Impacts on Cable HFC Networks

Robert W Harris
Senior Consultant,
Technology Futures, Inc.
rharris@tfi.com

TFI Communications Technology Asset Valuation Conference

Thursday, January 30, 2014

13740 Research Blvd., Bldg. C-1 • Austin, Texas 78750
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Overview

- Issues and challenges over the next 10 years
- Traffic trends and implications
- Direction of network evolution

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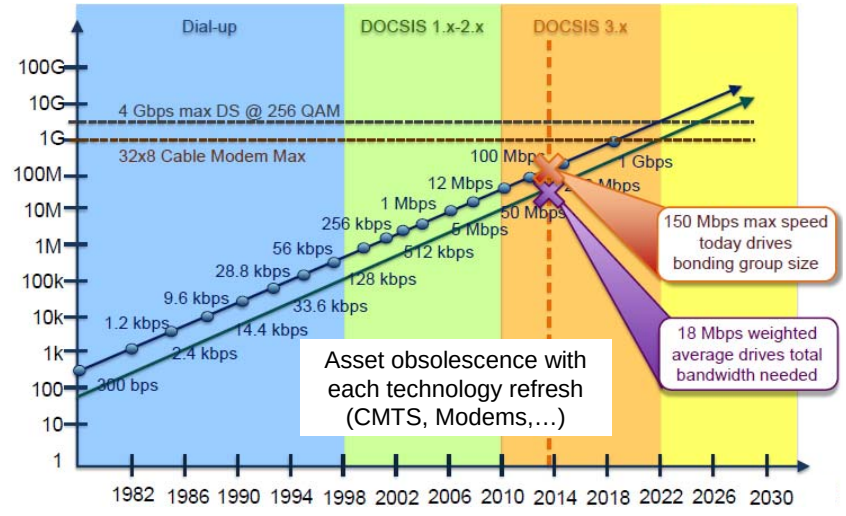
High Speed Data Consumer Speeds



Source: Jeff Finkelstein, Cox Communication

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Revenue Challenges Over Next 10 Years

- Expanding data-carrying capacity at >50% CAGR
  - Equipment cost per Mb/s must decline by >33% to keep prices constant
- Monetizing new services
  - Expecting limited revenue from Over the Top (OTT) services
  - Cloud-based, healthcare, home security, education, business services, wireless backhaul
- Flat ARPU
  - How to manage CAPEX requirements and control costs for growing and operating new businesses

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Technology Factors: Next Decade

- Service migration to all-IP → equipment obsolescence
  - Analog Video to MPEG Digital Video
  - MPEG Digital Video to IP Digital Video
- Infrastructure improvements
  - Migrating the cable network that was originally built for one-way (broadcast) communications
  - Outside plant upgrades and expansion
  - Decommissioning legacy systems

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Cable Network Evolution Options

- Address congestion of HFC with current solutions
  - Smaller serving groups through Node splits and extensions
- To get to Gbps speeds over HFC requires new technologies
  - Modify the RF spectrum to expand the downstream and upstream bandwidth capacities
  - Migrate from DOCSIS 3.0 to DOCSIS 3.1
- All options require dealing with an aging HFC plant
- Upgrade to FTTH

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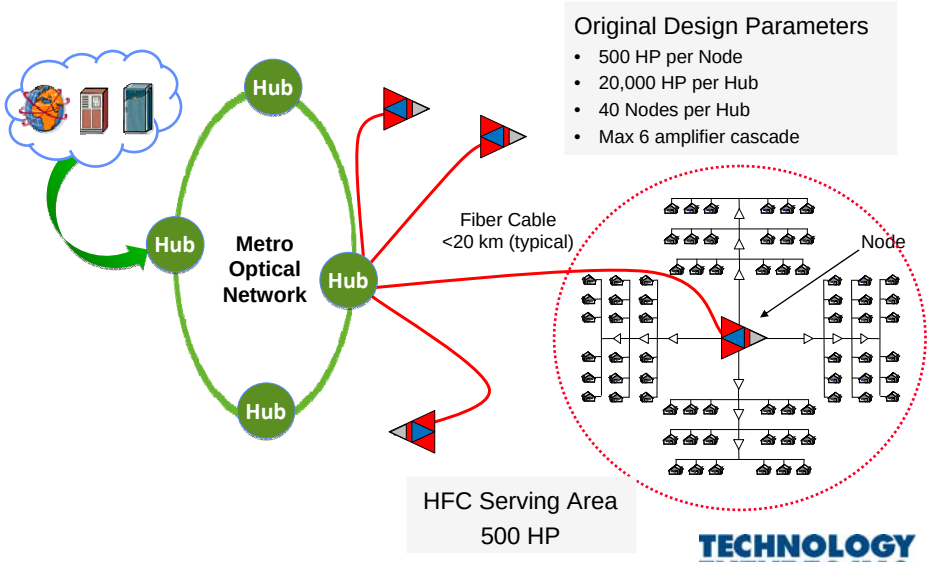
Typical HFC Access Network



