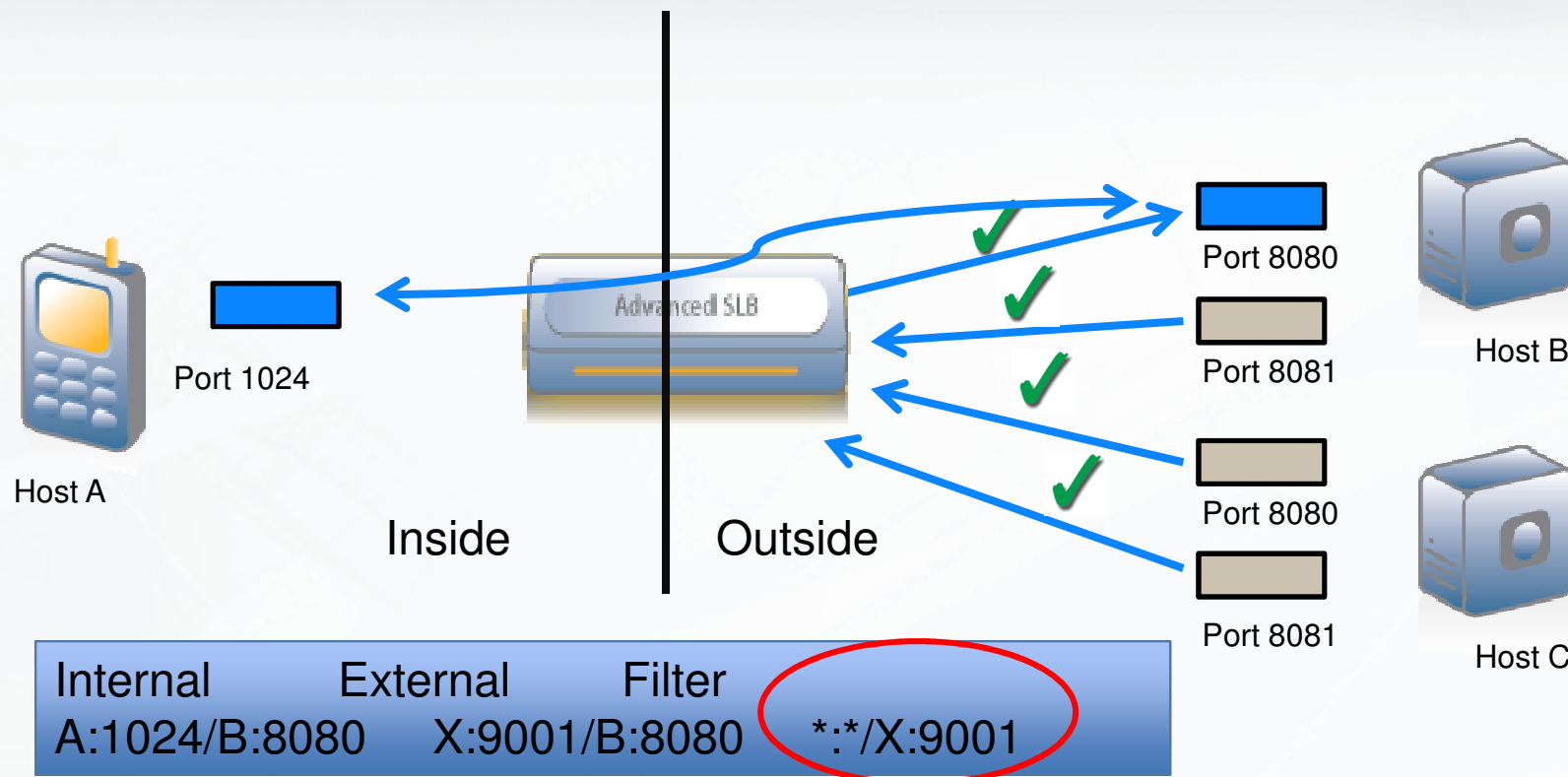
Address and Port Dependent Filtering

Internal	External	Filter
A:1024/B:8080	X:9001/B:8080	B:8080/X:9001