IPv6 @ Comcast
Managing 100+ Million IP Addresses

NANOG 37

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Agenda

- Comcast needs for IPv6
- Comcast plans for IPv6
- Challenges

Comcast Needs for IPv6

Simplistic View of Comcast IP problem

20 Million video customer

2.5 set-top box per customer

2 IP addresses per set-top box

Total: 100 Millions IP address

And we have not yet talked about High Speed Data…
nor Comcast Digital Voice…
nor merger/acquisition…

From Net 10 to IPv6 in the Control Plane

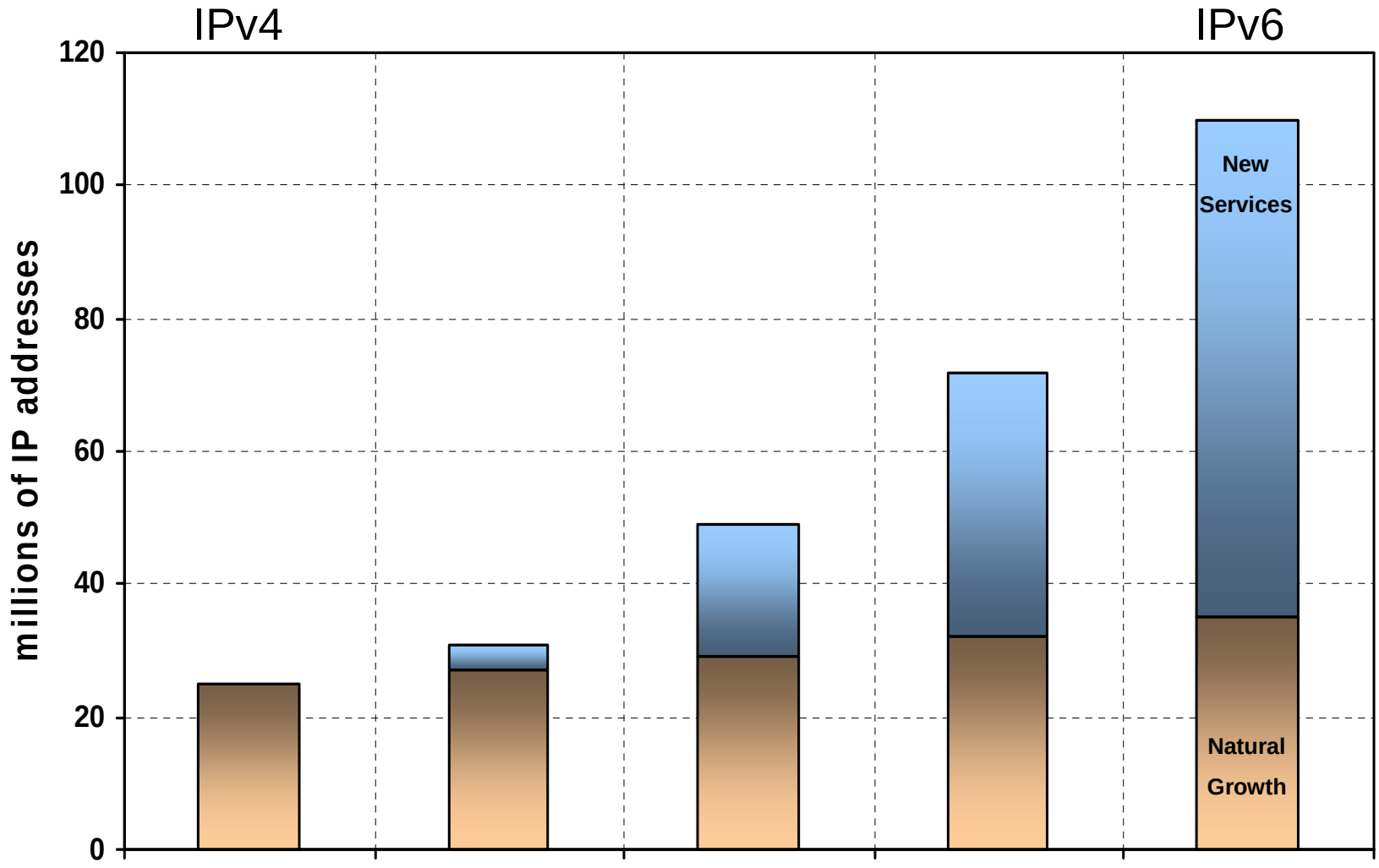
- Until recently, Comcast was using ***Net 10 (RFC1918)*** for managing the cable modems.
- That space has been ***exhausted*** in 2005.
- Comcast recently was allocated the largest part of ***Net 73*** and has renumbered cable modems in that space.
- In the control plane, all devices need to be remotely managed, so NAT isn't going to help us…
- IPv6 is the clear solution for us
- However, even we are starting now, the move to IPv6 is not going to happen overnight

