THE FULL (BAND) STORY:
HOW SMART CPE WILL CHANGE HFC MAINTENANCE FOREVER

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History of CMTS/CPE Polling

Not A New Concept But…

▶ Historically Relegated To Secondary Role
- And accessible only by a select few

▶ Historical Barriers To Widespread Usage
- Service provision impact concerns
- Bandwidth consumption concerns
- Complexity of polling/interpreting responses
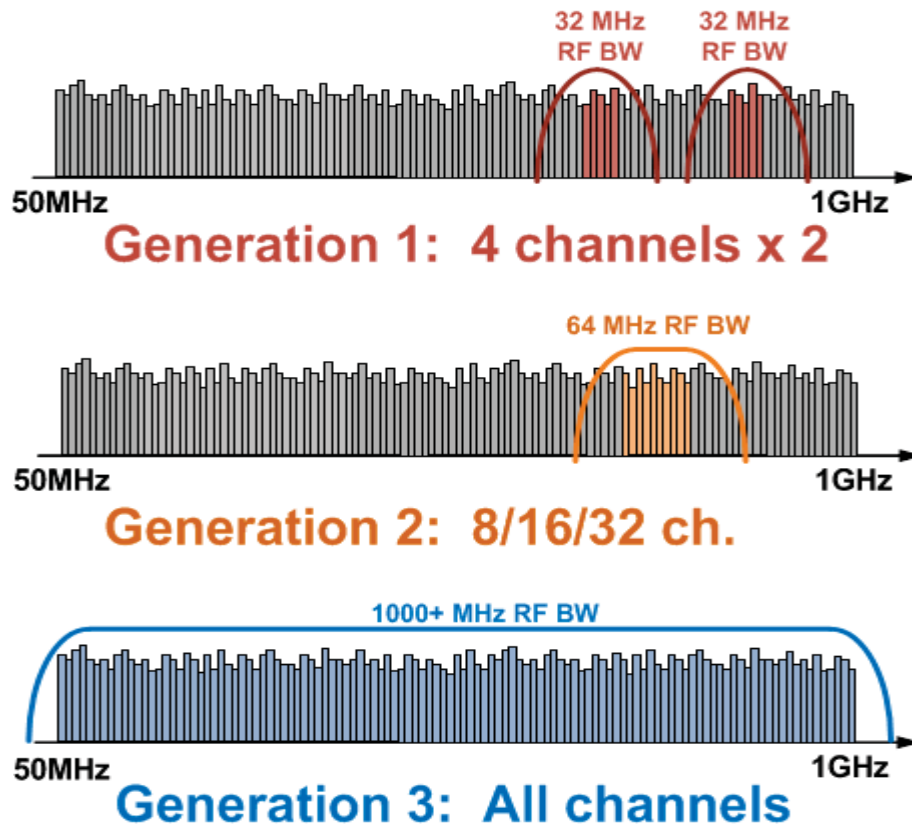
Inflection Point: *Pre-Eq Revolution*

The Breakthrough That Broke Through Barriers

- Published in 2008, 1st Implemented ~2009

- Result: Benefits >> Barriers

- Collaborative development aided ramp (PNM)
  - Rapid tool development/iteration
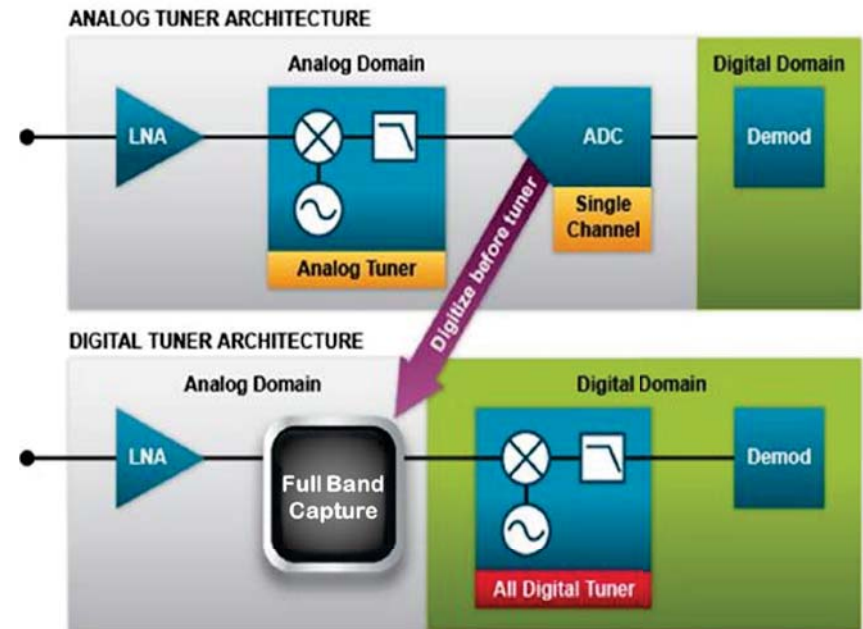 - Deployment / Mgmt support lessons learned
  - MIB standardization

