CMTS IOS Features Update

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Agenda

- Bighorn IOS update
  - features

Bighorn System Pre-requisites

- CMTS with Bighorn and PRE2 or PRE4
- IOS takes 68 Mbytes of flash disk space
  - Also FPD images for SIP-600
- 12.2(33)SCC image is > 65 MB and requires TFTP servers capable of downloading large images
- 5X20S cards not supported on Bighorn
- Requires US connectors in fiber node now
- SPA and DS Ch ID numbering different starting with Amazon

MC20x20 with Bighorn

20x20 & Features in Bighorn, 12.2(33)SCC

License/PID	Label on faceplate	Description
UBR-MC20X20V-20D	Configured as UBR-MC20X20V-20D	Supports 20 DS chs on 5 connectors

- I-CMTS support
- DOCSIS 3.0 features such as S-CDMA, Logical Chs, US Ch Bonding, …
- 20x20 can backup 5x20 cards for N+1
- DS bonding within card, but not across cards or to SPA
- SPA and 20x20 coexistence supported
- Requires DTCC cards, but still supported with PRE2
- If it is an exclusive I-CMTS setup, DTI server & “cable clock dti” not required
- Mixed annex mode not supported

HCCP Update

HCCP Blocking CLI

- For 5x20 cards, CLI restriction only for cable interface
- For 20x20 cards, CLI restriction for cable interface, controller interface, IC interface, WB interface and CGD on “Crane”
- No CLI restriction for Modena
- Permission for configuring Protect LC is used for troubleshooting only
  - Will enable this function by internal command “service internal”, but no official support for customer
- Protect LC should reflect Working LC accurately
  - Should not be changed manually
  - Any change should come from Working LC

Removal of Legacy HCCP Configs

- Interface level HCCP configs not supported in Bighorn

```
hccp <group> working <member>
hccp <group> protect <member> <ip_addr>
hccp <group> revertive
hccp <group> reverttime <reverttime>
```

- If input legacy HCCP CLIs, get following warning message:

```
 Router(config-if)#hccp 1 working 61
Interface level HCCP commands are deprecated. Please
use global configurations.
```

- HCCP exec level CLIs not supported in Bighorn

```
hccp <group> switch <member>
hccp <group> lockout/unlockout <member>
hccp <group> resync <member>
```

- SNMP-Server Manager needed now

3-Level Dynamic Modulation

Three Step Dynamic Modulation

- US interface mod config accepts 1, 2, or 3 parameters
- Only 2 mod profiles allowed per US when assigned to spectrum group
- Dynamic modulation supports automatic mod profile selection from pool of up to 3 configurable profiles
  - High performance > mid performance > robust

    For example: 64 QAM > 16 QAM > QPSK
- Dynamic modulation continues to support legacy two mod profile configuration
- Three step dynamic modulation only supports basic spectrum management features
  - No mod profile changes based on CNR measurements or thresholds

Configurable Upgrade Threshold Hysteresis

- New command at US interface level that allows customization of hysteresis value
- Defaults to 3 dB (same as previous releases)
- User configurable between 0 and 10 dB
- Used by spectrum management when assessing upgrade criteria for both SNR thresholds and both CNR thresholds
- Used by both advanced and basic spectrum management features
  - Dynamic Modulation
  - Dynamic Channel Width

Dynamic Modulation Change Ideas

- 3 choices without spec groups
- Rely on SNR AND FEC thresholds for logic
- 3 dB default hysteresis with 15 sec hold time
- Pros
  - No reliance on CNR, which could be fixed with ingress cancellation
  - Req, IM, & SM burst remain the same, so time offsets don't change

    CMs should stay online and less disruption
  - Change from 64-QAM to 16-QAM is ~ 7 dB more robust
  - CMs max out at 55 dBmV for 16-qam (maybe more) & 54 for 64-qam
- Cons
  - Available throughput drops from ~27 Mbps to 19 Mbps - affects load balance, admission control, aggregate UGS support

US Logical Channels

The Problem

- Linear distortions cause problems with wider ch widths and higher modulation schemes
- Linear distortions affect MER(SNR) differently for different CMs
  - May be compensated for with PRE-EQ

    Cab upstream 0 equalization-coefficient

    Direct Load pre-eq added for misbehaving CMs

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The Case for Logical Channels

- Logical Ch original intent
  - Support SCDMA & ATDMA on same ch/freq
- Ability to assign parameters for 1.0 CMs vs 1.1 vs 2.0 and more conducive for per-CM issues
- Instead of changing modulation for all CMs on an US port, move CMs to different logical ch with more robust modulation
- Lower modulation allows higher max Tx from CMs
- We support max of 2 logical chs
  - Spec mentions 4

Logical Channels Requirments

- Logical Chs must all use same symbol rate
  - Supporting 1.x CMs will limit US to max of 3.2 MHz, which precludes using 6.4 MHz for 2.0 CMs
- Logical Chs require more DS maps
  - Typical overhead is ~ 1 Mbps, this could be 2 Mbps on DS to support 2 logical chs on all 4 US ports

Logical Channel ID Mapping (in UCD)

Logical Channel	UCD Channel ID
Upstream 0 0	1
Upstream 0 1	9
Upstream 1 0	2
Upstream 1 1	10
Upstream 2 0	3
Upstream 2 1	11
Upstream 3 0	4
Upstream 3 1	12
Upstream 4 0	5
Upstream 4 1	13
Upstream 5 0	6
Upstream 5 1	14
Upstream 6 0	7
Upstream 6 1	15
Upstream 7 0	8
Upstream 7 1	16

- Logical ch 0s retain legacy ch IDs
- Channel ID mapping stays the same for any Mac-Domain config
  - Ch ID for “logical channel 0 1” is 9 for either 1x4 or 1x8 domain

Logical Ch Interaction with Other Features

- US Bonding
  - Only logical ch 0 can be part of US bonding group

    Bonding of 2 logical chs on same phy port not supported

    For US bonding, configuring of multiple logical chs not recommended
- Load Balancing
  - Load balancing between 2 logical chs on same physical port not supported

    LB between logical chs not meaningful as BW is dynamically shared
  - When LB is configured, CMs can only load-balance into logical ch 0

    Modems can load balanced out of logical ch 0 and 1
- Spectrum Management
  - Basic Spec Management (dynamic modulation) supported at logical ch level
  - Advanced Spectrum Management not supported for logical chs

Upstream Bonding

USCB Prerequisites

- uBR10012 running 12.2(33)SCC or later
  - 5x20H linecard
  - 20x20V linecard
- uBR72xxVXR will be supported with 8x8 CLC in 12.2(33)SCD
- D3.0 CM