Triple Play Effect on the Use of IP Addresses

	2005 HSD only	2006+ Triple Play
Cable Modem (CM)	1 (private only)	1
Home Computer / Router	1	1
eMTA (Voice adaptor)	0	1 – 2
Set Top Box (STB)	0	2
Total number of IP addresses (assume 2.5 STB per household)	**1 – 2**	**8 – 9**

IP Addresses: Natural Growth vs New Services

(in the coming years)



Note: this graph shows trends, not actual data

Contingency Plans: Buying Time to Deploy IPv6

or how to Get 100 Million IPv4 Addresses (and more)?

Plan	Description	Impact (to us…)
Public Address Space	Go to ARIN and ask for address space every time we can justify it in accordance to policies.	Minimal.
“Dark” Space	Use already allocated, non-globally routed, public IPv4 address space.	Operationally minimal unless a conflict arises.
Federalization	Subdivide the network into several independently managed domains (e.g. division boundaries).	Loss of global visibility in the network. Need to redesign the network & provisioning systems.

Comcast Plans for IPv6

IPv6 Strategy

- ***Start early***
  - Deployment plans have started back in 2005
- Deploy IPv6 ***initially*** on the ***Control Plane*** for the ***Management*** and ***Operation*** of the ***Edge Devices*** we manage
  - Docsis CM, Set Top boxes, PacketCable MTA (Voice),…
- Be ready to offer our customers new services that take advantage of IPv6

IPv6 Deployment – Guiding Principles

- The migration to IPv6 project has the following principles:
  - Deploying IPv6 must be minimally disruptive to the operations of existing networks and devices
  - IPv6 must be included in the roadmap of next generation equipment and devices
  - Operations, infrastructure and systems must become ready to support IPv6-enabled devices
  - IPv6 will slowly penetrate Comcast DNA

IPv6 Deployment: Principles and Approach

- Primary objective is to deploy IPv6 for the IP addresses of the CM & STB
- Architecture: ***dual-stack at the core, v6-only at the edges***
- Deployment approach: ***from the core to the edges***
  - Backbone -> Regional Networks -> CMTS -> Devices
  - This is an incremental deployment; existing deployments will be unaffected in the beginning.
- Follow same operational model as with IPv4

NEWS FLASH…

All routers on Comcast IP backbone are IPv6 enable

First PING on our 10GE production backbone:

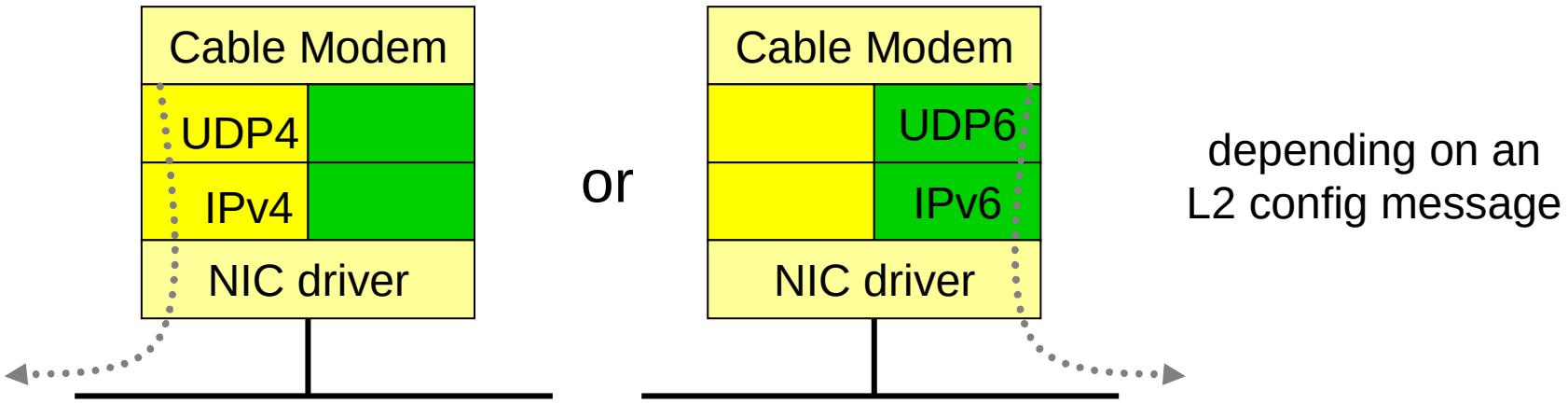
```
ping ipv6 2001:558:0:f501::1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:558:0:f501::1, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 3/5/14 ms

Jun  2 09:31:49.589, len: 162, hits: 1, i/p i/f: TenGigE0/7/0/0
00146a7d 29810014 6ac4dd08 86dd6000 0000006c 3a3c2001 05580000 f5010000
00000000 00022001 05580000 f5010000 00000000 00018000 50fae0da 00004480
3e53000f 062b0809 0a0b0c0d 0e0f1011 …

Jun  2 09:31:53.533, len: 162, hits: 1, i/p i/f: TenGigE0/0/0/0
00146ac4 dd080014 6a7d2981 86dd6000 0000006c 3a402001 05580000 f5010000
00000000 00012001 05580000 f5010000 00000000 00028100 4ffae0da 00004480
3e53000f 062b0809 0a0b0c0d 0e0f1011 …
```

Modems and Mode of Operation

- New CM will be IPv6 ready (dual-stack capable)
- On an IPv4-only CMTS, CM will be provisioned with IPv4 only
- On IPv6-enable CMTS, CM will be provisioned with IPv6 only
  - CM will never have both IPv4 & IPv6 addresses at the same time (If we could give both an IPv4 and an IPv6 address at the same time, we will not need IPv6 in the first place!)

