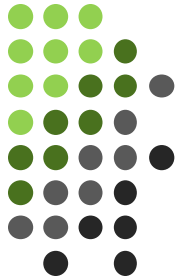
Technology and Status Summary

Burlington Telecom Advisory Board

March 11, 2015

Areas Covered

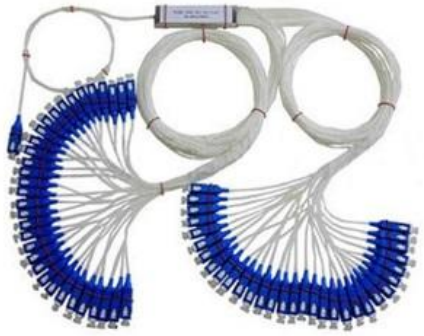


- Gigabit Passive Optical Network
- Voice Services
- Cable (CATV) Services
- Internet Services
- Summary

GPON Defined

- **GPON – Gigabit Passive Optical Networking**

  - **GPON** technology is at the heart of most of the services BT delivers
  - **PON** is a way to take a single fiber to service a number of customers
  - ITU G.984 – 1st GPON standard ratified in 2003
    - V1 – 1.2Gbps Down – 622Mbps Up
    - V2 – 2.5Gbps Down – 1.2Gbps Up
  - ITU G.987 – 2nd GPON 2010
    - V1 – 10Gbps down – 2.5Gbps Up
    - V2 - XG-PON2 - 10Gbps Native Symmetrical



Fiber capabilities are "limitless" as compared to other technologies…

GPON Ecosystem

- **GPON consists of 3 major components**
  - **OLT** – Optical Line Termination – This is the “main” unit that provides the services to the end users
  - **Optical Splitters** - Can split a serving fiber up to 64 ways, allowing a single OLT port to serve 64 customer.
  - **ONT/ONU** – Optical Line Terminal/Unit – This is the equipment placed at a customer’s premise .

GPON as Deployed by BT

- BT has deployed GPON equipment from Calix
  - Gen 1 Equipment
    - Fiber Drive (FD) – Maximum of 25M – symmetrical service
      No longer supported by vendor
    - F5 – Same core capabilities with more intelligent management
      - Currently Supported by Calix
  - Gen 2 Equipment
    - E7 - 2.5G/1.2G – Able to provision 1Gbps symmetrical
  - Gen 1 and Gen 2 ONT's not interchangeable.

GPON Forward Plan

- BT has effectively capped Gen 1 GPON system
  - Only new 5Mbps customers added, or TV and/or Phone only subscribers
  - Existing customers above 5Mbps will be migrated onto E7
  - New customers with more than 5Mbps of service are provided with E7
- Alternative GPON Vendors – BT is not locked into Calix products

Voice Services Overview

- Burlington Telecom's voice telephony network is similar to most CLEC's (competitive local exchange carriers).
  - Class 5 Switch
  - Voice Application Servers
  - External Circuit Transport Equipment for Trunking to PSTN (public switched telephone network) – Intra and Inter-Lata/ Out of State - Long Distance

Voice Services - Class 5 Switching

- Taqua T7000 class 5 soft switch
  - Bulk of BT's voice offerings originate from this switch.
  - Capacity to serve many thousands of additional customers.
  - This platform has been deployed at 100's of LEC's across the US.
    - Anticipated to be vendor supported for many years to come
    - Newer generations of cards routinely released increasing the lifespan Of the product
    - Capable of carrying BT traditional voice services well into the future

Voice Services - VoIP Application Server

- Broadsoft M6 VoIP Application Server

  - Native VoIP service primarily used on large commercial accounts
  - Platform end of vendor support is on 3/31/2015.
  - We anticipate system will continue to function long past this date.
  - New VoIP application server planned FY16
  - will allow BT to offer a more fully featured and robust VoIP solution.

Voice Services:
Voice Application Systems – Advanced Features

- Innovative Systems AP (Application Peripheral)
  - Provides voice mail service and various other advanced features, such as calling codes and automated directory.
  - While end of support has been formally announced, licensing has become cost prohibitive
  - BT will be introducing a newer AP MAX this spring , enabling it to migrate away from the legacy AP.
  - The AP MAX will also replace some of the existing Broadsoft M6 functionality, enabling a more streamlined path to migrate off the M6
  - Total AP MAX cost of $56k (25% down + 12 even monthly payments)

Voice Services - PSTN Circuit Transport

- Calix C7: Multi-Service Transport Platform

  - To receive calls into and out of BT network, local and long distance trunking is required to the PSTN (public switched telephone network)

  - These circuits (trunks) go to FairPoint's tandem switch.

  - The Calix C7 is expected to by supported at least another 5 years.

Voice Services and Systems:
Forward Plan

- BT will be replacing our AP with an AP MAX at a total cost of $56k.
- Later in FY16, the Broadsoft M6 will be replaced with a new system. Initial estimates are at $65k – bringing the total voice systems replacement at ~$120k.
- AP Max Solution in place as early as late July.
- Although the M6 is EOL, we intend to cap the platform and grow onto the replacement.
- Existing M6 customers migrated at a comfortable pace (for BT and our customers)
- Over the next 3-5 years, BT can expect to spend a total of $30-$40k on expansion cards and licensing as a normal course of growth of business .

