The Road to IPv6

Building the Foundation for the

3G Wireless Internet

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IPv6 and Networked Economy

- **The World Today**
- **Nortel's Internet Focus**
  - *"What do you want the Internet to be?"*
- **Nortel Network's IPv6 strategy**
- **Nortel Network's IPv6 Enabled Products**
- **Summary**

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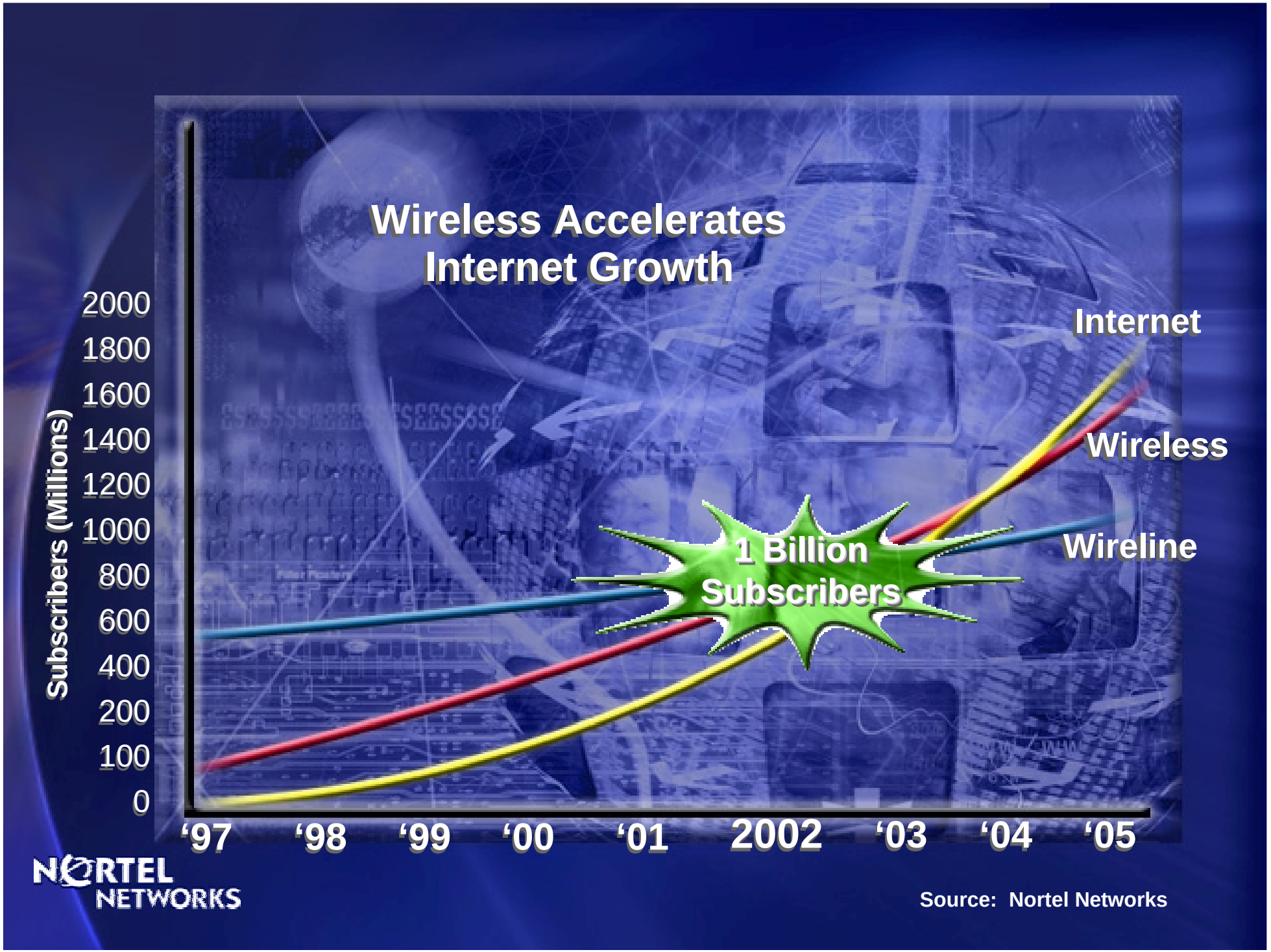
Wireless Accelerates
Internet Growth
Subscribers (Millions)
2000
1800
1600
1400
1200
1000
800
600
400
200
100
0
Internet
Wireless
Wireline
1 Billion
Subscribers
'97
'98
'99
'00
'01
2002
'03
'04
'05
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Source: Nortel Networks


