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OCTOBER 21-24 / ATLANTA, GA

CCAP CASE STUDY:
ENABLING CONVERGED VIDEO + DATA THRU SPACE & POWER SAVINGS

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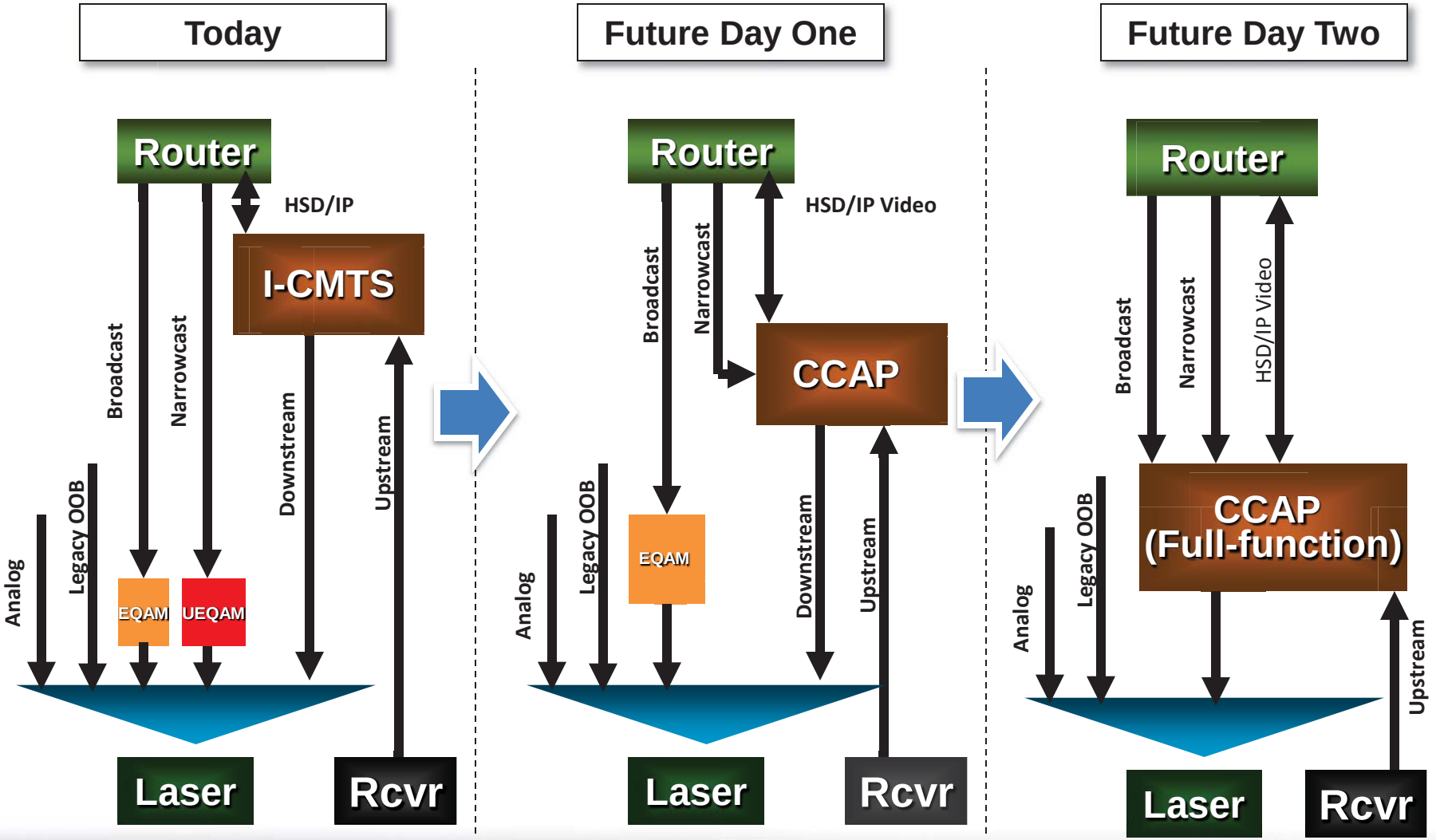
Migration Scenario – Integrated CMTS (I-CMTS) Example



