Unleashing the Speed with DOCSIS 2.0

Supporting the Burgeoning Commercial Market

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Agenda

- **Speeds and Feeds**
  - **Competitive Outlook (FiOS)**
  - **Objectives**
  - **Current and New Speed Offerings**
- **Future Evolution Options**
- **Cablevision's Choice**
  - **Cabling Ideas**
  - **Other Ideas**
- **New Technology Cornerstones**

Competitive Outlook & Objectives

- **Offerings from Verizon**

  15 Mbps/2 Mbps FTTH

- **Use existing HFC network**
- **Separation of tiers of service**
- **Bandwidth usage monitoring/shaping**
- **Number of subscribers per port**
- **Traffic patterns changing**

Current and New Speed Offerings

- **Typically 1 tier at 3M DS by 384K US**
- **MSOs using 1.1 migrating to multiple tiers of service**

  Dial-up replacement 128K x 128K

  Low speed 1M x 256K

  Medium speed 3M x 384K

  High speed 5-7M x 512-768K
- **New residential & commercial offerings**

  15x2 - Cox

  10x1, 15x2, 30x2 - CV

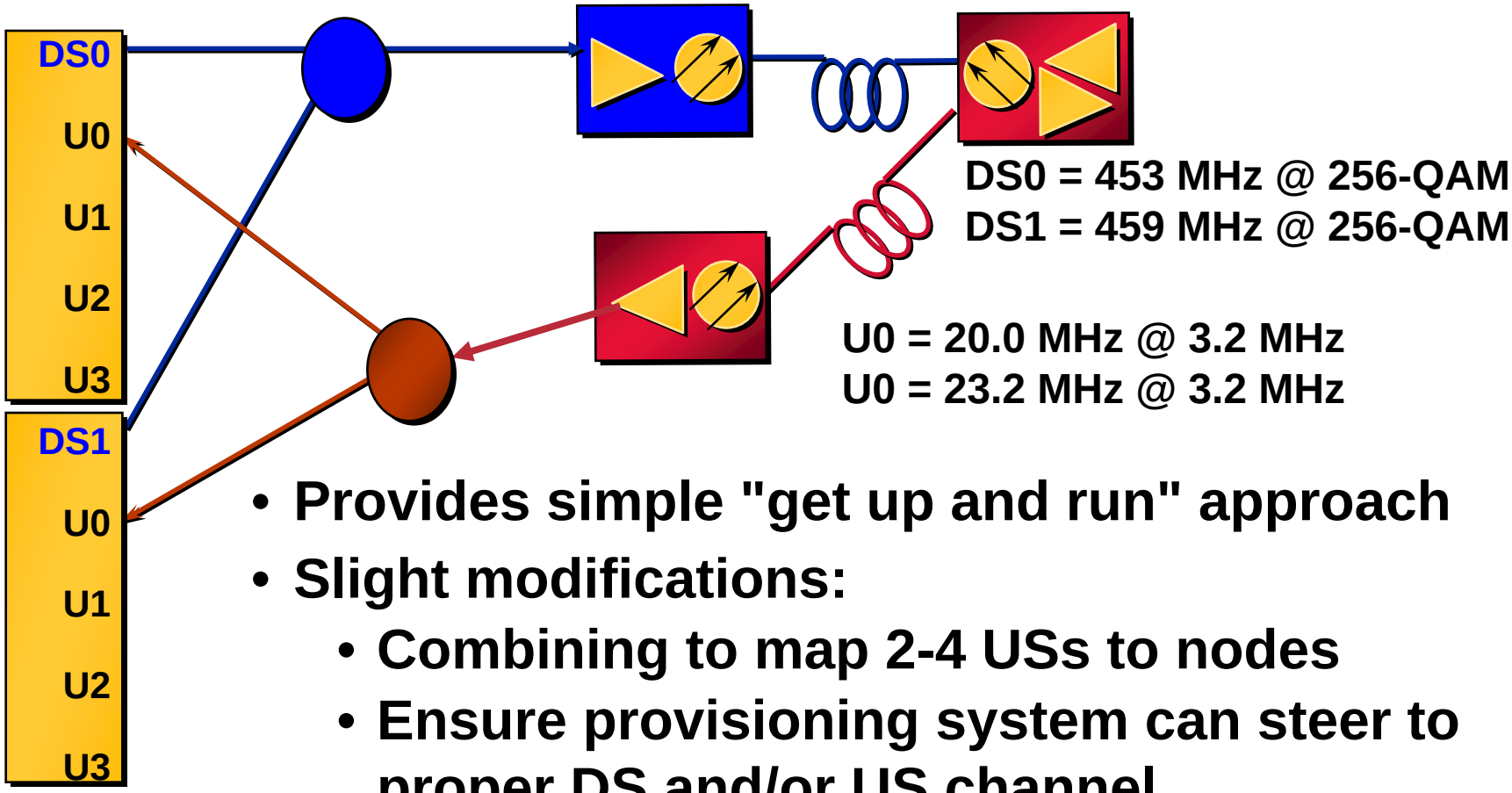
  16x1 - Adelphia

  20x? – RCN
- **Max DS burst (perception is reality, but VoIP jitter?)**

Option 1 - Same CMTS with Freq Separation

- **Choices include:**
  - **Do nothing and watch competition erode subscriber base**
  - **Segment fiber nodes or use FTTx**
  - **“Bonding” US & DS channels**
- **Map 2 DS freqs and 2 US Rxs into same node**
  - **Frequency A serving residential subscribers and frequency B serving new subscribers**
- **Client-class processing "steers" residential subscribers to A and new subscribers to B**
  - **Set DS frequency and/or US Channel ID in CM’s configuration file**
- **US and/or DS load balance**
  - **Allow residential subscribers to use under-utilized commercial US**

Option 1 - Separating CMs via FDM & Provisioning



- Provides simple "get up and run" approach
- Slight modifications:
  - Combining to map 2-4 USs to nodes
  - Ensure provisioning system can steer to proper DS and/or US channel
- US and DS load balancing possible
  - “Poor man’s” redundancy

Option 1 - Cons

- **Requires combining work**
- **Requires DS and US spectrum availability**
- **Moving to new DS requires new US**
- **Catastrophic outage could make CMs register on incorrect DS and affect each other - how fast they come online**
- **CMs will need to be client-class processed with info in their DOCSIS configuration files**