USCB Configuration

- MTC-Mode ON by default
  - Default mode attribute-mask required (0x80000000 def mask)
  - ‘cable mtc-mode’ disables attribute requirement
  - Turn off using ‘no cable mtc-mode’ (Disable USCB)
- Fiber-node requires US connectors be configured
- US chs in a BG do NOT need to be:
  - Adjacent channel frequencies
  - Identical baud rate
  - Identical modulation or mod profiles
- All chs must be within 12 dB receive level at CMTS
- USBG configured at MAC Domain level
- MTC-Mode adds 400 usecs to MAP Advance calculation
  - Does not affect modem offsets

USCB Restrictions

- US frequencies limited to 42 MHz (NA) and 65 MHz (EU)
  - 3G60 can receive US data at frequencies up to 85 MHz band edge
- For 5x20H card, USCB is handled by software
  - Limited to 100 Mbps per linecard (No restriction on MAC Domain)
  - 20x20 card is HW based, so linerate is achievable
- Always check CM firmware for latest image
  - Older CM code will not work with current IOS USCB

USCB Tips & Tricks

- Default SID Cluster is 1 with 1 outstanding request
  - Done to prevent D1.x/2.0 modems to not get starved
  - Can tune to allow max throughput and not starve legacy modems
  - Can cause lower than expected throughput in mixed channel configurations
- Two SID Clusters with one request
  - Works well up to 50-60 Mbps (per-modem speed) (tested)
  - MAX Request set to 1 MB
  - Does not deplete requests on channels in USBG
- Unlimited max-requests allow max throughput
  - For lab use only
  - Will max out number of requests an US can handle (scheduler)
- max-outstanding-byte and max-total-byte
  - Spec is grey in this area
  - Ignored by CMs
- REQ-Multiplier
  - Used when large requests would be made
  - Field is 16-bit field
  - Possible values are 1, 2, 4, 8 ,16
  - Requests for USCB are in bytes not mini-slots

S-CDMA

S-CDMA D3 (Channel Type 4SR)

- Bighorn will also support “SCDMA D3” or Channel Type 4SR
- Inclusion of Channel Type 4SR is for improved ingress cancellation performance provided by enabling of Selectable Active Code 2 (SAC2) mode for BCM3140
- BCM3140 SAC2 Ingress Cancellation performance is on-par with ATDMA ingress cancellation performance
- Only D3 CMs can register on 4SR ch and thus, not usable by D2 CMs
- This channel type allows usage of IUCs 5,6,9,10, and 11 at same time (however, for Bighorn, post registration, IUCs 5 & 6 are not utilized)
- Channel Type 4SR or SCDMA-D3 option is only available under “Global Modulation Profile” mode
- For Bighorn, benefit to using SCDMA D3 is that it takes advantage of the SAC2 ingress cancellation performance improvements

SCDMA Configuration

- Use US “docsis-mode” command to configure SCDMA
  - cable upstream x docsis scdma
  - (config-if)#cable up 0 docsis-mode ?

```
        atdma        DOCSIS 2.0 ATDMA-only channel
        scdma        DOCSIS 2.0 SCDMA-only channel
        scdma-d3     DOCSIS 3.0 SCDMA-only channel
        tdma         DOCSIS 1.x-only channel
        tdma-atdma   DOCSIS 1.x and DOCSIS 2.0 mixed channel
```

- SCDMA supported on MC20x20 for Bighorn
- SCDMA option available for upgraded 520H hardware & Comcast only
  - SCDMA configurable only when using latest HW (HW Rev VID V08 or later)
  - All previously shipped 520H boards require rework for SCDMA operation!!!
- Note: “scdma-d3” option only available when using Global Mod Profile mode option
- Global Mod profile mode supports D3.0 power range

SCDMA Throughput Performance

- SCDMA ingress cancellation requires using only 112 active codes (per BCM recommendation)
  - Linerate will be reduced by 12.5 % compared to ATDMA linerates
- To use 128 active codes, ingress cancellation must be disabled
- When using full 128 active codes, similar throughput results as ATDMA for single ch & and bonded ch cases
- RFDVT expected to perform official impulse noise testing and release results post Bighorn FCS

CM Minimum Tx Power Level Requirements

Active Codes	Codes per Mslot	Spreader Off Ranging (dBmV)	Spreader On 1 Mslot (dBmV)	Spreader On Max Mslots (dBmV)
128	2	42.24	24.18	42.24
128	4	39.23	24.18	39.23
128	8	36.22	24.18	36.22
128	16	33.21	24.18	33.21
112	2	41.66	24.18	42.24
112	4	38.65	24.18	39.23
112	8	35.64	24.18	36.22
112	16	32.63	24.18	33.21

- CM min tx power level example for 6.4 MHz channel width with QPSK/64QAM for ranging/data

E-QAM/DTCC Upgrade Requirements for S-CDMA Compatibility

- Ensure EQAM and DTCC firmware are up-to-date
- NSG9000 – must use firmware rev 1.4.5.15
  - - Or firmware rev 1.5.2 or higher. For rev 1.5.2, it must be configured to operate in “highly accurate” DS symbol rate via GUI

    This mode disabled by default so it must be enabled manually
- RFGW-1 – must use firmware rev 2.2.10 or higher
- RFGW-10 – CCO release okay
- DTCC Clock Card – Recommend using DTI version EPLD 0xEF, FPGA 0x12, HW Rev 0xA0

Restrictions/Limitations

- Following SCDMA advanced features not supported:
  - Maximum Scheduled Code (MSC) not supported

    However, MSC will be supported in future releases
  - Code Hopping not supported
  - Trellis Coded Modulation (TCM) not supported
  - Per DOCSIS spec, SAC2 is only available when Channel Type 4SR (D3 SCDMA) mode configured
- Other CMTS config restrictions per BCM recommendation:
  - When SCDMA ingress cancellation enabled (which is default mode), only 112 active codes are available for ingress cancellation performance enhancements
  - To use 128 active codes or any other active code settings, ingress cancellation must be disabled

Other Notable S-CDMA Limitations/ Restrictions

- CMs required to Re-range for US frequency or Ch width changes
  - CM may incur service disruption
- Load Balancing using DCC (per DOCSIS)
  - Init tech 2 MUST NOT be used for DCC transactions involving SCDMA to TDMA chs
  - Init tech 4 MUST NOT be used if CM is operating in SCDMA and if any below parameters are changed:

    US modulation rate

    US M/N ratio, which can be changed when DS annex/modulation rate is changed

    DS Ch changes
- Advanced Spectrum Management not supported for SCDMA (and ATDMA). However, Basic Spectrum Management (i.e., SNR/FEC based dynamic modulation) is supported for SCDMA
- US Channel Type (docsis-mode) change
  - When changing US Ch type from TDMA or ATDMA to SCDMA and vice versa, CMs may require re-ranging, causing service disruption

Load Balancing

Top Points

- 80 LBGs possible
- May need 5 DSs * 8 cards = 40 for DS
- US LBGs can be reused if not in same DS LBG
  - Typical US = 4 channels, but can be 8
  - May need 4 or less LBGs for US
- cab load-balance group n policy us-groups-across-ds
  - Used on DS LBG
- cab load-balance group n dcc-init-technique 4
  - Used on DS LBG
  - New code will also use for US LBG
  - Makes sense when doing utilization method

Top Points (cont)

- cab load-balance group n method utilization
  - US and/or DS
  - Doesn't work with Dynamic Bandwidth Sharing (DBS) for D2.0 & 3.0 traffic

    Fixed in Bighorn
- cab load-balance group 1 threshold load 10 enforce 25
  - Set enforce % to reflect median tier of service
- Note: dcc tech 1-4 not supported across cards
- When MAC domain DS (e.g. 520DS) is added into a LBG, all DSs under that domain become members of that LBG

Load Balance Roadmap

- CM steering features delivered in Amazon
  - US attributes based CM steering (D2.0 CM to 2.0 US)
  - Policy ID based exclusion (Exclude certain CM from LB)
  - STID based CM DFO – steer CM from one CMTS to another overlay CMTS at registration
- Bighorn LB features
  - Utilization-based DS Dynamic LB with DBS
  - Configurable policy thresholds for selecting which CM to move
  - CLI to configure # of failed DCC attempts before excluding CM from further LB
  - LB Exclude feature is now on a per LB group basis (as opposed to global)
- D2.0-based LB (mutually exclusive with Cisco LB)
  - Restricted LB Groups
  - Ability to put channels into multiple LB groups

New LB Features in Bighorn

- Utilization based Dynamic LB supported with DBS
  - DS in DBS (Dynamic BW Sharing) mode allowed to participate in LB processing
- QAM utilization will be used as load if DBS enabled
- If SBS (Static BW Sharing) configured on any WB interface that is sharing a particular QAM, QAM marked “LB Down”
  - This is for case of 1 QAM being part of 2 Bonding Groups, one configured for DBS and the other for SBS
  - Dynamic LB not supported in this case
  - Most customers will use DBS exclusively – hence not a major issue

Load Balance with D3.0

- D3.0 bonding CMs should only be load balanced between bonding groups
- Legacy CMs in an MxN mac domain may need special “tweaking” to the E-qam for time offset issues
- If CM count used, then D3.0 CMs could be load balanced first time
- WB CM excluded from DS LB, but may be moved for US LB
  - Recommended CM version is Doral-1A (090710)
  - Need BC5 or higher, or Amazon to support USLB w/ DCC tech 4
- Cross-CGD DS load balancing is supported
  - DCC init tech 0 enforced between DS Chs hosted by different MC5x20 linecards

Attribute Commands for Modem Steering

- Restrict legacy eMTAs to Local DS
- Enforce legacy CMs to only register on Primary-only DS or move to a specific DS frequency
- Enforce legacy CMs to move to specific DS freq
- Force 3.0-capable CMs to initialize on Bonding-capable DS
- Can specify UCDs sent for each DS

Main Difference Between Legacy and DOCSIS LB

- Static LB at ranging time is unavailable in DOCSIS LB
- Channel based vs. CM based
  - CM random selection vs. priority sorted list
- MAC-domain level vs. channel level in DS side
- Single group vs. multiple groups on a channel

Pure-ds-load

- Current LB implementation, max(ds-load, avg-us-load) will be used for comparing and selecting DS target
  - Load of DS for comparing = max(ds-load, avg-us-load)
- This will result in some imbalance like following:

Interface	State	Group	Utilization	Reserved	Modems	Flows	Weight
Cable5/0/0 (459 MHz)	up	50	80%(80%/45%)	1%	190	360	37
Cable5/0/0/U0	up	50	46%	2%	103	293	10.2
Cable5/0/0/U1	up	50	44%	0%	87	235	10.2
Cable5/0/1 (465 MHz)	up	50	84%(19%/84%)	1%	259	513	37
Cable5/0/1/U0	up	50	85%	1%	143	422	10.2
Cable5/0/1/U1	up	50	84%	2%	116	335	10.2

Pure-ds-load (cont.)

- To resolve problem, pure-ds-load introduced in DOCSIS LB
- US load will not be considered if pure-ds-load is applied
- The formula will be: Load of DS for comparing = ds-load

```
uc-cr10k-6(config)#cable load-balance docsis-group 1
uc-cr10k-6(config-lb-group)#policy ?
  pcmm           Enable balancing of modems with active PCMM service flows
  pure-ds-load   Do not count US load when calculating DS utilization
  ugs            Enable balancing of modems with active UGS service flows
  us-across-ds   Load balancing on US groups across DS, DS group method will be
ignored
```

NB LB with DBS

- For service-flow or modem count based LB, MC interface can participate in LB processing without restriction
- For utilization-based LB, MC interface can participate in LB processing only if MC interface works in either SBS or pure DBS mode
  - SBS: Static Bandwidth Sharing
  - DBS: Dynamic Bandwidth Sharing
  - Pure DBS: If a MC interface works in DBS mode, and all the WB interface sharing the same QAM channel work in DBS mode, LB consider the MC interface works in pure DBS mode
  - Non-pure DBS: If a MC interface works in DBS mode, and at least one WB interface sharing the same QAM channel work in SBS mode, LB consider the MC interface works in non-pure DBS mode.

NB LB with DBS (cont.)