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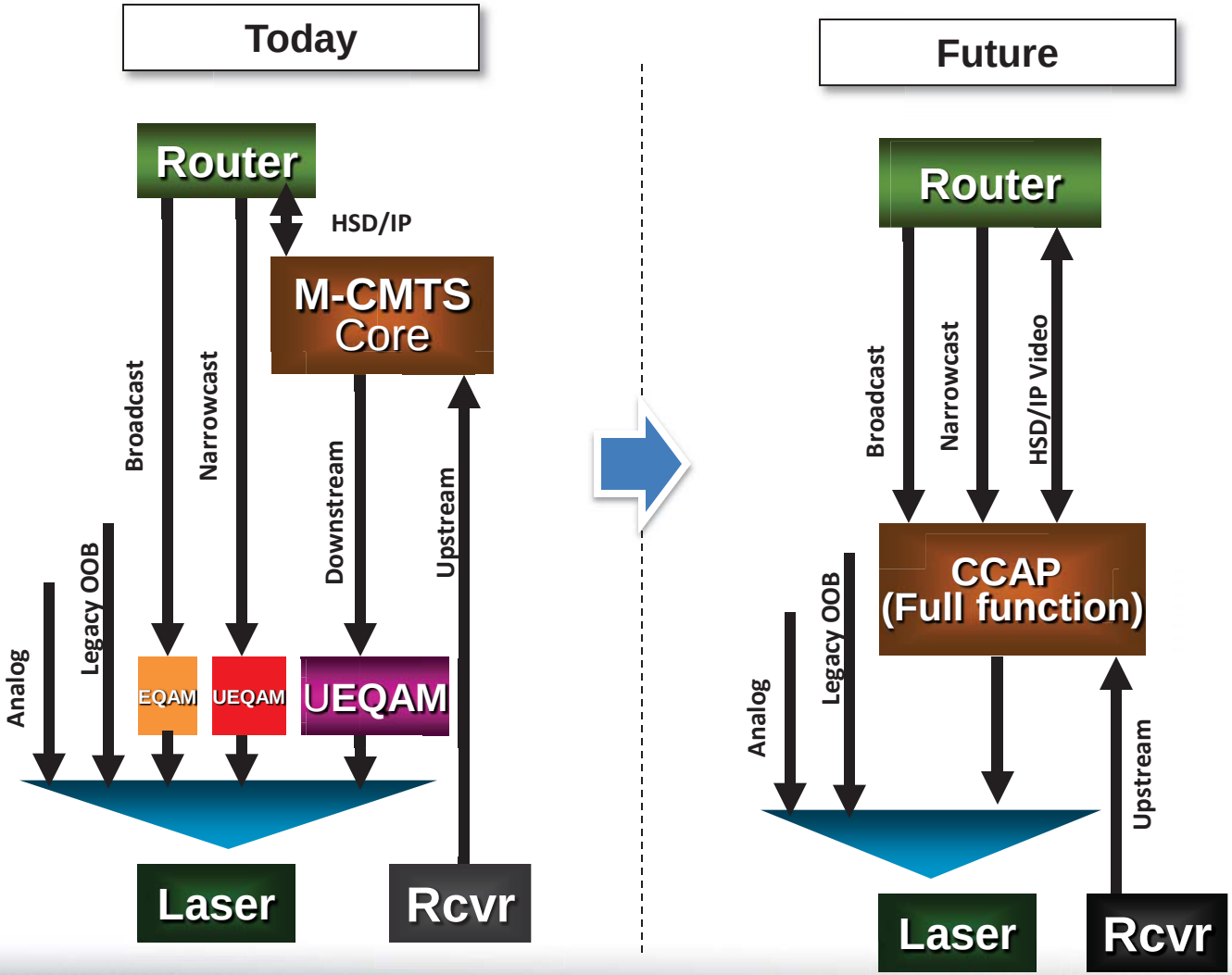