CATV Services Overview

- BT's television offering is delivered over a technology called IPTV – Internet Protocol Television It is not served via the Internet.
  - IPTV technology provides for a practically unlimited number of channels.
    - AT&T U-Verse product is IPTV – They have over 12 million subs
    - Google's TV offering is IPTV
  - Many of the systems are the same as traditional CATV companies - satellite dish and receivers, video splitters and signal processors.
  - IPTV requires set top boxes at the customer premise
  - Control and access management is achieved through middleware
  - Video content encryption is required by many content owners

CATV Services - Dish

- Dish – BT has a Simulsat 5b Multibeam dish located at 287 Shelburne Road – 7 Meters
- One dish receives all BT's required satellite signals
- Satellite signals sent back to 200 Church St over fiber for processing
- Existing Dish required engineering modifications to support structure in 2012
- Newer signal modulations from satellite may eventually require BT to replace Simulsat 5b with a newer model.
- This is not anticipated in the next 5 years. It will likely be driven by mass adoption of 4k and 8k video services.
- Potential cost could be $100k.

CATV Services – Signal Processing

- Receivers: Content is received from dish feeds and decoded by receivers. Many of BT's IRDs are old or EOL, but continue to function. Programmers are increasingly forcing newer models of receivers . BT typically has to pick up the cost.

- Digital Turnaround: Signals from the receiver output must be further processed and placed into IPTV format. BT's current Astria system is EOL/EOS and BT has been migrating onto the Prostream 9000, which will be completed in the next 12-18 months.

- Transcoding: For some content we receive, we must convert from HD to SD or just reduce the stream size of the HD content. Transcoding is required to do this. We have sufficient hardware capacity to carry us forward for 2-3 more years.

CATV Services – Encryption

- Many content owners require an additional layer of security in the form of channel encryption. A subscriber's set top box receives decryption keys to decrypt signals.

- Verimatrix VCAS (Video Content Authority System) – BT's platform for encrypting video content.

- Full replacement/upgrade of system occurred last summer at a cost of $61k. This upgrade was mandated by the vendor to continue to receive support.

- Any additional costs to this platform in the next 3-5 years will occur only on the licensing side: 1.) If BT needs additional channels encrypted 2.) Set top box license for additional set top boxes.

CATV Services – Access and Control

- Middleware – IPTV CATV systems require middleware. Essentially the operating system of the set tops, it:
  - controls the access and provisioning of services to subscribers.
  - provides the look and feel (ie. the user experience on the set top boxes).

- BT currently uses the Minerva Networks iTV platform, running a version that is many versions behind their latest

- No compelling reason to upgrade given the cost and the potentially negative impacts on a currently stable system

- Minerva continues to offer support on BT's version of software , with no announcement of an end of support date.

CATV Services – Video on Demand

- As part of BT's CATV service, we have a Video on Demand (VOD) offering.
- The VOD platform is a Harmonic Streamliner.
- Though this has been EOL/EOS for 3 years it continues to function
- Until early 2014, there was no off the shelf replacement
- Several available today – would require a major middleware update, or conversion to other middleware. Cost would likely exceed $200k
- BT to evaluate alternatives and plan for FY2017 replacement

CATV Services – Set Top Boxes

- Set Top Boxes – One of the single largest capital costs of providing CATV service is the ongoing spend required to deploy new set tops.
- Non-DVR units are at ~$140 and DVR units are at ~$250.
- The oldest boxes are being withdrawn from service or used for our SD only customers.
- All HD customers are using the latest STB's

CATV Services – Forward Plan

- BT intends to keep our CATV ecosystem, as is, for the foreseeable future and spend the minimum needed to keep it in operation. This includes re-using as many existing set tops boxes as possible.

- Ever increasing content acquisition costs, coupled with a trending national decline in the purchase of CATV services make the economics of a traditional CATV offering marginal – especially for small operators.

- Over the next 5 years: BT can expect to spend $15k - $20k annually on receiver replacements and upgrades, and one time charges of $30 - $40k

- BT will plan to replace its VOD platform, at a cost in excess of $200k

Internet Services - Overview

- In late 2014 BT completed the changes necessary to become a Tier 2 Internet Provider for the first time
- BT now buys Internet Access from Tier 1 providers - large Internet exchanges located in Boston and NYC rather than from its competitors
- A Tier 1 provider has their own nationwide/international network and does not buy access from anyone. They exchange traffic in peering arrangements with other Tier 1 providers. Level3 is the only Tier 1 provider who directly serves Vermont.
- The planning and execution for this significant change took almost a year
- This has put BT's service on a level playing field with most of our competition, and removed control of BT's destiny from its competitors
- Additionally, we are now capable of peering with entities like Netflix and Google, which improving overall network performance while driving down costs even further.
- Internet 2 service is acquired through UVM, which is connected to UCAN.

Internet Services – Routing and Switching

- BT's internet service is driven by Cisco Catalyst 6500 series switches/routers using the 3BXL routing engine

Internet Services – Soft Services

- Soft services, such as email, DHCP, DNS, and traffic graphing are provided through a variety of Intel based servers running various Linux based operating systems.

Internet Services – Forward Planning

- Our current Cisco CAT6509 hardware is largely still supported. And could be expected to function for several more years.
- Individual lines cards can be replaced and upgraded fairly inexpensively.
- BT will be requiring more 10Gbps line cards which will cost us $10k-$15k per year over the next 3-5 years.
- Current servers are redundant and can be replaced with “off the shelf” server hardware. We expect to spend $10k-$15k on server hardware over the course of 5 years.
- As BT continues to grow, we may need to purchase additional transport to an Internet exchange to buy more access which would likely incur a one time CAPEX charge of $10-$15k for additional lasers and line cards.

Summary

- BT's equipment and software infrastructure will require updating/replacement in several areas over the coming years
- The current team understands the equipment and its capabilities intimately
- The key current focus is on replacing aging GPON equipment
- In the coming years BT will also need to replace one of its phone switches and its VOD system and video middleware
- Upgraded equipment will in every case provide meaningful increased functionality
- Internally generated cash flow is predicted to cover BT's anticipated needs
- BT's move to become a Tier 2 ISP has been a game changer for BT