Wireless Bandwidth Cycle
Wireless Users
Services & Applications
Higher Connectivity Speeds
Infrastructure
Services & Applications
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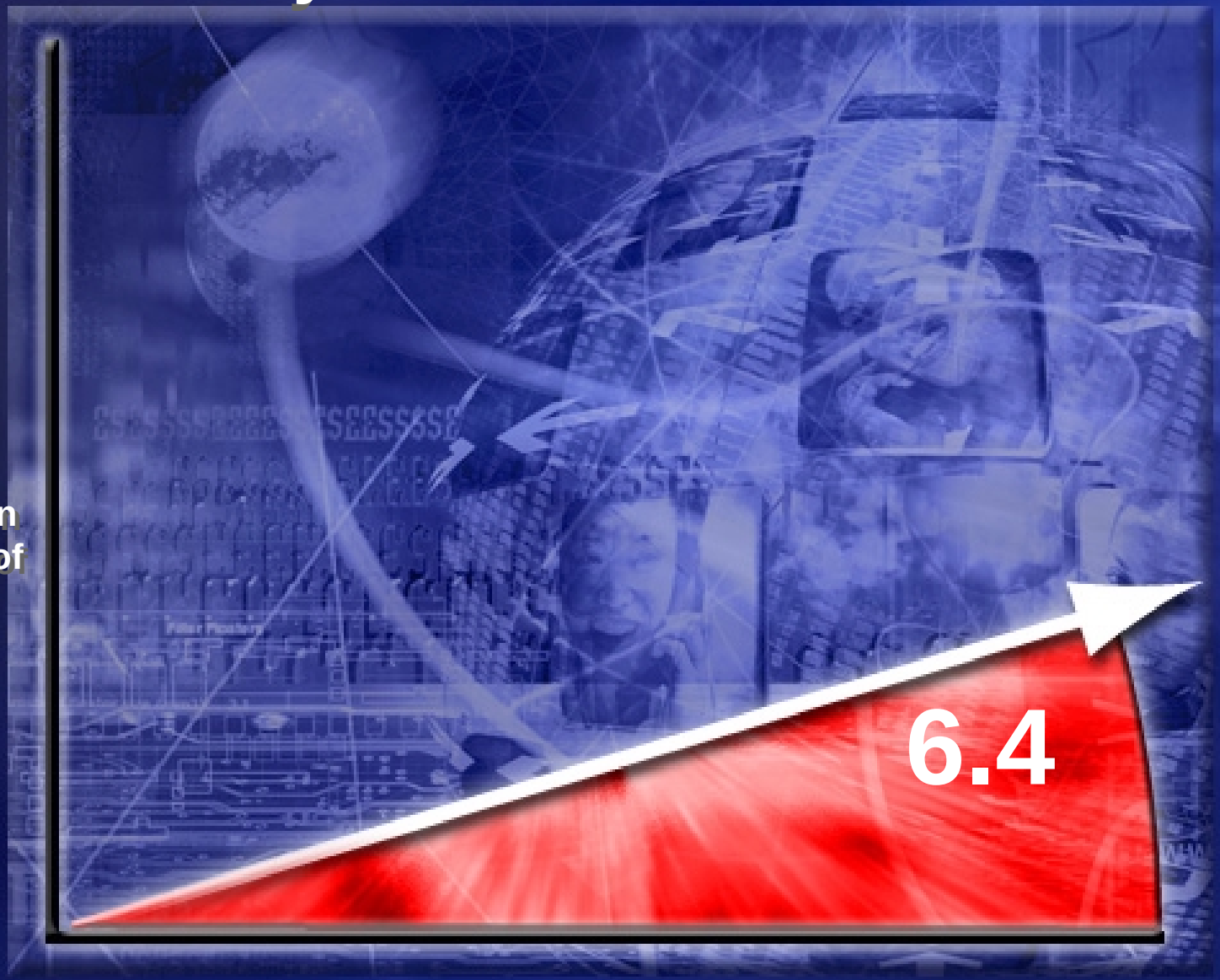
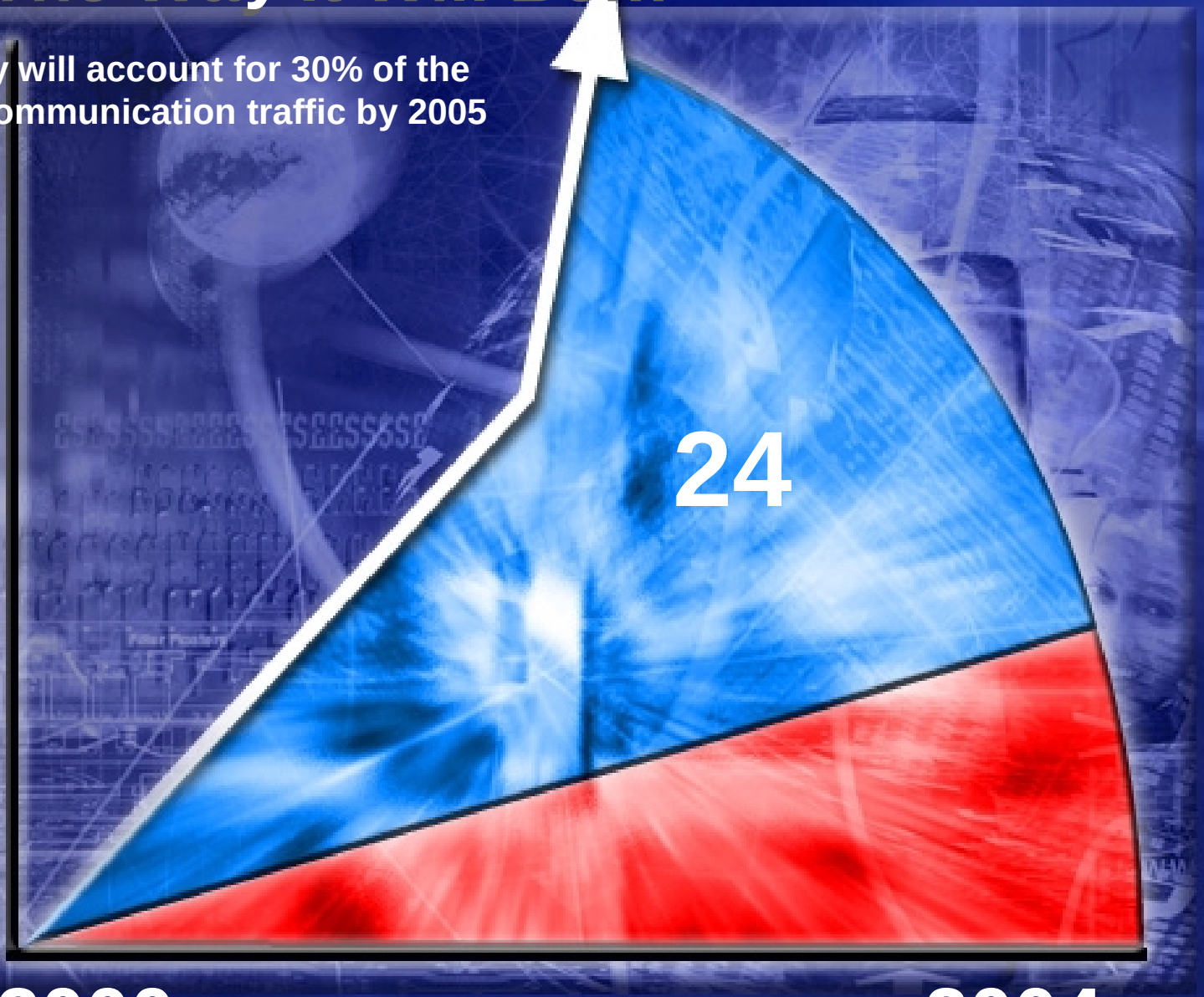
2G: The Way It Was …