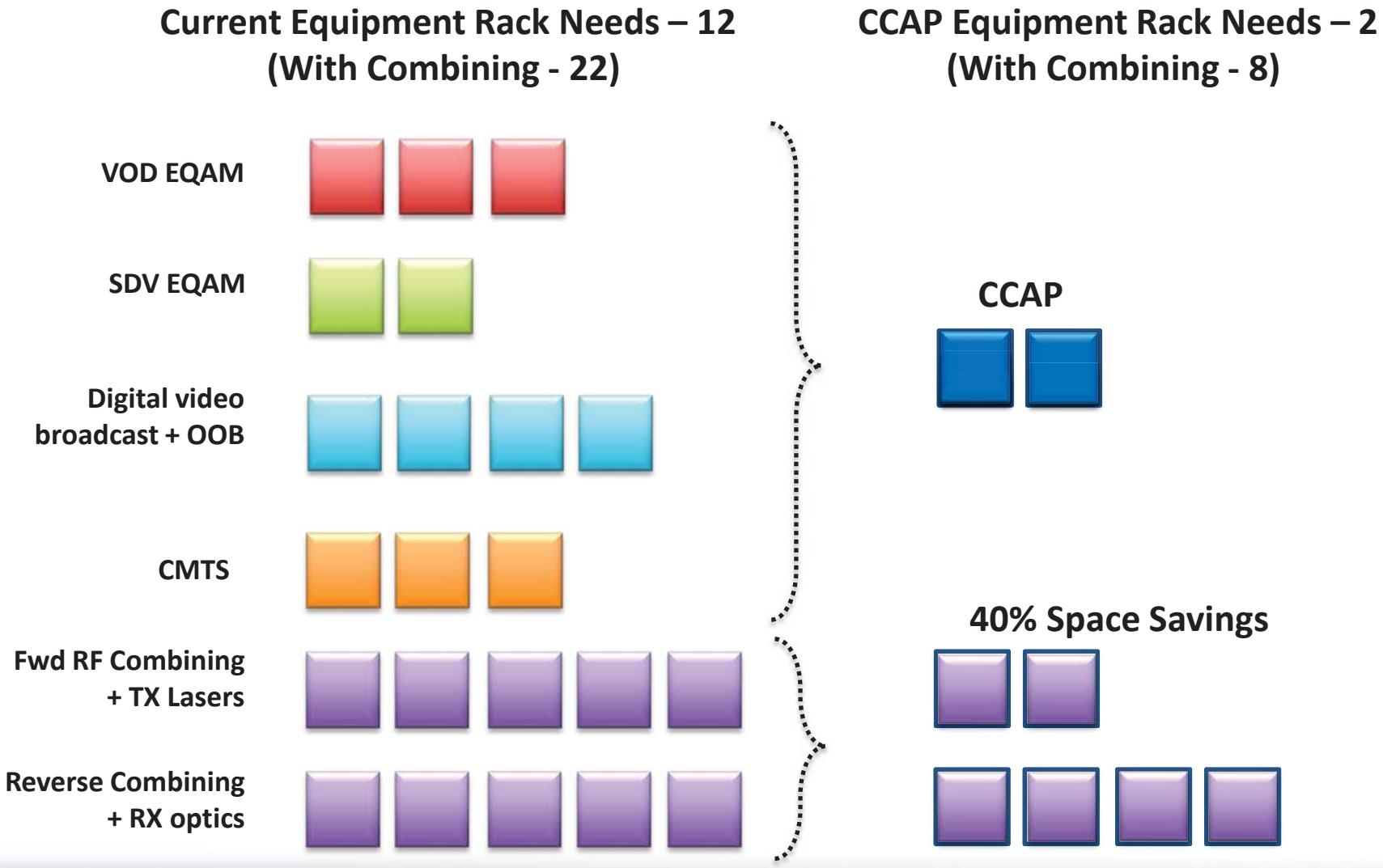
Migration Scenario – Modular CMTS (M-CMTS) Example