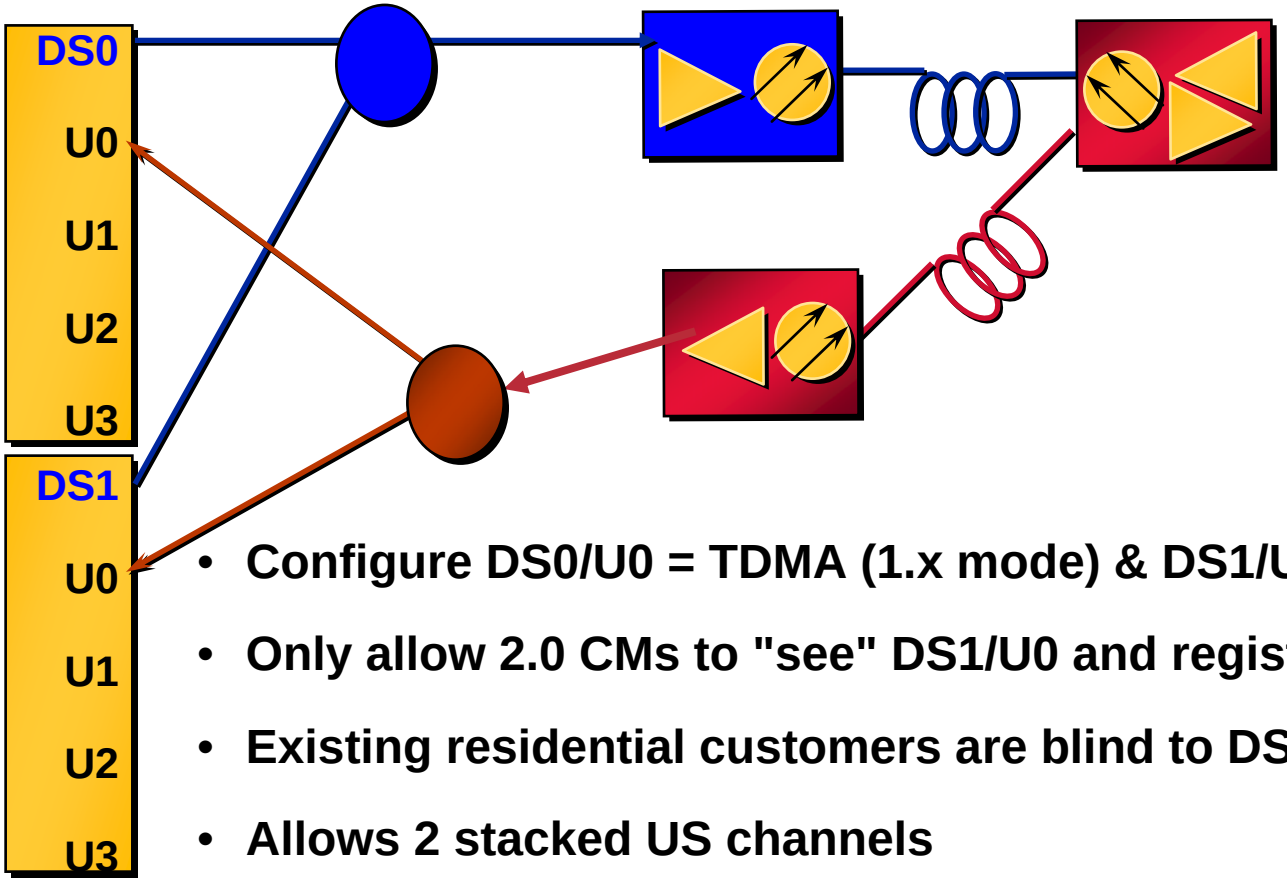
Option 2 - Separate CMTSs

- Map US/DS ports from 2nd CMTS into existing fiber nodes
- Connection for 2nd CMTS to core network
- Provisioning to steer commercial CMs to proper frequency and CMTS
- Pros include: hardware isolation, future expansion and “poor-man’s” HA
- Cons include:
  - 2nd CMTS and CPU max out if one chassis dies
  - More power draw and rack space in HE/hub
  - Must integrate second chassis to network
  - Need address space for additional CMTS
  - CMs could lock on wrong CMTS and lead to packet drops and IP address depletion

Option 3 - Same CMTS Utilizing ATDMA

- **Utilize ATDMA-only US ports for commercial CMs**
- **Only allows 2.0 CMs to "see" US port and register**
- **Existing residential subscribers are blind to ATDMA port**
  - **Don't understand MAC message 29 included in UCD**
- **Need to configure provisioning to block commercial CMs from registering on 1.x US port**
  - **Use provisioning to force specific DS frequency and/or US Channel ID**

Option 3 - Diagram



- Configure DS0/U0 = TDMA (1.x mode) & DS1/U0 = ATDMA (2.0-only)
- Only allow 2.0 CMs to "see" DS1/U0 and register on it
- Existing residential customers are blind to DS1/U0
- Allows 2 stacked US channels
- Only appears as one for residential customers
- If spectrum available and “clean”, 2.0 CMs could use 6.4 MHz channel and 64-QAM to give ~ 27 Mbps usable speed