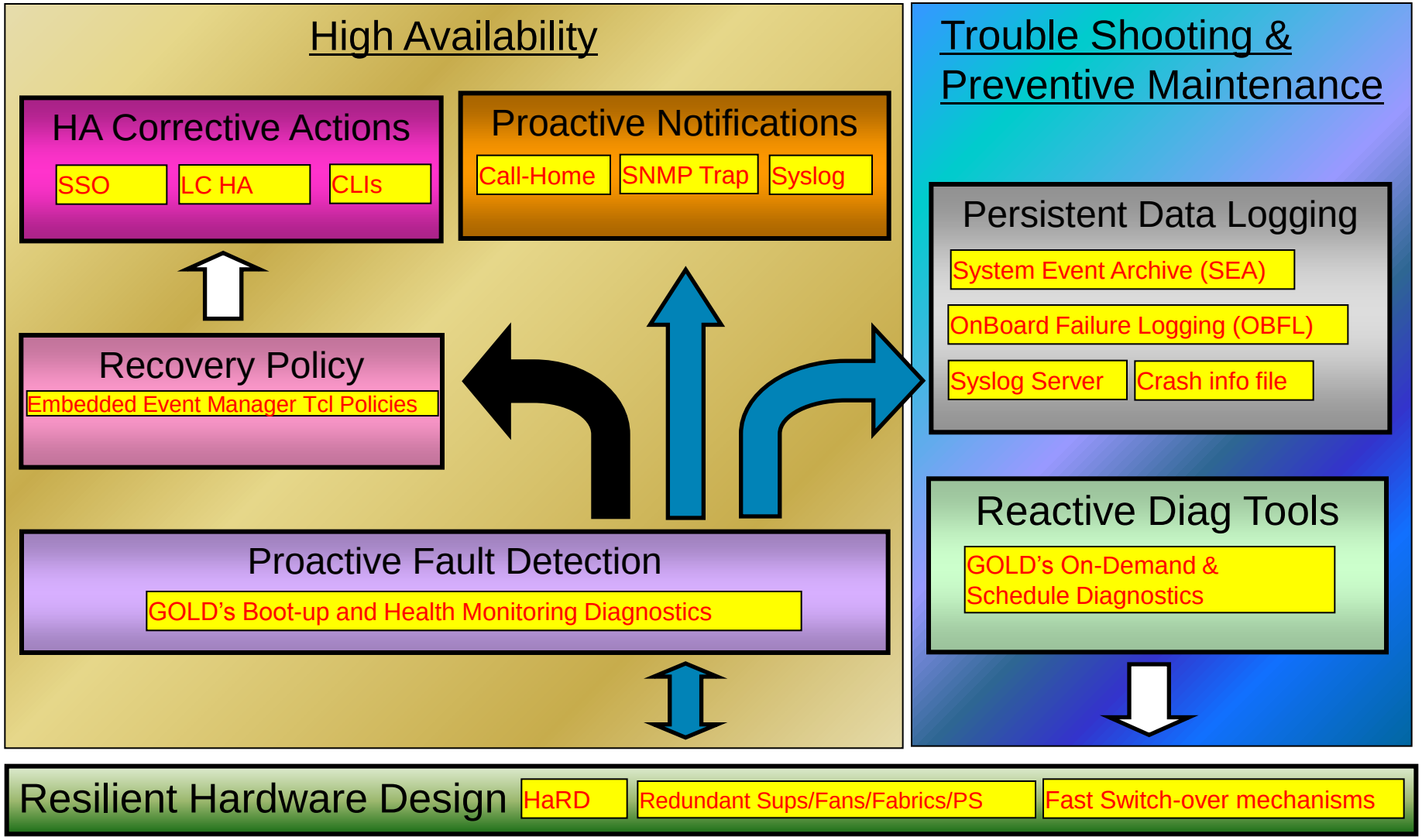
- LB will mark the MC interface as “down” state if the MC interface works in non-pure DBS mode
  - So MC interface won’t participate in LB processing
- MC interface load in LB:
  - If MC interface works in SBS mode, interface load is treated as MC interface load
  - If MC interface works in DBS mode, QAM load is treated as MC interface load

LB Retry Counter

- If LB failed to move CM more than configured threshold, CM will be excluded from dynamic LB
- `uc-cr10k(config)#cable load-balance modem max-failures ?`
- `<0-100>  Max failures before modem is removed from dynamic LB`

CMTS Debuggability Enhancements

Elements of a Diagnosable System



CMTS Debuggability Enhancements in Bighorn

- New set of features aimed at providing greater visibility when debugging problems both internally and at customer sites
- CMTS Health Monitoring
  - Generic On-Line Diagnostics (GOLD) : GOLD is most appropriately used to proactively poll for system errors that don't generate an explicit interrupt
  - System Event Archive (SEA) : SEA provides logging of events to non-volatile storage on RP
  - 5x20H OnBoard Failure Logging (OBFL) : Onboard Fault Logging allows software to store vital information that can assist in understanding and debugging field failures upon a board's RMA
  - CMTS GOLD Tests – Initial set ; LLQ Drop Test , CLC Memory Leak Test, Guardian Index Leak Test
- IPC Stats tool: Helps with IPC control traffic profiling
- SNMP Engine CPU Monitor: Monitor "SNMP ENGINE" process CPU utilization per MIB object level

GOLD Infrastructure

- GOLD infrastructure was developed by the cat6k to provide online diagnostic capabilities that can run at bootup, in the background on a periodic basis during normal system operation, or on demand from the CLI
- GOLD is most appropriately used to proactively poll for system errors that don't generate an explicit interrupt
- Tests can be designed to run locally on the PRE or remotely on a linecard but in both cases the tests run on a per card (ie. slot/subslot/bay) basis
- Infrastructure could be enhanced to support global tests associated with the PRE rather than a particular card
- Upon test failure, a syslog message should be generated and corrective action can be optionally taken
- Infrastructure supports integration with EEM for corrective action
- Exec level CLI exists to start/stop on demand tests and display registered tests and results
- Config level CLI exists to enable/disable tests as well as control the interval between iterations

GOLD Infrastructure CLI

- View registered tests and their parameters
  - ubr-122s-1# show diagnostic content …
- Start an on demand test:
  - ubr-122s-1# diagnostic start …
- View test results:
  - ubr-122s-1# show diagnostic results …
- Enable/disable a test
  - ubr-122s-1(config)#[no] diagnostic monitor …
- Change a test interval:
  - ubr-122s-1(config)#[default] diagnostic monitor interval …

Note that in all diagnostic CLI commands, jacket cards are referenced as “slot x”, cable cards are referenced as “subslot x/y”, and spas are referenced as bay “x/y”

System Event Achieve (SEA)

- SEA provides logging of events to non-volatile storage on RP
- syslog messages and events generated using SEA API on RP and LC are logged. Jacket card has separate SEA API to log events.
- Enabled by default
- Requires ATA PCMCIA disk or Compact Flash based storage (disk or bootflash)
- Supported only on uBR10K
- Secondary PRE SEA events are logged to local disk

SEA Storage File

- File name “sea_log.dat”
- Default location
  - PRE2 : disk0
  - PRE4 : bootflash
- File size: Depends on the disk/bootflash size
  - It will be smaller of 10% of the disk size and 32 MB
  - For example, for 512 MB disk, it will be 32 MB, for 256 MB disk, it will be 25 MB
- Logs are stored in a circular manner