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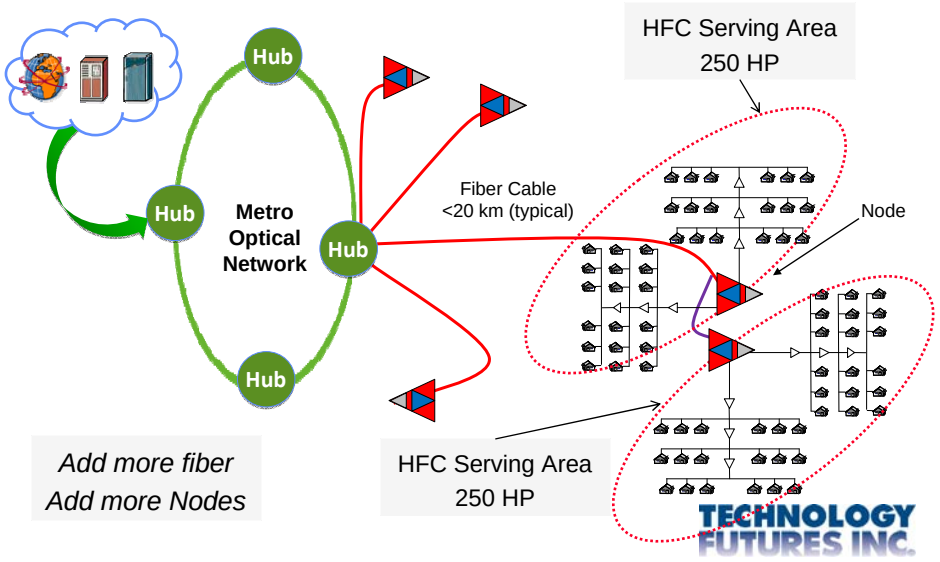
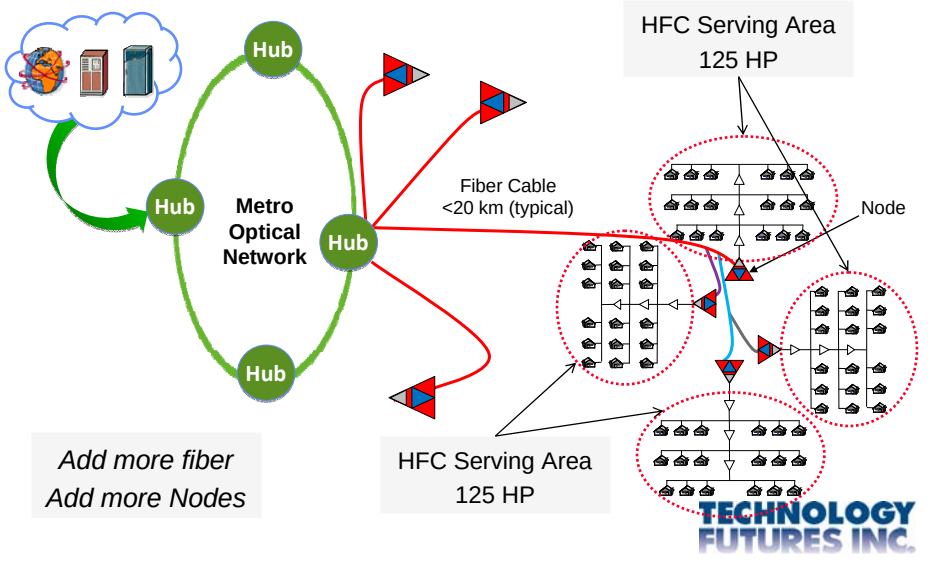
Node Split to Reduce Service Group Size