3G: The Way It Will Be…

IP Telephony will account for 30% of the Global Telecommunication traffic by 2005



Source: Merrill Lynch 1999, US Bancorp, 2000

Nortel Networks' Solutions Focus

Optical Internet

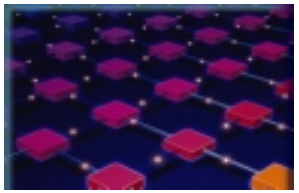
"Telecom" and "The Internet"

Wireless Internet

"Wireline Internet" and "Wireless Telephony"

Internet Telephony

"Telecom Services" and "The Internet"



Intranet Services

"Corporate Networks" and "The Internet"

…Delivering Unified Networks

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Can IPv4 support the Networked Economy?

- **Explosive Internet growth is outstripping IPv4 capabilities**
  - Expectations that there will be over a Billion Wireless subscribers by 2002.
  - IPv4 address space is running out of capacity
  - Networks have evolved with non-uniform address hierarchy
- **Manual administration is a continued burden**
- **Lack of inherent security limits utility of IPv4 Networks**
- **IPv4 stop-gap extensions help *but are problematic:***
  - **NAT** - Performance and connectivity issues
  - **CIDR** - Useful for backbone route aggregation - but many IPv4 routes do not summarize well.
  - **QOS** - Not inherent to IPv4, deployment is therefore slow and complex.
  - **Configuration** - v4 DHCP approach requires management.
    - No auto-configuration.

Enter IPv6

- **IPv6 was designed to alleviate these issues:**
  - 128-bit address space gives near infinite addresses
  - Hierarchical addressing reduces the number of routes in the Internet core routers
  - Auto-configuration eases the task of network management and address administration
  - Built-in authentication and encryption ensures security
  - Support for QoS and Differentiated services

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Nortel's IPv6 Position

- **Nortel Networks fully supports the migration to IPv6**
  - We are a pioneer in the implementation of IPv6 in enterprise networks and bring the power of a complete end-to-end portfolio to the new high performance Internet. (Commercial IPv6 releases since 1997)
  - Nortel today has a leading position in IPv4 core and optical networks coupled with world-class wireless products in support of best-in-class infrastructure. This IPv4 emphasis will continue to enable a smooth transition.

As an example..

- **Nortel's solutions for 3G wireless will support IPv6.**
  - Our third generation network combines the mobility of anytime, anywhere, wireless access with the speed, capacity and reliability of our industry-leading Optical Internet.
  - Nortel understands the need to deliver revenue-generating services quickly on the new 3G networks.
  - Nortel Networks will be fully compliant with the R'00 standards as defined by the 3GPP standards bodies.

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Nortel IPv6 Timeline

- **IPng (Next Generation) began in IETF working groups during 1992.**
- **IPv6 formalized in 1995.**
- **First Nortel Router availability in 1997!**
- **Nortel Networks a founding member of the IPv6 Forum and Technical Directorate (1999). IETF RFC Contributor.**
- **Operational sites on the 6Bone both in North America and Europe.**

Nortel Networks is a early pioneer in the IPv6 routing space

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Product Activity - Overview

- **Nortel Networks has IPv6 compliant products TODAY to help leading edge Internet users transition NOW.**
- **BayRS V12 product release with IPv6 first shipped in 1997**
  - Common routing software for router line.
  - Current Version is 14.10
  - Available on several platforms including:
    - ARN, ASN, BN, BSN, Passport 2430, Passport 5430 …
- **RSP2 – Route Service Processor**
  - Successor to RSP
  - Native H/W IPv6 support
  - Targeted for Nortel's future carrier products
  - OC192 forwarding rate
- **Wireless Solutions**
  - IPv6 enabled 3G UMTS/CDMA networks
- **In Planning stage on additional platforms**

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BayRS IPv6 Support

- **BayRS 12.0 shipped in October 1997 for early migrations**
  - **Generally available release - not beta code.**
  - **Routing Support**
    - IPv6 RIP
    - Static Routes
  - **IPv6 Auto-configuration**
    - Stateless Auto-configuration
    - Ability to change MAC address as part of address calculation.
  - **Transition Mechanisms**
    - Static Tunneling - Full v6 addresses
    - Automatic Tunneling - v4-compatible addresses