Potential CCAP Head End Space Savings
(160 node example)



CCAP Benefits

- Frees Rack Space
- Reduces Head End power
- Less Network + RF Interconnections
- Fewer Boxes to manage

Paper is a case study of multiple actual Head End sites to quantify the above benefits

Case Study only considers integration of narrowcast EQAM + CMTS into CCAP, Broadcast left external

Overview of Sites

- Urban Sites:
  - Very Large I-CMTS Master Head End
  - Very Large M-CMTS Master Head End
  - One Extremely Packed Hub site
- Suburban Sites:
  - Hub #1: I-CMTS site
  - Hub #2: M-CMTS site

Site Sizing	Urban #1 Master HE	Urban #2 Hub	Suburban Hub #1	Suburban Hub #2	Urban #3 Master HE
VOD Service Groups	672	304	90	72	179
SDV Service Groups	-	-	-	-	226
HSD Downstream SG	672	304	92	73	432
HSD Upstream SG	672	304	153	87	432
Optical Nodes	723	368	177	94	452
CCAP Converged DS SG	672	304	104	94	448
CCAP Upstream SG	672	304	168	94	448

Reduced Chassis Count
(Simplified Operations: Management)

Chassis Count	Urban #1 Master HE	Urban #2 Hub	Suburban Hub #1	Suburban Hub #2	Urban #3 Master HE
Video EQAM	81	31	5	4	160
M-CMTS EQAM	-	-	-	5	6
CMTS	31	15	5	2	6
Total Chassis	112	46	10	11	172
CCAP Chassis	12	6	2	2	8
Chassis Savings	89%	87%	80%	82%	95%

Many Fewer Boxes to Manage:
80% to 95% less Chassis

CCAP Space Savings
(Equip only)

"Wire Once" strategy Provides Significant Rack Savings

60%+ Savings at Most Head Ends

Smaller M-CMTS Hub had 40% Savings [newer EQAM, partially loaded CCAP]

Space (RU) - Equip		Urban #1 Master HE	Urban #2 Hub	Suburban Hub #1	Suburban Hub #2	Urban #3 Master HE
Existing Chassis RU	Video EQAM	162 RU	62 RU	10 RU	8 RU	220 RU
	M-CMTS EQAM	-	-	-	10 RU	78 RU
	CMTS	434 RU	210 RU	70 RU	36 RU	108 RU
	Total Equip	596 RU	272 RU	80 RU	54 RU	406 RU
CCAP Space		192 RU	96 RU	32 RU	32 RU	128 RU
CCAP Equip Savings		404 RU	176 RU	48 RU	22 RU	278 RU
% Savings		68%	65%	60%	41%	68%