520H On-Board Fault Logging (OBFL)

520H OBFL

- Onboard Fault Logging allows software to store vital information that can assist in understanding and debugging field failures upon a board's RMA
- CMTS platform currently supports OBFL on PRE4 based RP, Spumoni (SIP-600) Jacket Card, 20x20, 8x8 and now the 520H CLC
- Information is logged to non-volatile memory on the board
- On 520H, 2 MB of FLASH storage (bootflash) is dedicated for OBFL data storage

520H OBFL

- UDI (PID, VID, S/N) information
- OS Version
- Firmware & HW Versions
- Boot time Information (time, slot location, volt)
- Reset Reasons
- Total Run Time (Hours in use)
- Voltage variations & history
- Fatal Hardware events
  - To be added as part of Bighorn rebuild

SNMP Engine CPU Monitor

SNMP Engine CPU Monitor

- Monitor “SNMP ENGINE” process CPU utilization per MIB object level
- Statistics information:
  - Functional routine address: for decode usage
  - 5 seconds CPU utilization: arithmetic average
  - 1 minute CPU utilization: arithmetic average
  - 5 minute CPU utilization: arithmetic average
  - Running duration: ms level, doesn’t count suspend time
  - Pure CPU runtime: us level, counting suspend time in
  - Invoked time: how many times this object has been polled
  - Object OID: current object name

SNMP Engine CPU Monitor - CLIs

- ALL CLIs are only available in “service internal” mode
- Enable feature
  - ubr10k-nm-4#test snmp cpu start
    SNMP cpu stats is enabled!
- Disable feature
  - ubr10k-nm-4#test snmp cpu stop
    SNMP cpu stats is disabled!
- Clear status
  - ubr10k-nm-4#clear snmp cpu-status
    SNMP process CPU stats info cleared.
- Show status
  - ubr10k-nm-4#show snmp cpu-stats
    ADDR 5sec% 1min% 5min% Running(ms) Time(usecs) Invoked OID

SNMP Engine CPU Monitor – CLIs (cont)

- Sample result

```
ubr10k-nm-4#show snmp cpu-stats
    ADDR 5sec% 1min% 5min% Running(ms) Time(usecs)  Invoked OID
60FA184C  0.95  0.07  0.01           0          22    70 ifIndex
60FA184C  0.95  0.07  0.01           0          24    70 ifDescr
60FA184C  0.95  0.07  0.01           0          21    70 ifType
60F9082C  0.95  0.07  0.01           0         158    1 atEntry.1
61014678  0.00  0.00  0.00           1        1692    7 docsIfCmtsCmStatusEntry.2
61014678  0.00  0.00  0.00           0        1510    7 docsIfCmtsCmStatusEntry.3
61014678  0.00  0.00  0.00           0        1524    7 docsIfCmtsCmStatusEntry.4
61014678  0.00  0.00  0.00           0        1545    7 docsIfCmtsCmStatusEntry.5
...
```

SNMP Engine CPU Monitor – CLIs (cont)

- Sample result

```
ubr10k-nm-4#show snmp cpu-stats time greater-than 500
    ADDR 5sec% 1min% 5min% Running(ms) Time(usecs)  Invoked OID
61014678  0.00  0.00  0.00         1    1692   7 docsIfCmtsCmStatusEntry.2
61014678  0.00  0.00  0.00         0    1510   7 docsIfCmtsCmStatusEntry.3
61014678  0.00  0.00  0.00         0    1524   7 docsIfCmtsCmStatusEntry.4
61014678  0.00  0.00  0.00         0    1545   7 docsIfCmtsCmStatusEntry.5
...
```

CMTS IPv6 Features

List of New IPv6 Features in Bighorn

- Support for IPv6 over cable Bundle sub-interfaces of CMTS
- Full Docsis 3.0 Gold support for DPM and APM CM
- Dual-stack CPE support
- Source Address Verification (D3.0)

CM Provisioning Modes

- DPM
  - Dual-stack Provisioning Mode where a CM gets online with IPv4 and IPv6
- APM
  - To improve provisioning reliability
  - CM first uses primary provisioning protocol IPv6. A docsis 3.0 CM MUST always attempt IPv6 first.
  - If primary provisioning mode fails, the CM tries to provision itself using the other protocol (IPv4)

CMTS IPv6 Features (1)

- Support docsis 3.0 Gold level IPv6 compliance for both ubr7200 and ubr10k CMTS
  - ubr10k CMTS IPv6 code still runs only in punt path
- IPv6 bridged modems are supported in single-and dual-stack mode will all failure conditions handling working for DPM and APM
- IPv6 over Bundle sub-interfaces is supported
- Dual-stack CPE is supported

CMTS IPv6 Features (2)

- Source Address Verification
  - Complements legacy source verification
  - Provides additional ways to authorize Static IP addresses for CPEs

    Allows configuration of unique prefixes per CM or an SAV Group for multiple CMs

    An US packet sourced from an IP address within the prefix assigned for that CM is considered to be authorized and forwarded.

    If the source does not match any SAV prefix, the packet is dropped.

    SAV is the only means of supporting Static IPv6 CPEs

Dual-Stack Host Behind CM (CPE)

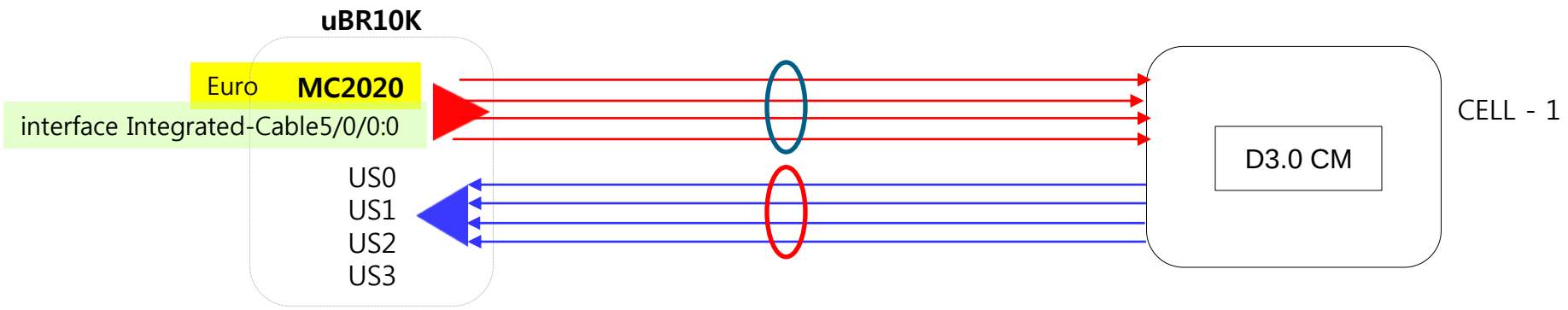
- Support CPEs which have IPv6 and IPv4 stacks active concurrently
  - CPE gets an IPv4 and an IPv6 address
- Only DHCPv6 addresses are supported for dual stack CPE
- No additional configuration required on the CMTS for dual stack CPE support
- Differential address assignment is not supported to fork DHCPv6 traffic to modems vs. CPEs
- Sample CPE show output is shown on next slide
- Restrictions
  - SLACC is not supported
  - Dual stack CPE with DHCPv6 and static IPv4 is not supported