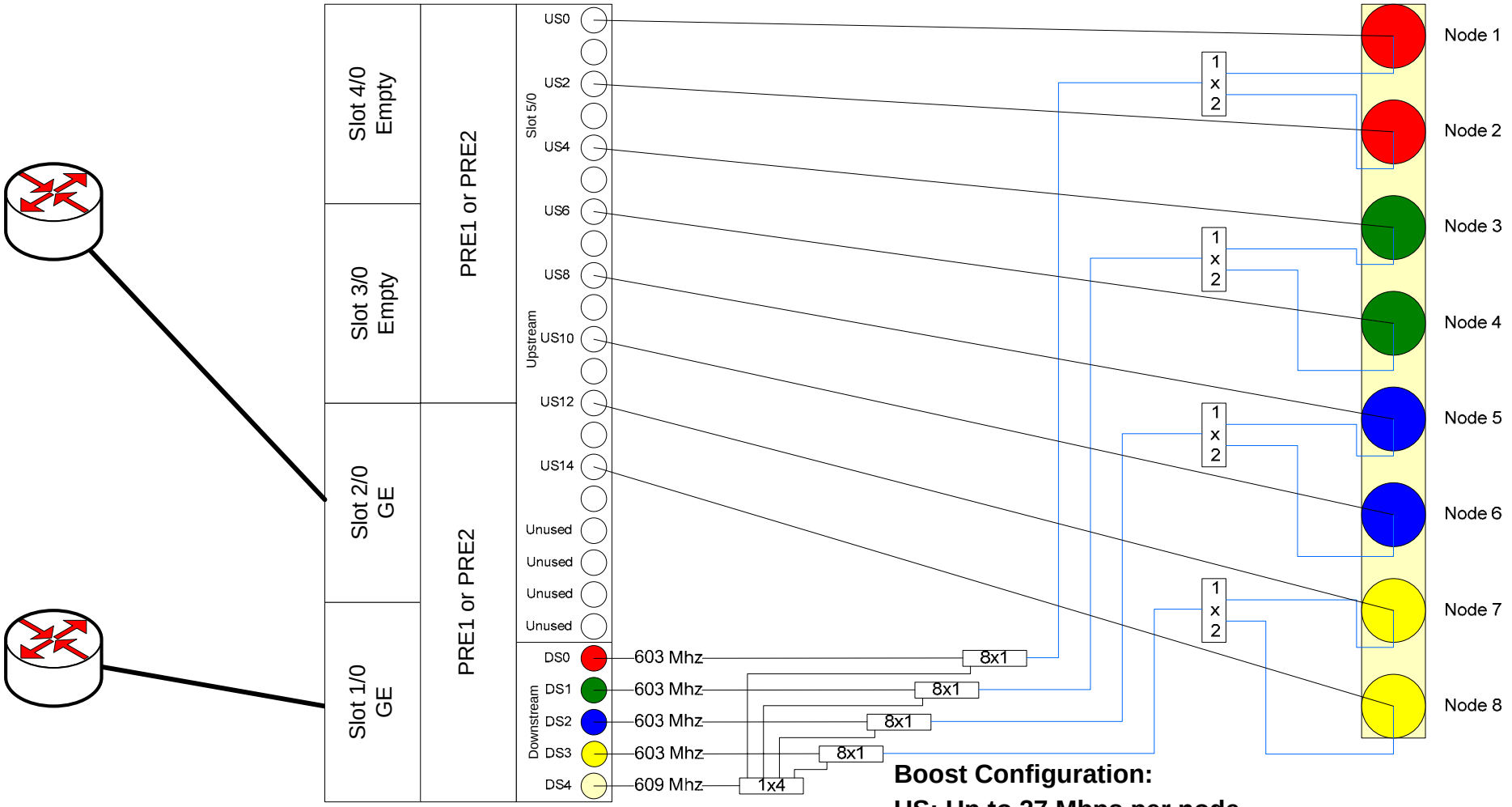
DOCSIS 2.0 Benefits

- **Increases US capacity (30.72 Mbps)**
- **IUCs added for 1.x/2.0 mixed environment**
  - **9 = a-short, 10 = a-long, 11 = a-ugs**
- **Better statistical multiplexing**
  - **6.4 MHz channel is better than 2, 3.2 channels**
- **Enhances flexibility when used in combination with Virtual Interfaces**
  - **1x1 MAC domain makes more sense**

Option 3 - Cons

- Requires new “high speed” users to have 2.0 CMs
- Requires provisioning work to "block" 2.0 CMs from registering on residential frequency
- If residential subscriber buys own 2.0 CM, they could lock to the commercial US without provisioning interdiction
  - Use TLV 39=0 for residential CMs
  - Forces 1.x mode even if they are 2.0 capable
- Can’t utilize load balancing
  - Configure mixed-mode with utilization-based LB
- May require dynamic freq hopping or modulation changes

New Architecture Idea Using Option 3



- **This could be further segmented down to 4 nodes**

Boost Configuration:
US: Up to 27 Mbps per node
DS: ~25 Mbps per 8 nodes at 64-QAM
DS: ~35 Mbps per 8 nodes at 256-QAM

Questions to Answer

- **Back-office procedures and implementation**
  - **What happens when:**
    - **New CM registers on wrong DS**
    - **Catastrophic failure on entire node**