CCAP removes almost Two Thirds of Equip RU While providing 400% increase in capacity

CCAP Space Savings
(RF combining and Total RU)

"Wire Once" strategy Provides Significant Rack Savings

1 Dozen Total Racks Recovered at each Master HE site

[CCAP SG Expansion: includes broadcast; excludes optics]

Space (RU) - RF Combining	Urban #1 Master HE	Urban #2 Hub	Suburban Hub #1	Suburban Hub #2	Urban #3 Master HE
RF Combining Savings (narrowcast only)	120 RU	128 RU	40 RU	40 RU	250 RU
CCAP Equip Savings	404 RU	176 RU	64 RU	38 RU	278 RU
Combined RU Savings	524 RU	304 RU	104 RU	78 RU	528 RU
CCAP SG: Replacement	672	304	104	94	448
CCAP SG: Expansion using All Space Savings	2464	1400	448	392	2296
CCAP Space Multiplier	3.7X	4.6X	4.3X	4.2X	5.1X

Equip + RF Combining Space Savings enable 4X Growth in CCAP ports (i.e. 2 node splits)

CCAP Power Savings

51% - 63% Savings at Large Head Ends
Smaller Hubs had
31% - 41% savings

Power per Channel is reduced by order of magnitude (7X to 10X)

Power Savings		Urban #1 Master HE	Urban #2 Hub	Suburban Hub #1	Suburban Hub #2	Urban #3 Master HE
Existing Chassis (KW)	EQAM	40.6	15.6	2.8	4.9	48.8
	CMTS	82.5	39.9	9.0	3.6	10.8
	Total	123.1	55.5	11.8	8.5	59.6
Power per DS+US (W)		11.4	11.3	8.0	7.3	8.6
CCAP Total Power (KW)		45.0	20.9	7.0	5.9	29.2
CCAP Pwr per DS+US (W)		1.1	1.1	1.1	1.0	1.0
Net Pwr Savings (KW)		78.1	34.6	4.8	2.6	30.4
% Savings		63%	62%	41%	31%	51%

CCAP reduces Power in ALL Head Ends
While providing 400% increase in capacity

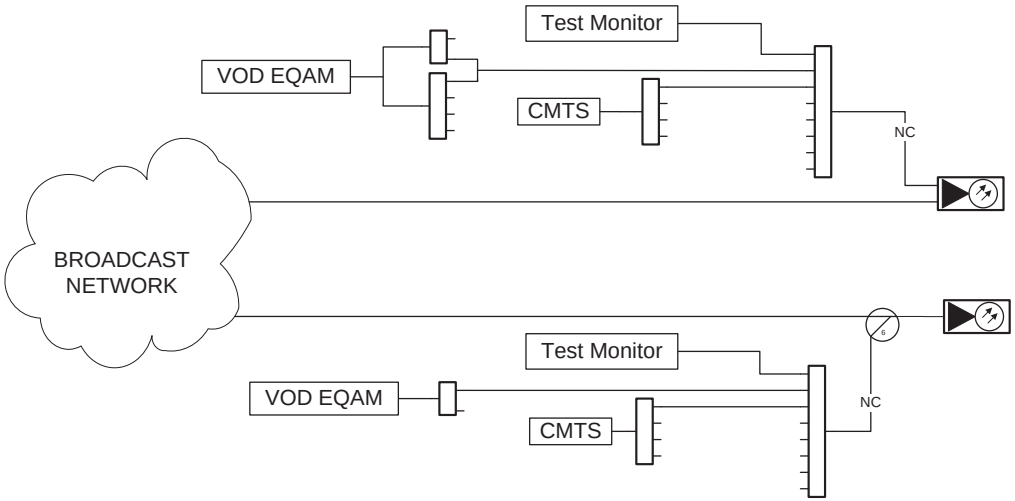
Simplified Operations
(RF + Ethernet Interconnections)

RF + Ethernet Interconnections	Urban #1 Master HE	Urban #2 Hub	Suburban Hub #1	Suburban Hub #2	Urban #3 Master HE
Total RF Interconnects: Existing EQAM	1458 ports	558 ports	4956 connects	2632 connects	1348 connects
Total RF Interconnects: CCAP	675 ports	306 ports	2832 connects	1504 connects	448 connects
RF Interconnect Savings	783 ports 54%	252 ports 45%	43%	43%	67%
Total Ethernet Connections: Existing EQAM (1G)	273	108	30	54	301
Total Ethernet Connections: CCAP (10G)	50	22	8	8	32
Ethernet Port Savings	223 ports 82%	86 ports 80%	22 ports 73%	46 ports 85%	269 ports 89%