Dual-Stack CPE Show Output

```
ta-vxr1#scm6 reg
Interface    Prim Online       CPE IP Address                                MAC Address
             Sid  State
C4/0/U2      6    online       0   2001:420:3800:809:4C7A:D518:91C6:8A18   0019.474a.c18c

ta-vxr1#scm6 reg
Interface    Prim Online       CPE IP Address                                MAC Address
             Sid  State
C4/0/U2      6    online       1   2001:420:3800:809:4C7A:D518:91C6:8A18   0019.474a.c18c

ta-vxr1#scm 0019.474a.c18c cpe
IP address        MAC address      Dual IP     Device Class
50.3.37.11        0011.2544.f33b     Y          Unknown

ta-vxr1#scm 0019.474a.c18c ipv6 cpe
MAC Address    IP Address                                Domain Name
0011.2544.f33b 2001:420:3800:809:607A:DAC7:6F3:58B9
```

참고
Confiugration

Case 1 : 200Mbps with MC2020V



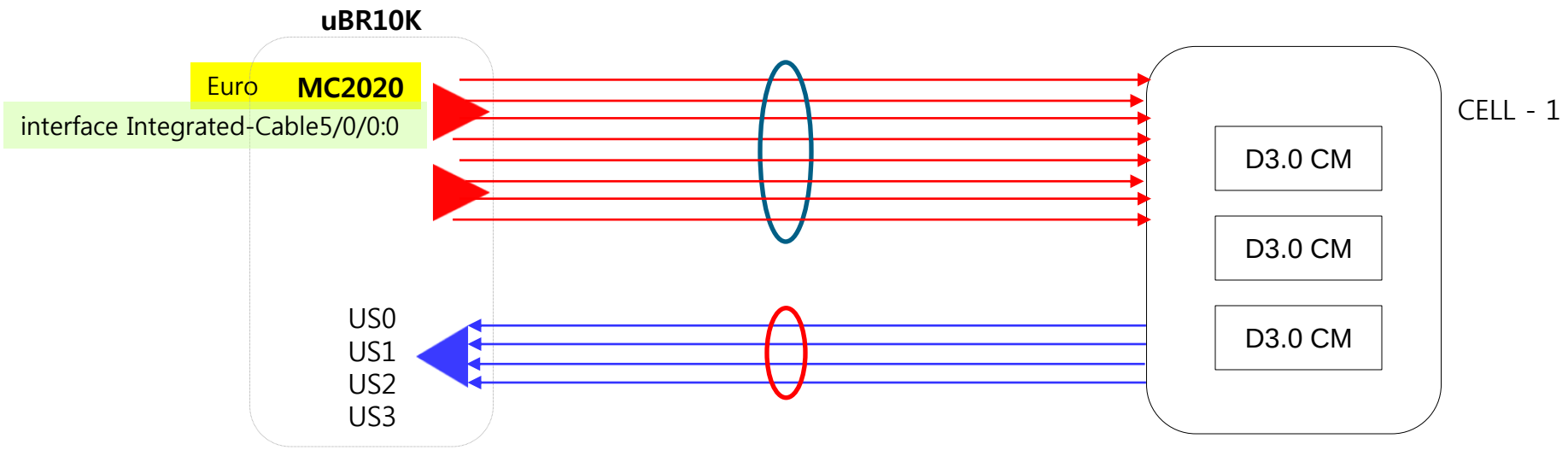
DS 4 channel bonding & US 4 channel bonding

```
controller Integrated-Cable 6/0/0
 rf-channel 0 frequency 513000000 annex A modulation 256qam interleave 12
 rf-channel 0 rf-power 52.0
 no rf-channel 0 rf-shutdown
 rf-channel 1 frequency 521000000 annex A modulation 256qam interleave 12
 rf-channel 1 rf-power 52.0
 no rf-channel 1 rf-shutdown
 rf-channel 2 frequency 529000000 annex A modulation 256qam interleave 12
 rf-channel 2 rf-power 52.0
 no rf-channel 2 rf-shutdown
 rf-channel 3 frequency 537000000 annex A modulation 256qam interleave 12
 rf-channel 3 rf-power 52.0
 no rf-channel 3 rf-shutdown
```

Case 1 : 200Mbps with MC2020V - conf

```
interface Cable6/0/0
 downstream Integrated-Cable 6/0/0 rf-channel 0
 cable mtc-mode
 cable bundle 1
 cable upstream max-ports 4
 cable upstream bonding-group 600
  upstream 0
  upstream 1
  upstream 2
  upstream 3
  attributes 80000000
 cable upstream 0 connector 0
 cable upstream 0 frequency 17000000
 cable upstream 0 channel-width 6400000 6400000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 2
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 no cable upstream 0 shutdown
 cable upstream 1 connector 1
 cable upstream 1 frequency 24000000
 cable upstream 1 channel-width 6400000 6400000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 2
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 no cable upstream 1 shutdown
 cable upstream 2 connector 2
 cable upstream 2 frequency 31000000
 cable upstream 2 channel-width 6400000 6400000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 2
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 no cable upstream 2 shutdown
 cable upstream 3 connector 3
  cable upstream 3 frequency 38000000
  cable upstream 3 channel-width 6400000 6400000
  cable upstream 3 docsis-mode atdma
  cable upstream 3 minislot-size 2
  cable upstream 3 range-backoff 3 6
  cable upstream 3 modulation-profile 221
  no cable upstream 3 shutdown
 !
 interface Wideband-Cable6/0/0:0
  cable bundle 1
  cable dynamic-bw-sharing
  cable rf-channel 0 bandwidth-percent 10
  cable rf-channel 1 bandwidth-percent 10
  cable rf-channel 2 bandwidth-percent 10
  cable rf-channel 3 bandwidth-percent 10
 !
 interface Wideband-Cable6/0/0:1
  cable bundle 1
  cable dynamic-bw-sharing
  cable rf-channel 0 bandwidth-percent 10
  cable rf-channel 1 bandwidth-percent 10
  cable rf-channel 2 bandwidth-percent 10
 !
 interface Integrated-Cable6/0/0:0
  cable bundle 1
  cable dynamic-bw-sharing
  cable rf-bandwidth-percent 30
 !
 cable fiber-node 60
   downstream Integrated-Cable 6/0/0 rf-channel 0-3
   upstream Cable 6/0 connector 0-3
```