    - **Residential subscriber buys their own 2.0 CM**
    - **CMs move between DS and/or US ports**
- **Physical implementation**
  - **Is DS spectrum available for 256-QAM**
  - **Can US laser handle multiple carriers and higher modulation schemes**

Concerns

- **IP Address Implications**

  How to prevent IP address exhaustion during ranging onto incorrect DS frequency

- **CM issues with multiple DS and US frequencies?**

  Long time to register (CMs cache DS frequency)

- **Power level when 2nd US frequency added?**

  CMTS performs pwr on per-US freq and CW

  Analog front-end could overload and cause harmonics

- **Per-CM speeds**

New Technology Cornerstones

- **DOCSIS 3.0**
  - **Channel Bonding for higher capacity links**
    - **Enable faster HSD service**
    - **M x N MAC domains now**
    - **Enable Video over IP solutions**
- **M-CMTS**
  - **New architecture for better economics**
    - **Lower cost DS PHY**
    - **Decouple DS and US ports**

Other Commercial Offerings & Summary

- **T1/E1 offerings such as CEoIP**
- **PCMM, DOCSIS WIC, MPLS-VPN / L2VPN**
- **BoD and RS-DVR**
- **Math and new designs are beginning steps**
- **Monitor actual traffic load and manage fair use of network**
- **Determine when additional capacity is necessary**