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Wireless Drivers for IPv6

- **Current wireless data networks migrating from TDM technology to an IP enabled infrastructure.**
- **Vendor commitments to deliver IP enabled hand held devices.**
- **1.3 billion wireless internet subscribers projected by 2004.** – *In-Stat Research*
- **Current shortage of IPv4 address space equates to costly and performance hindered workarounds.**
- **3GPP mandates IPv6 support within UMTS R5 IM Subsystem.**

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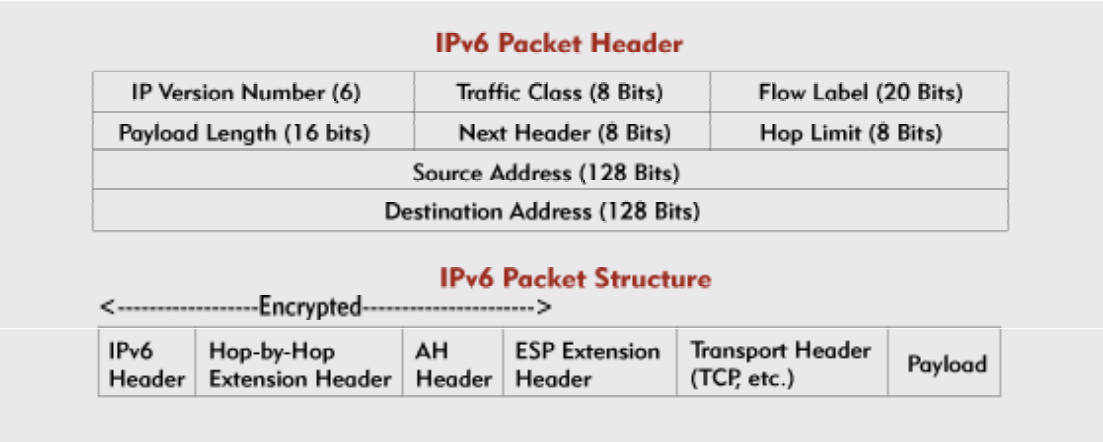
Wireless: IPv6 Features Leveraged

- **Address length grows from 32 bits to 128, equating to an increase in address space of 2^{96}!**
- **Security through inherent support of IPSec.**
- **Auto-configuration of addresses in a mobile environment.**
- **Routing efficiencies through address aggregation.**



Challenges for the Wireless Operator

- **Shortage of IP networking design and engineering expertise in-house.**
- **Wireless networks need to evolve to IPv6 but the services and content from the Internet is still IPv4.**
- **Spectrum auctions impose tougher pressures in generating more revenue from today's wireless data services.**
- **With the migration from IPv4 to IPv6, network investment and stability becomes key.**

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Introducing IPv6 into IPv4 Networks

- **Dual stack approach, hosts and routers support both IPv4 and IPv6.**
- **Tunneling approach, manually or automatically configured.**
  - Manual, end points based on IPv4 are configured
  - Dynamic, tunnels created through IPv6's "IPv4 compatible" addresses.

- **6TO4**
  - Interconnect Ipv6 domains through IPv4. Requires unique 6to4 TLA prefix.
  - Endpoints defined in prefix of IPv6 domain.
- **6over4**
  - Interconnect IPv6 hosts through an IPv4 domain.
  - No explicit tunnels required.
  - IPv4 multicast used to create a virtual link for Ipv6 hosts.

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Wireless Migration with Dual Stacks

- Dual stacks (IPv4 and IPv6) within wireless access and core is best approach.
- Migrate SW on GGSN and SGSN to offer support for both stacks and PDP types.
- NAT-PT, static/dynamic tunnels required on gateway to public Internet.
- DNS, DHCP, RADIUS support for IPv6 AAAA records to be supported through Nortel's Preside Policy Services
- Server load-balancing offered through IPv6 support on Nortel's Alteon Web Switches.