Inflection Point: Full-Band Capture
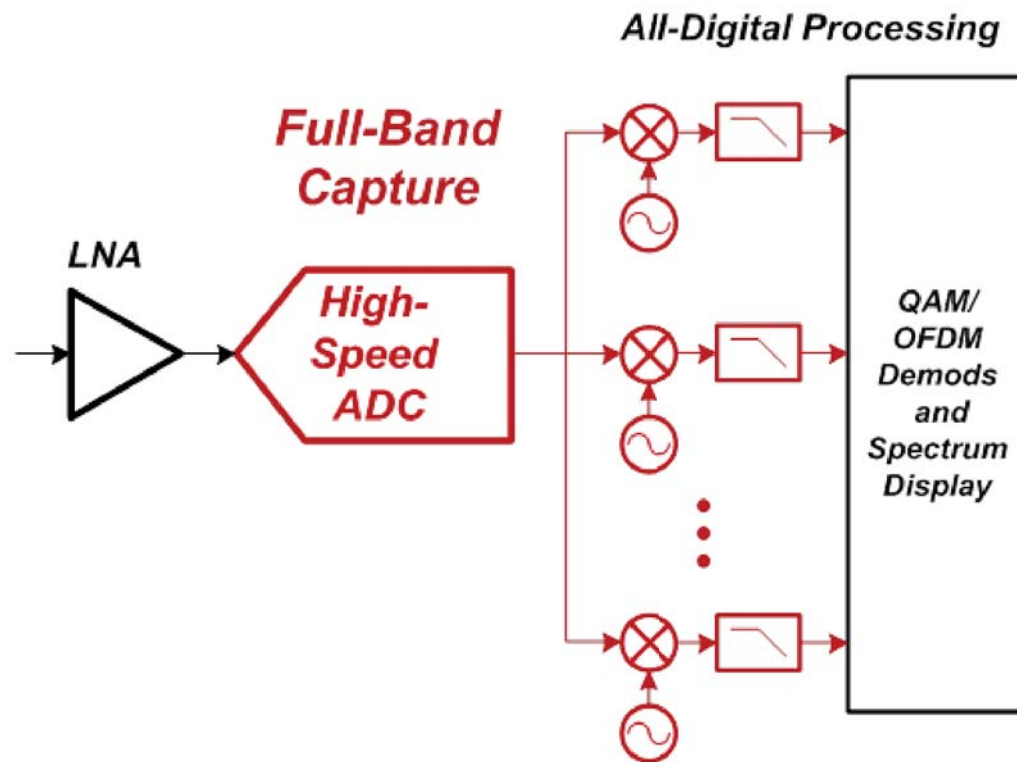
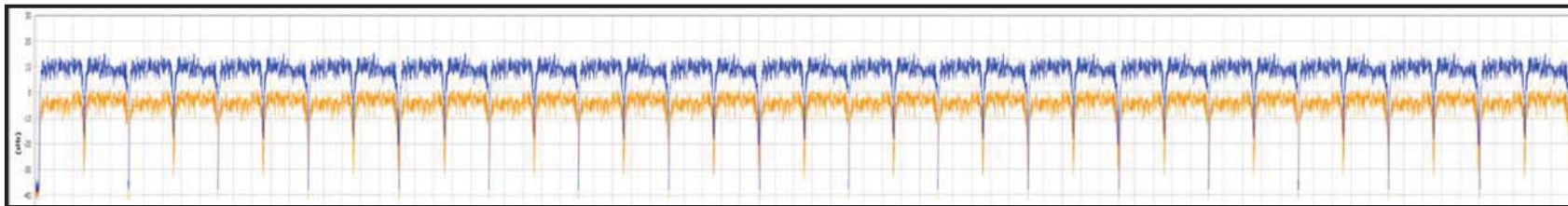## What Does "Full-Band Capture" Really Mean?