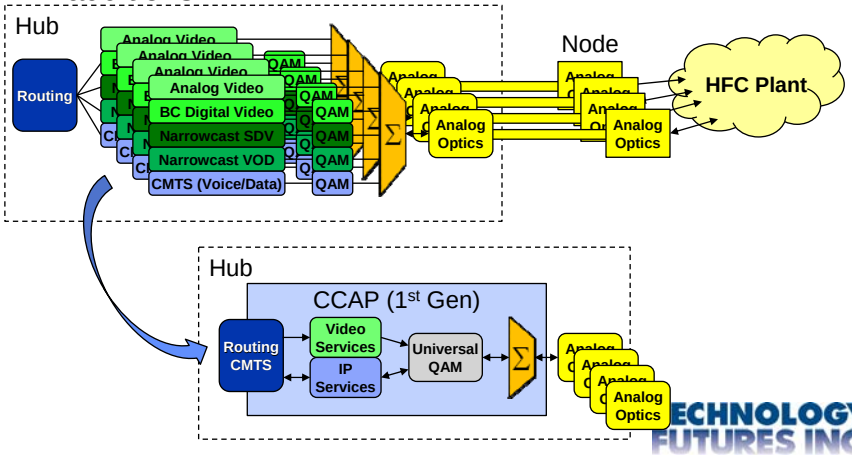


Node Split to Reduce Service Group Size



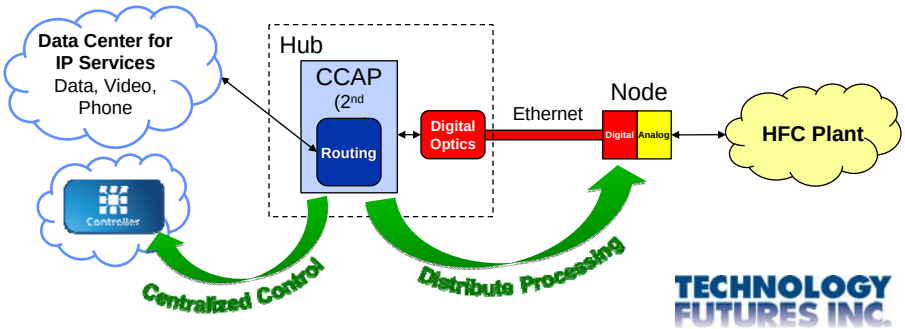
Impact of Smaller Service Groups

- Acquire more equipment in the Hub and outside plant along with associated construction costs for fiber additions

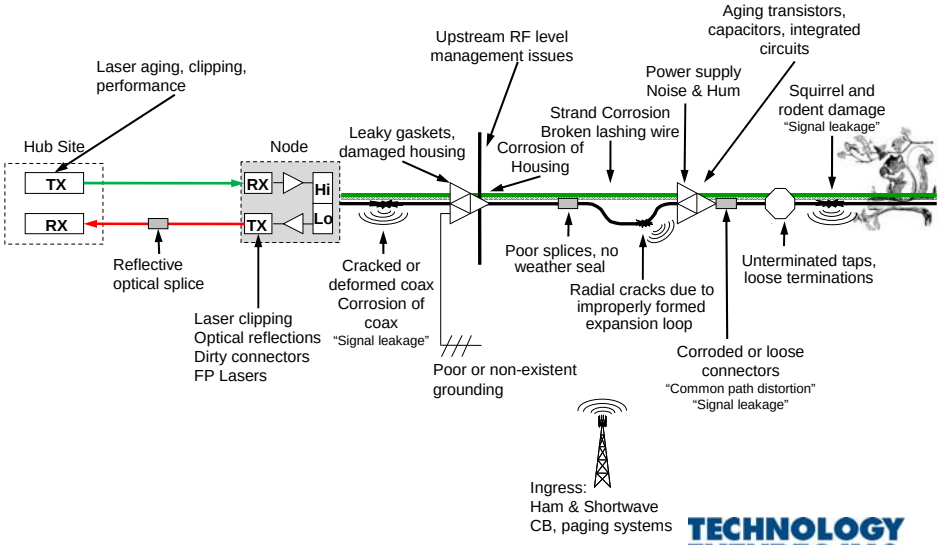


Converged Cable Access Platform (CCAP)

- All services supported on a single platform
  - Provides a smaller facility footprint, lowers OPEX
  - New hardware (new capital outlays) starting 2014
  - Multiple technology refreshes (CMTSs, Nodes, QAMs, analog/digital video systems,…)