Case 2 : 400Mbps with MC2020V



Case 2 : 400Mbps with MC2020V - conf

```
# DS 8 channel bonding  & US 4 channel bonding #

controller Integrated-Cable 6/0/0
 rf-channel 0 frequency 513000000 annex A modulation 256qam interleave 12
 rf-channel 0 rf-power 52.0
 no rf-channel 0 rf-shutdown
 rf-channel 1 frequency 521000000 annex A modulation 256qam interleave 12
 rf-channel 1 rf-power 52.0
 no rf-channel 1 rf-shutdown
 rf-channel 2 frequency 529000000 annex A modulation 256qam interleave 12
 rf-channel 2 rf-power 52.0
 no rf-channel 2 rf-shutdown
 rf-channel 3 frequency 537000000 annex A modulation 256qam interleave 12
 rf-channel 3 rf-power 52.0
 no rf-channel 3 rf-shutdown
!
controller Integrated-Cable 6/0/1
 rf-channel 0 frequency 513000000 annex A modulation 256qam interleave 12
 rf-channel 0 rf-power 52.0
 no rf-channel 0 rf-shutdown
 rf-channel 1 frequency 521000000 annex A modulation 256qam interleave 12
 rf-channel 1 rf-power 52.0
 no rf-channel 1 rf-shutdown
 rf-channel 2 frequency 529000000 annex A modulation 256qam interleave 12
 rf-channel 2 rf-power 52.0
 no rf-channel 2 rf-shutdown
 rf-channel 3 frequency 537000000 annex A modulation 256qam interleave 12
 rf-channel 3 rf-power 52.0
 no rf-channel 3 rf-shutdown
```

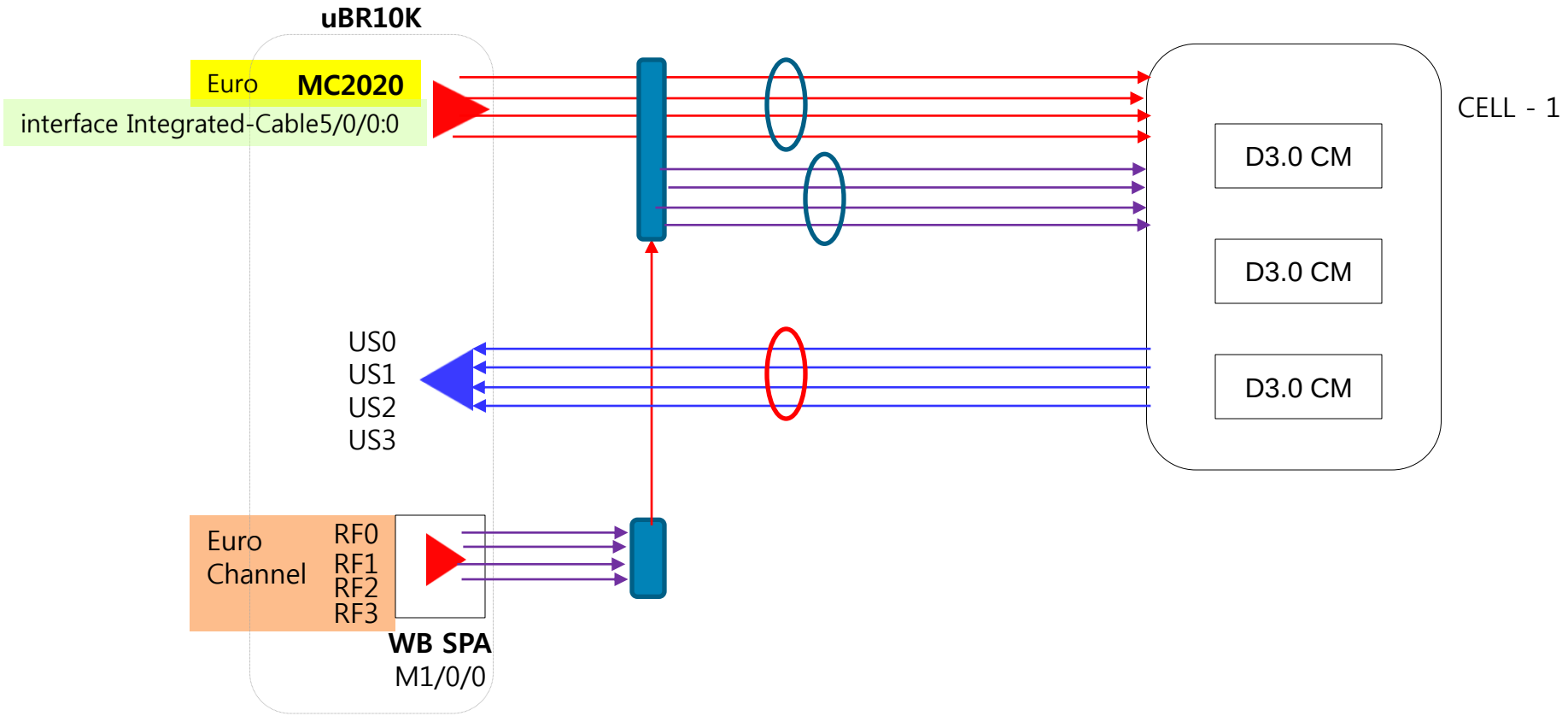
```
interface Cable6/0/0
 downstream Integrated-Cable 6/0/0 rf-channel 0
 cable mtc-mode
 cable bundle 1
 cable upstream max-ports 4
 cable upstream bonding-group 600
  upstream 0
  upstream 1
  upstream 2
  upstream 3
  attributes 80000000
 cable upstream 0 connector 0
 cable upstream 0 frequency 17000000
 cable upstream 0 channel-width 6400000 6400000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 2
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 no cable upstream 0 shutdown
 cable upstream 1 connector 1
 cable upstream 1 frequency 24000000
 cable upstream 1 channel-width 6400000 6400000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 2
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 no cable upstream 1 shutdown
 cable upstream 2 connector 2
 cable upstream 2 frequency 31000000
 cable upstream 2 channel-width 6400000 6400000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 2
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 no cable upstream 2 shutdown
```