More Efficient RF + Ethernet Networking
Wire Once Strategy

Simplified Operations
Wire Once Strategy

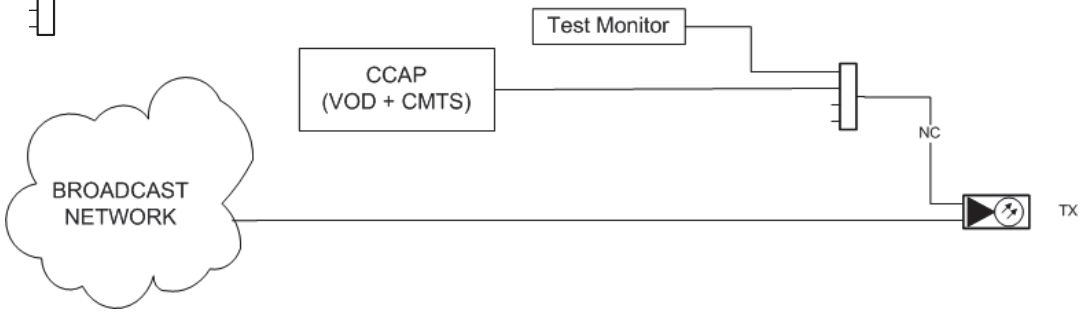
Current Narrowcast RF Combining – Suburban Site



50% Less RF Interconnections for M-CMTS + Video integration

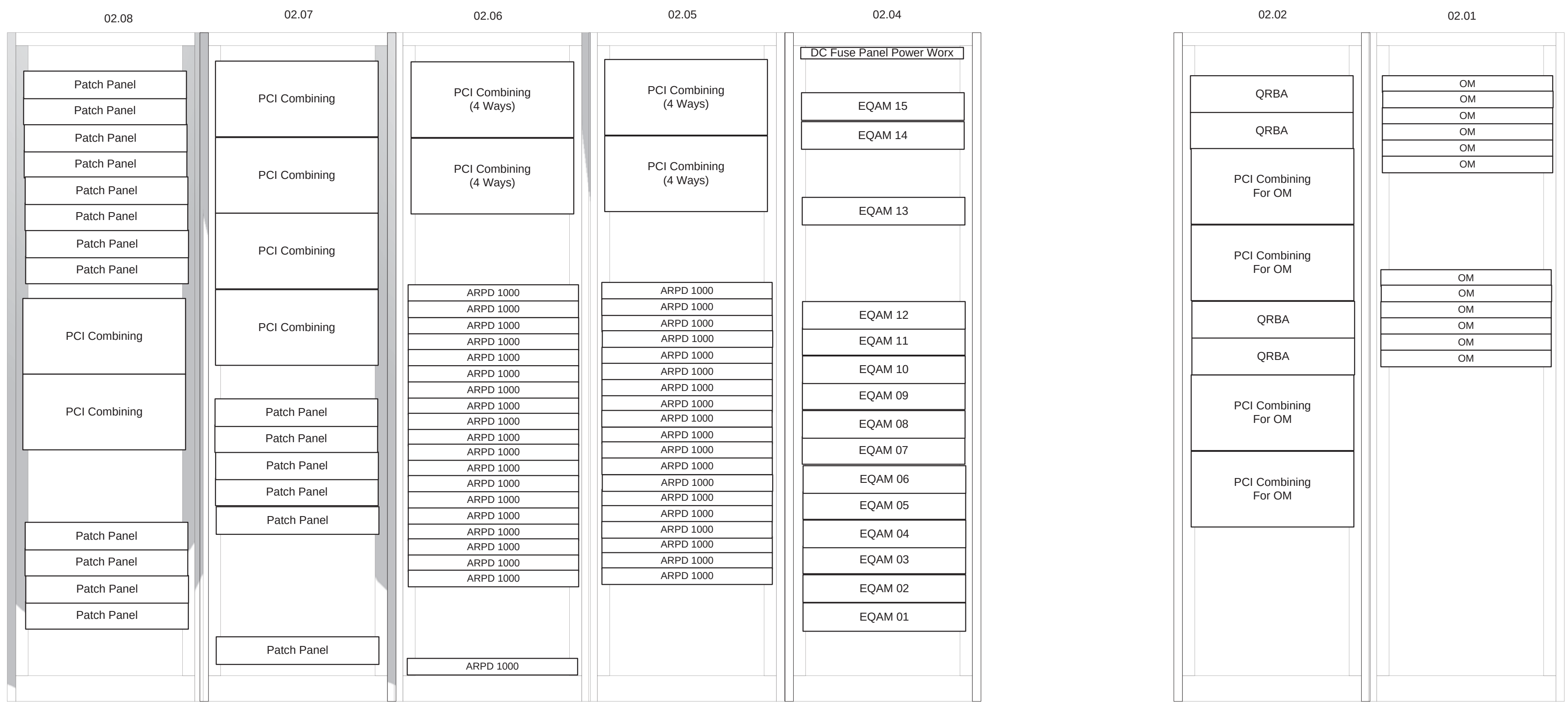
"Wire Once" strategy for simplified, converged Service Group mgmt