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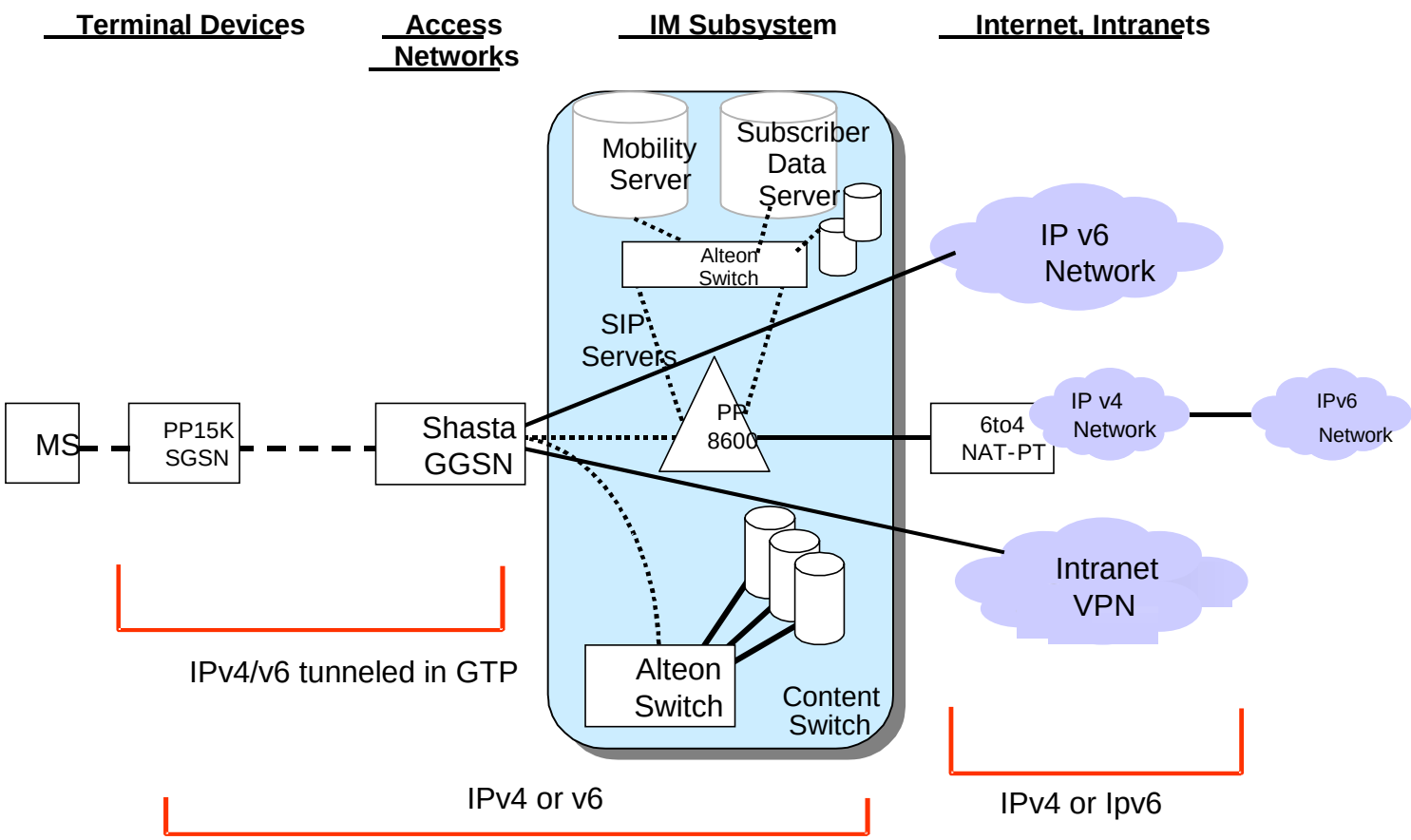
Nortel's All-IP IM Subsystem (3G)



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Nortel's "IPv6 Core Team"

- **Corporate-level customer-focussed initiative bringing IPv6 to Nortel's product line.**
- **Representation from across the company:**
  - IPv6 Engineering Management
  - Product Management: IPv6 Roadmap
  - Service and QA
  - 3G/Wireless
- **Nortel's IPv6 implementation is portable across the product line.**
  - Operational consistency
  - Faster feature rollouts

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Summary

- **Nortel Networks takes a leadership position in the migration to IPv6 within the wireless data environment through its experience.**
- **Importance of generating revenue today through IPv4, migrate infrastructure through a dual stack approach by upgrades.**
- **Corporate Initiative to ensure end-end IPv6 operation across Nortel's product line.**
- **Investment protection:**
  - IPv6 platforms = IPv4 platforms + upgrade

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