Issues from HFC Plant Aging



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HFC vs. FTTH OPEX per Mile of Plant

	HFC	FTTH
Technical Supervision	$ 42.03	$ 10.51
Service Trouble Truck Rolls (for plant problems)	$ 226.15	$ -
Plant Maintenance Truck Rolls	$ 235.50	$ -
Material Inventory	$ 49.64	$ 4.90
Electricity Consumption	$ 446.81	$ -
Power Supply Battery Replacement	$ 43.49	$ -
Power Supply Equipment Repair	$ 1.77	$ -
RF Line Equipment Repair	$ 35.46	$ -
Vehicle Accident Loss	$ 8.80	$ -
Employee Injury Loss	$ 5.01	$ -
Emergency Cable Repair	$ 8.51	$ 85.11
Total annual O&M expense per mile of OSP plant	**$ 1,103.17**	**$ 100.52**

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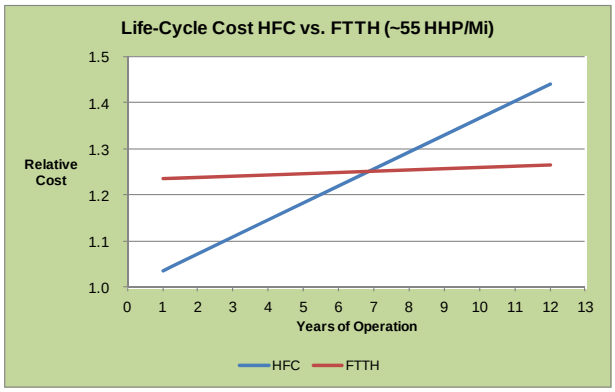
Life-Cycle Cost of HFC vs. FTTH

- Broad assumptions but a generally appropriate curve
- Difficult for MSOs to justify the required outlay of CAPEX



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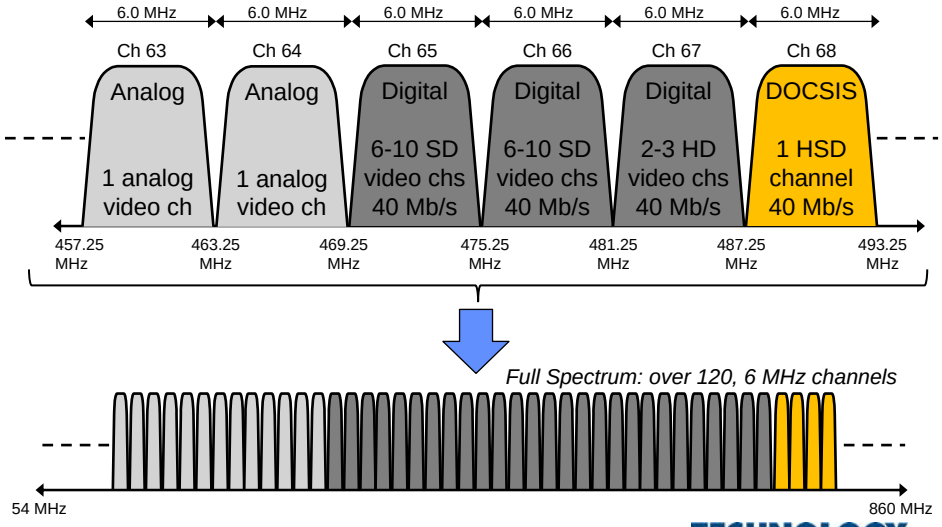
Example Cable TV Channel Usage