Proposed CCAP RF Combining

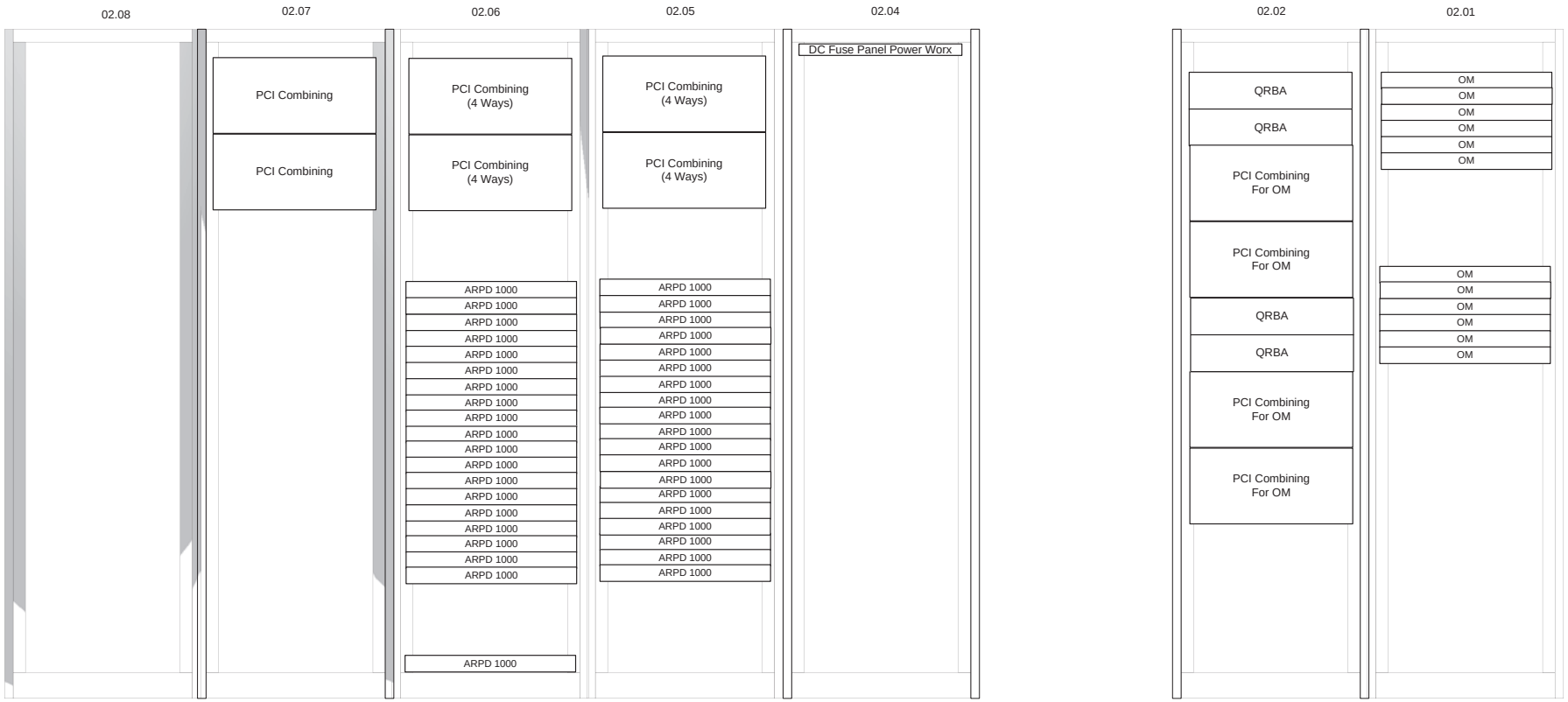


CCAP RF Design Conservative Room for Additional RF savings

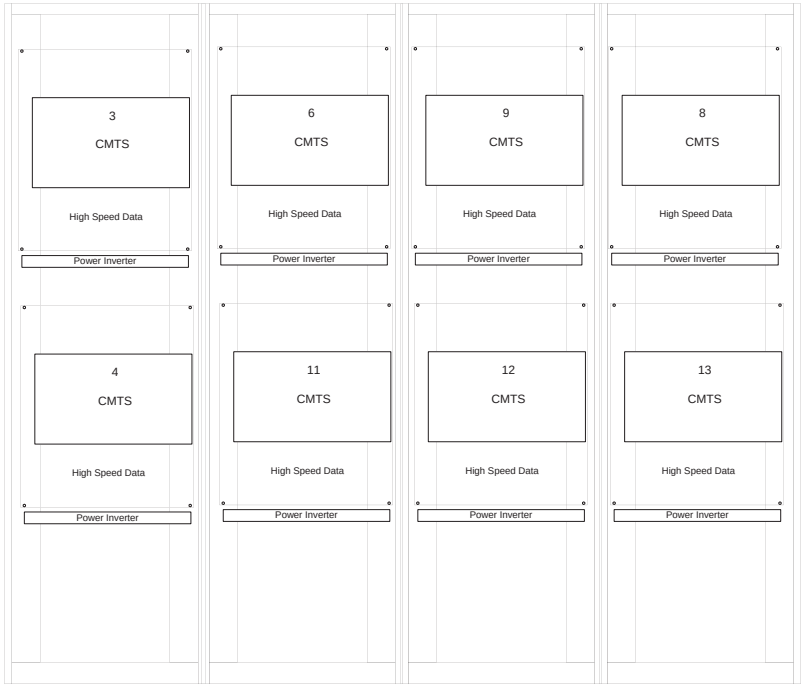
Urban Hub EQAM & RF Combining Rack Elevations – Existing



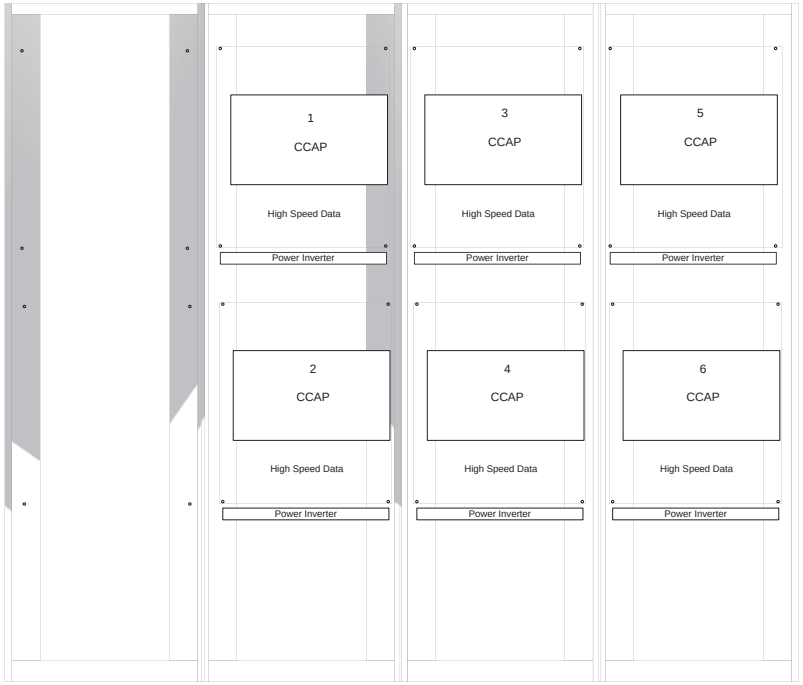
Urban Hub EQAM & RF Combining Rack Elevations – with CCAP