Case 2 : 400Mbps with MC2020V - conf

```
 cable upstream 3 connector 3
 cable upstream 3 frequency 38000000
 cable upstream 3 channel-width 6400000 6400000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 2
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 no cable upstream 3 shutdown
!
```

```
interface Wideband-Cable 6/0/0:0
 cable bundle 1
 cable dynamic-bw-sharing
 cable rf-channel 0 bandwidth-percent 10
 cable rf-channel 1 bandwidth-percent 10
 cable rf-channel 2 bandwidth-percent 10
 cable rf-channel 3 bandwidth-percent 10
!
interface Wideband-Cable 6/0/0:1
 cable bundle 1
 cable dynamic-bw-sharing
 cable rf-channel 0 bandwidth-percent 10
 cable rf-channel 1 bandwidth-percent 10
 cable rf-channel 2 bandwidth-percent 10
 cable rf-channel 3 bandwidth-percent 10
 cable rf-channel controller 1 channel 0 bandwidth-percent 10
 cable rf-channel controller 1 channel 1 bandwidth-percent 10
 cable rf-channel controller 1 channel 2 bandwidth-percent 10
 cable rf-channel controller 1 channel 3 bandwidth-percent 10
!
interface Integrated-Cable 6/0/0:0
 cable bundle 1
 cable dynamic-bw-sharing
 cable rf-bandwidth-percent 30
!
cable fiber-node 50
  downstream Integrated-Cable 6/0/0 rf-channel 0-3
  downstream Integrated-Cable 6/0/1 rf-channel 0-3
  upstream Cable 6/0 connector 0-3
!
```

Case 3 : 200Mbps with MC2020V & WB SPA DTI



Case 3 : 200Mbps with MC2020V & WB SPA DTI - conf

DS 4 channel bonding & US 4 channel bonding

```
controller Modular-Cable 1/2/0
 ip-address 30.1.1.1
 modular-host subslot 6/0
 rf-channel 0 frequency 764000000 annex A modulation 256qam interleave 12
 rf-channel 0 ip-address 30.1.1.2 mac-address 0050.4b11.34ee depi-remote-id 49150
 rf-channel 1 frequency 772000000 annex A modulation 256qam interleave 12
 rf-channel 1 ip-address 30.1.1.2 mac-address 0050.4b11.34ee depi-remote-id 49151
 rf-channel 2 frequency 780000000 annex A modulation 256qam interleave 12
 rf-channel 2 ip-address 30.1.1.2 mac-address 0050.4b11.34ee depi-remote-id 49152
 rf-channel 3 frequency 788000000 annex A modulation 256qam interleave 12
 rf-channel 3 ip-address 30.1.1.2 mac-address 0050.4b11.34ee depi-remote-id 49153

controller Integrated-Cable 6/0/0
 rf-channel 0 frequency 513000000 annex A modulation 256qam interleave 12
 rf-channel 0 rf-power 52.0
 no rf-channel 0 rf-shutdown
 rf-channel 1 frequency 521000000 annex A modulation 256qam interleave 12
 rf-channel 1 rf-power 52.0
 no rf-channel 1 rf-shutdown
 rf-channel 2 frequency 529000000 annex A modulation 256qam interleave 12
 rf-channel 2 rf-power 52.0
 no rf-channel 2 rf-shutdown
 rf-channel 3 frequency 537000000 annex A modulation 256qam interleave 12
 rf-channel 3 rf-power 52.0
 no rf-channel 3 rf-shutdown
```

Case 3 : 200Mbps with MC2020V & WB SPA DTI - conf

DS 4 channel bonding & US 4 channel bonding

```
interface Wideband-Cable1/0/0:0
 cable bundle 2
 cable dynamic-bw-sharing
 cable rf-channel 0 bandwidth-percent 10
 cable rf-channel 1 bandwidth-percent 10
 cable rf-channel 2 bandwidth-percent 10
 cable rf-channel 3 bandwidth-percent 10
!
interface Wideband-Cable1/0/0:1
 cable bundle 2
 cable dynamic-bw-sharing
 cable rf-channel 0 bandwidth-percent 10
 cable rf-channel 1 bandwidth-percent 10
 cable rf-channel 2 bandwidth-percent 10
!
interface Modular-Cable1/0/0:0
 load-interval 30
 cable bundle 2
 cable dynamic-bw-sharing
 cable rf-bandwidth-percent 10
!
interface Cable6/0/0
 downstream Integrated-Cable 6/0/0 rf-channel 0
 downstream Modular-Cable 1/0/0 rf-channel 0
 cable mtc-mode
 cable bundle 1
 cable upstream max-ports 4
 cable upstream bonding-group 600
  upstream 0
  upstream 1
  upstream 2
  upstream 3
  attributes 80000000
cable upstream 0 connector 0
 cable upstream 0 frequency 17000000
 cable upstream 0 channel-width 6400000 6400000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 2
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 no cable upstream 0 shutdown
 cable upstream 1 connector 1
 cable upstream 1 frequency 24000000
 cable upstream 1 channel-width 6400000 6400000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 2
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 no cable upstream 1 shutdown
 cable upstream 2 connector 2
 cable upstream 2 frequency 31000000
 cable upstream 2 channel-width 6400000 6400000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 2
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 no cable upstream 2 shutdown
```

Case 3 : 200Mbps with MC2020V & WB SPA DTI - conf

```
 # DS 4 channel bonding  & US 4 channel bonding #
interface Wideband-Cable6/0/0:0
 cable bundle 2
 cable dynamic-bw-sharing
 cable rf-channel 0 bandwidth-percent 10
 cable rf-channel 1 bandwidth-percent 10
 cable rf-channel 2 bandwidth-percent 10
 cable rf-channel 3 bandwidth-percent 10
!
interface Wideband-Cable6/0/0:1
 cable bundle 2
 cable dynamic-bw-sharing
 cable rf-channel 0 bandwidth-percent 10
 cable rf-channel 1 bandwidth-percent 10
 cable rf-channel 2 bandwidth-percent 10
!
interface Integrated-Cable6/0/0:0
 cable bundle 2
 cable dynamic-bw-sharing
 cable rf-bandwidth-percent 30
!
cable fiber-node 60
  downstream Integrated-Cable 6/0/0 rf-channel 0-3
  downstream Modular-Cable 1/0/0 rf-channel 0-3
  upstream Cable 6/0 connector 0-3
```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