Full Band Capture Front End

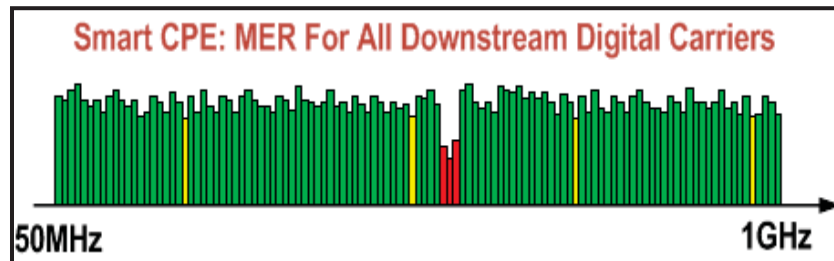## High Speed ADC and Digital Filter Bank

Increased Downstream Visibility

What New Capabilities Are Now Possible?

Remotely Accessible Downstream Spectrum Analyzer Inside Subscriber Homes!
Operates Non-Invasively – No Impact On CM/STB Performance

Legacy CPE: MER For Up To 8 DOCSIS Downstreams

50MHz — 1GHz

Smart CPE: MER For All Downstream Digital Carriers

50MHz — 1GHz
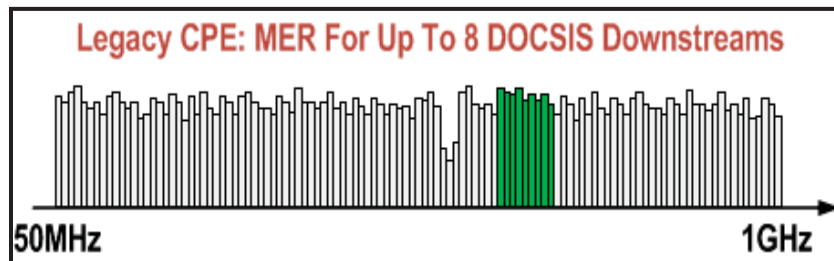
Remotely Accessible MER Values For All Downstream Digital Channels.
Operates Non-Invasively – No Impact On CM/STB Performance

SmartCPE Should Be Unobtrusive

▶ Problems with sharing resources with DOCSIS functions:

– Can degrade performance and/or move diagnostics to off-hours
– Diagnostics less accurate: Cable and home networks lightly loaded during off-hours; temperature/wind less volatile in middle of the night; modem environmentals different
– Typically not when customers are reporting issues

▶ Advantages of unobtrusive real-time/parallel operation:

– Extends the capability to resolve issues while customers are on line and traffic/noise is consistent with reported failure
– Typically do not roll truck at 3 AM

Inflection Point

CPE HW Breakthrough → Ecosystem Expansion

▶ Convergence of CPE and Test & Measurement Worlds
  – Faster implementation of T&M expertise into Smart CPE
  – Established field meter functions migrate to CPE
  – CPE polls replace truck rolls

Benefits To Operators

How Cable Operators Benefit from Smart CPE

▶ Detect Plant Weaknesses Before Customers Do
  – And know where to roll truck to begin searching

▶ Detect and Remotely Localize LTE/Off-Air Ingress

▶ Pre-Qual/Assess Self-Installs (using actual CPE)

▶ Target Preventative Maintenance

▶ Validate Fix Effectiveness *In Customers Home*

Impact On Job Functions

How Will Each Group Be Impacted?