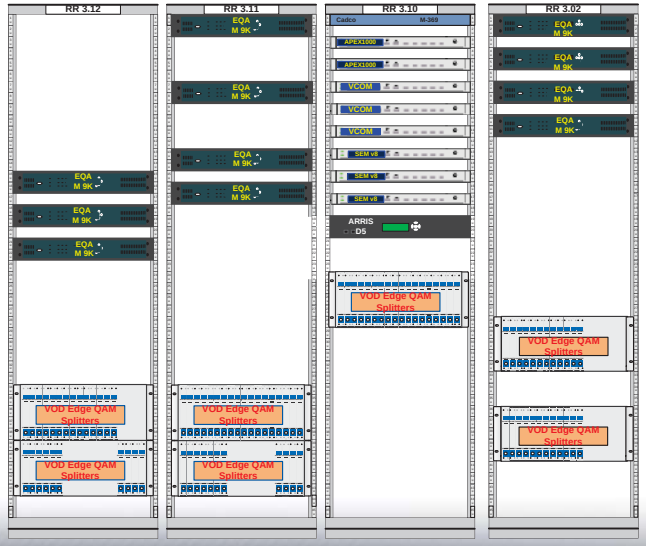
Urban Hub CMTS Room – Existing

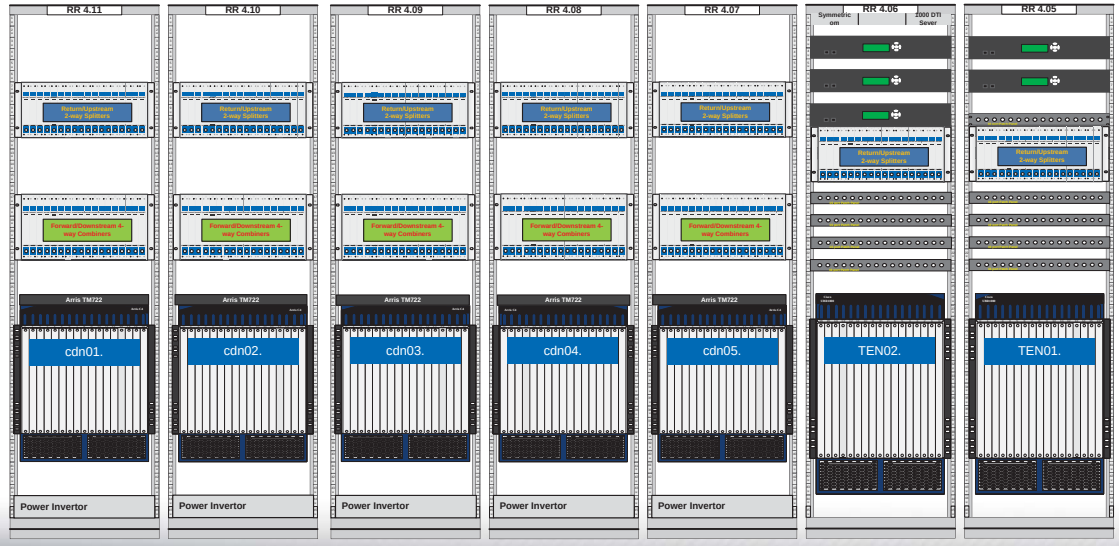


Urban Hub CMTS Room – with CCAP

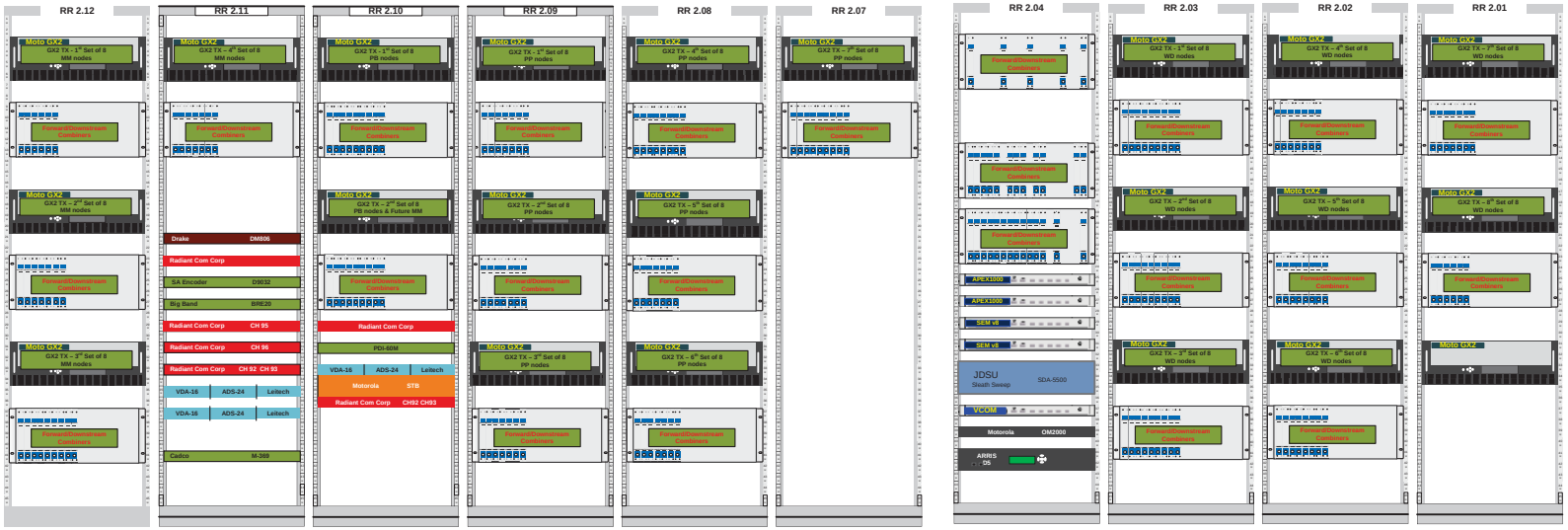


Suburban Rack Elevations – Existing





Suburban Rack Elevations – with CCAP



Summary: Measured CCAP Benefits

- Frees Rack Space
  - 60%+ savings of Equipment RU with 400% capacity boost
  - Wire Once Strategy: equal RU savings from reduced RF Combining
- Reduces Head End power
  - 50% to 63% reduction at large Head Ends
- Less Network + RF Interconnections
  - 73% to 89% reduction in Ethernet ports
  - Simplified RF Combining makes future SG splits easier
- Fewer Boxes to manage
  - 80% to 95% reduction

Equip + RF Combining Space Savings enable 4X Growth in CCAP ports (i.e. 2 node splits)

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