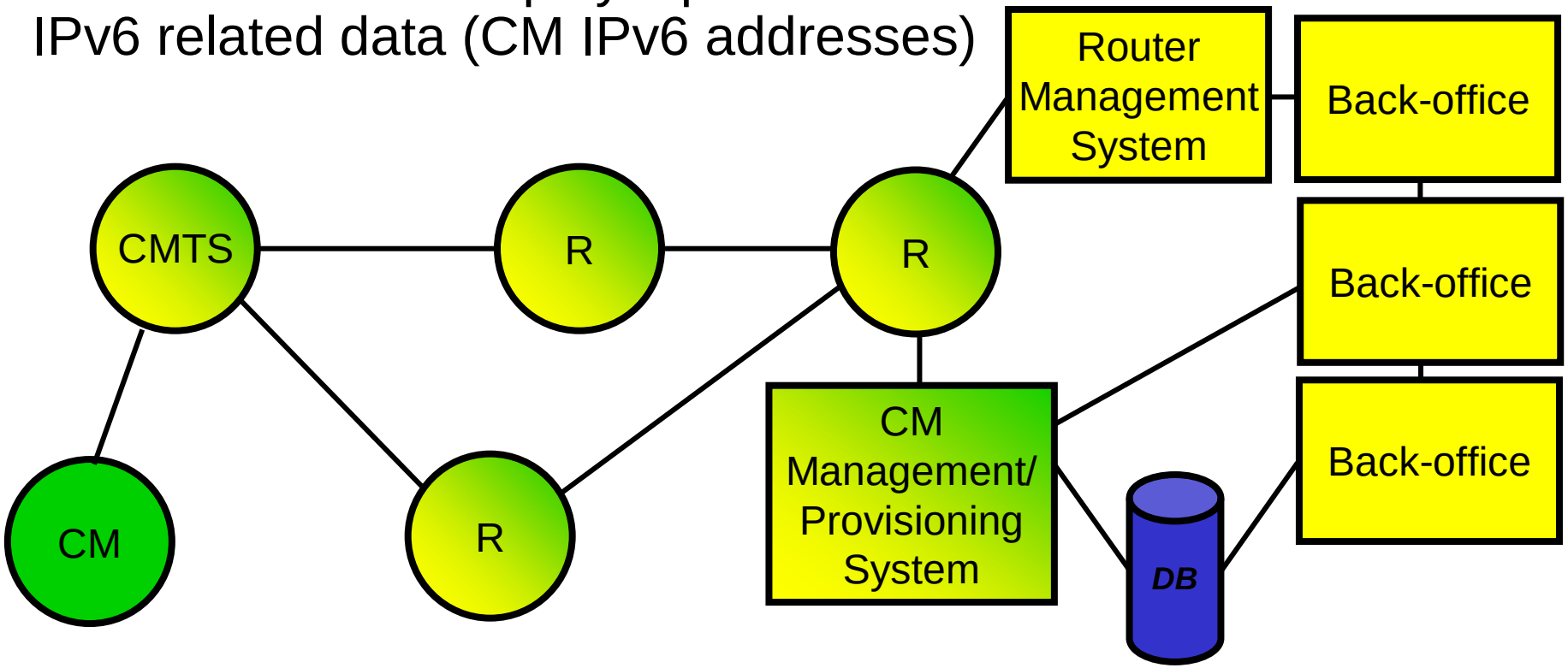


Provisioning, Monitoring, Back-Office

- Mostly a software upgrade problem
  - Not unlike the Y2K problem
  - Fields need to be bigger in database & web scripts
- Should system “X” be upgraded for IPv6?
  - Transport questions: Does system “X” communicate with devices that are potentially IPv6-only (e.g. CM)?
  - Payload questions: Does system “X” manipulate IP data (store, input or display) that could be IPv6?
- Comcast inventory analysis
  - About 100 “systems”
  - 10 need major updates for transport
  - 30 need minor updates for display/storage

Back Office Management of Cable Modems

- Back-office systems do not communicate directly with the CM, thus their network transport can and will remain IPv4.
- However back office systems may need to be modified to display/input/store IPv6 related data (CM IPv6 addresses)



Challenges

IPv6 Certification

- Basic IPv4 –compliance is somehow taken for granted today on most equipment
  - IP level component testing is thus limited
- ***IPv6 is still a very new technology***
- The level of maturity of implementations varies greatly among vendors
  - Some have had an IPv6 story for about 10 years
    - Even those implementations have some features that are not fully baked
  - Others have still nothing and are going to rush to buy a 3rd party stack and integrate it on their products
- The bar for acceptance of IPv6 product has to be set higher than for IPv4
  - Formal IPv6 requirement list at purchase time
  - IPv6 conformance certification to accept products

IPv6 Training

- ***IPv6 is still a very new technology***
- Most engineers have heard about it but don't know much about it
  - Fear factor is important to control
- We can expect new hires to have 2-4 years of IPv4 experience, but can't expect anything about IPv6
- ***Initial and continuous training is critical***
  - Academic style training presentation
  - Web-based classes
  - Hands-on experience

IPv6 Vendors

- Cable Modem (Docsis 3.0 / 2.0b)
- CMTS
- Router
- Provisioning system
- OSS
- Video / Voice back-end systems
- Retail Market (Consumer Electronic)
  - Home Gateways
  - Video (e.g. TV with embedded cable modem)

IPv6 Protocols

- MIBs
  - some OSS vendors implement ***RFC2465*** (deprecated IPv6 MIB)
  - some Router vendor implement partially ***RFC4293*** (new combined MIB)
- IGP
  - Comcast run OSPFv2 for IPv4
  - Looking at OSPFv3 and IS-IS for IPv6
- Integrating IPv4 & IPv6 security
- Integrating IPv4 & IPv6 QoS