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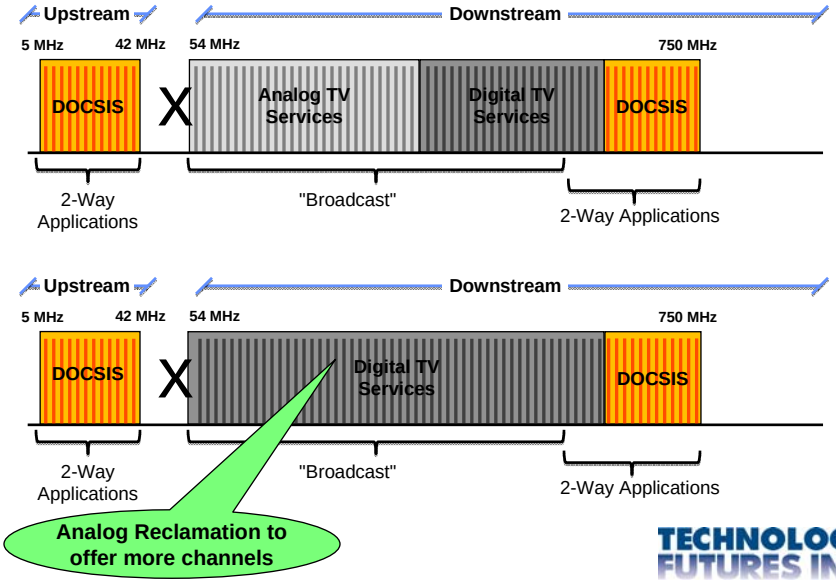
HFC RF Spectrum Today



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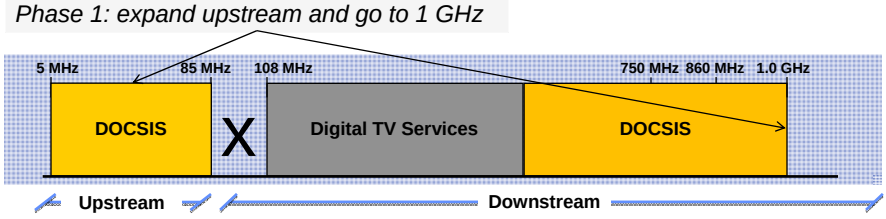
HFC RF Spectrum Transition

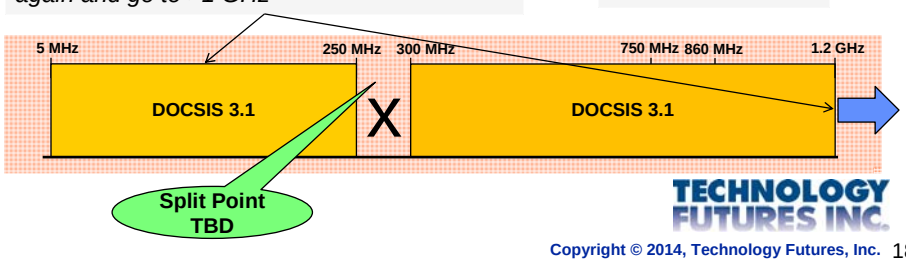
Requires Node and RF Amplifier Upgrades

Phase 1: expand upstream and go to 1 GHz



Phase 2: Migrate to "all-IP", expand upstream again and go to >1 GHz

Debate on skipping Phase 1



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DOCSIS 3.1 Considerations

- Major step up from DOCSIS 3.0
- Maintains backward compatibility
  - Will be compatible with DOCSIS 1.1, 2.0 and 3.0 but to get the faster speeds of D3.1 the modems will need to be replaced
  - Doesn't require replacing the HFC plant but the other activities discussed need to happen
- Extends the utility of HFC plant
  - Delivers higher speeds in the downstream (up to >5Gbps) and upstream (>1 Gbps)
  - Service offerings become competitive with FTTH

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Future Potential of DOCSIS 3.1

	Parameter	Now	Phase 1	Phase 2	Phase 3
Downstream	Frequency Band	54 - 1002 MHz	108 - 1002 MHz	(300) - 1002 MHz	(500) - 1700 MHz
	Modulation	256-QAM	256-QAM	≥ 1024-QAM	≥ 1024-QAM
	Channels	8	24	116	200
	Data Capacity	300 Mbps	1 Gbps	5 Gbps	10 Gbps
Upstream	Frequency Band	5 - 42 MHz	5 - 85 MHz	5 - (230) MHz	5 - (400) MHz
	Modulation	64-QAM	64-QAM	≥ 256 QAM	≥ 1024 QAM
	Channels	4	12	33	55
	Data Capacity	100 Mbps	300 Mbps	1 Gbps	(2) Gbps

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Key Conclusions

- All services will move to IP
- Keeping HFC viable requires major investments in infrastructure upgrades and replacing legacy equipment
  - Deploy more fiber and add more Nodes closer to the home
  - Converging all services onto a single platform with (CCAP) will impact Hub electronics (CMTS, analog/digital video systems)
  - Upgrade RF amplifiers & nodes to expand the RF spectrum
  - Upgrade DOCSIS modems to support higher speeds

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