- Field Tech: Shift toward proactive
- Tech Ops Mgmt: Unprecedented predictive visibility
- Installers: Improved install certification
- CSR/Tier I: Improved dispatch accuracy
- NOC: Increased # probes, see customer impact
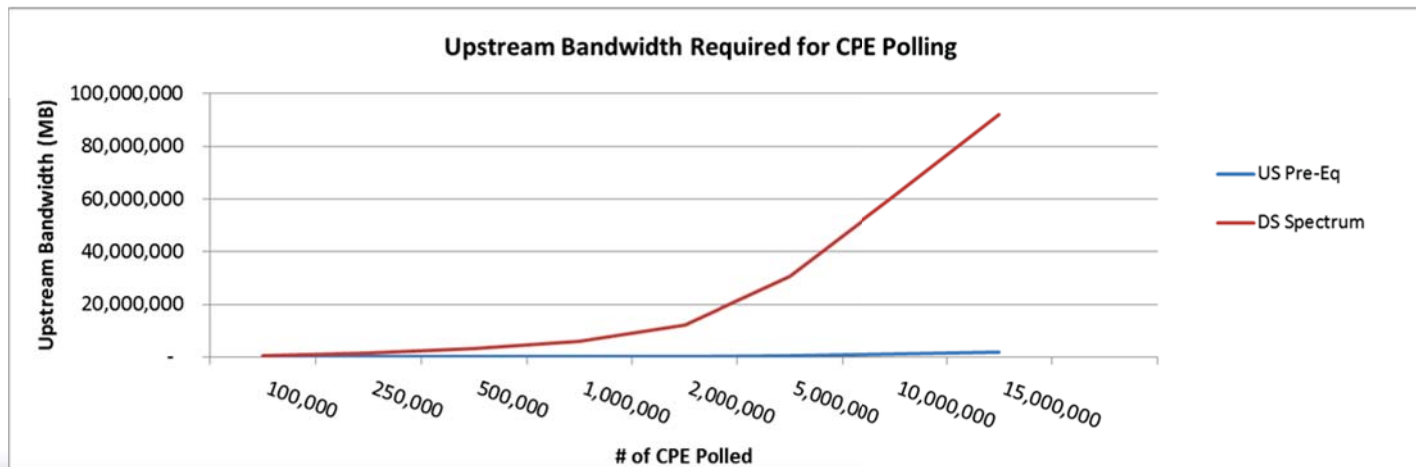- Management: New metrics to drive culture change

Result: Improved Customer Satisfaction & Reduced OPEX!
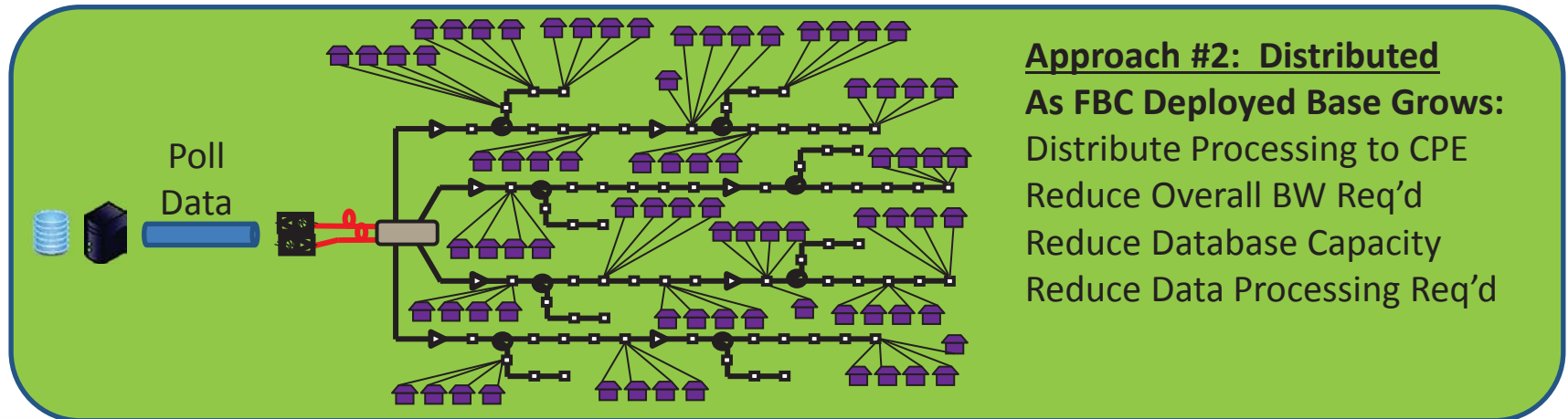
Where Will We Go From Here?
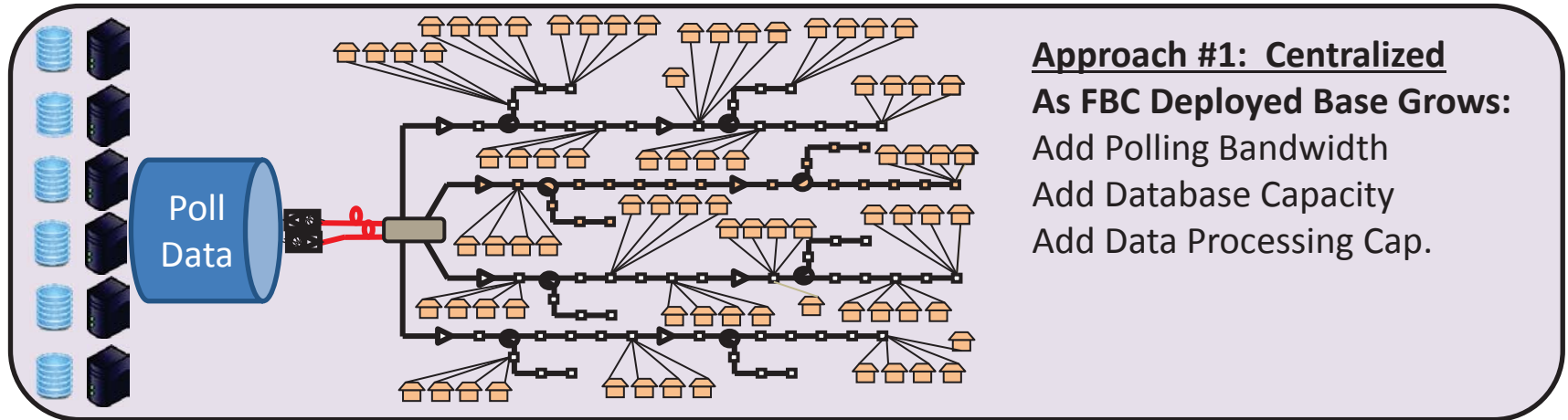
Capability Expansions: Legacy DOCSIS

▶ Continued evolution of back-end systems (DS)

▶ Continued feature migration: Field Meter→CPE

▶ Next-step automation within CPE

▶ Address impending data avalanche

Upstream Bandwidth Required for CPE Polling

Where Will We Go From Here?

Managing The Impending Data Avalanche

Approach #1: Centralized

As FBC Deployed Base Grows:

Add Polling Bandwidth

Add Database Capacity

Add Data Processing Cap.

Approach #2: Distributed

As FBC Deployed Base Grows:

Distribute Processing to CPE

Reduce Overall BW Req'd

Reduce Database Capacity

Reduce Data Processing Req'd

Where Will We Go From Here?

Designing Smart CPE Into DOCSIS 3.1

▶ Smart CPE test points:
- Spectrum Analyzer functions
- Vector Signal Analyzer functions
- Network Analyzer functions

Summary

Smart CPE Have Changed The World

- **Pre-Eq Revolution Started It All**
  - Collaboration will continue to accelerate progress

- **Smart CPE Will Continue To Get Smarter**
  - As will the back-end systems that leverage them

- **There Is Such A Thing As Too Much Data!**

- **DOCSIS 3.1 May Be Next Smart CPE Revolution**

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