Broadband Working Group Overview

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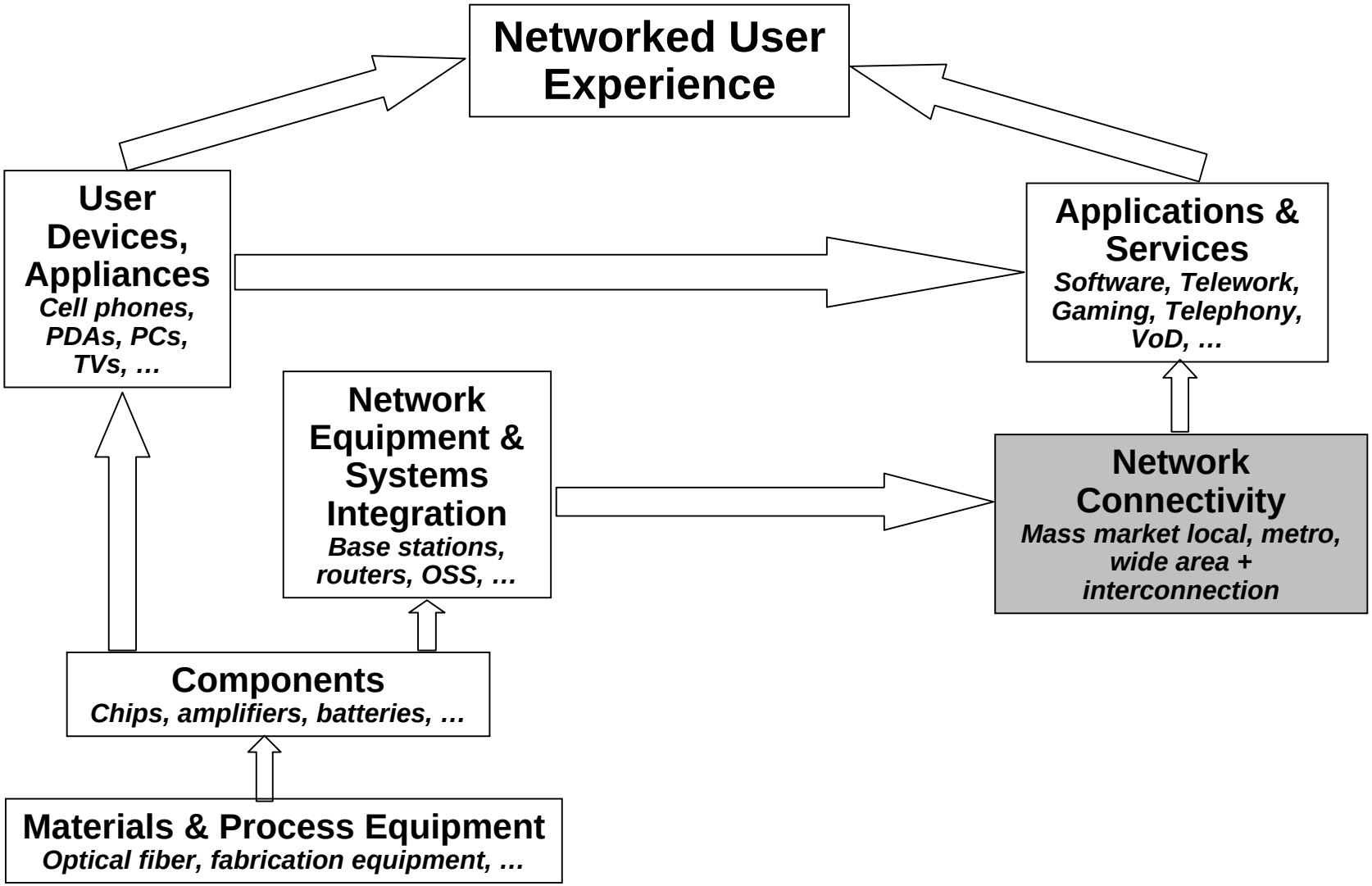
Broadband Working Group Co-Chair
MIT Communications Futures Program (CFP)
June 2005

Agenda: Broadband Sessions I & II

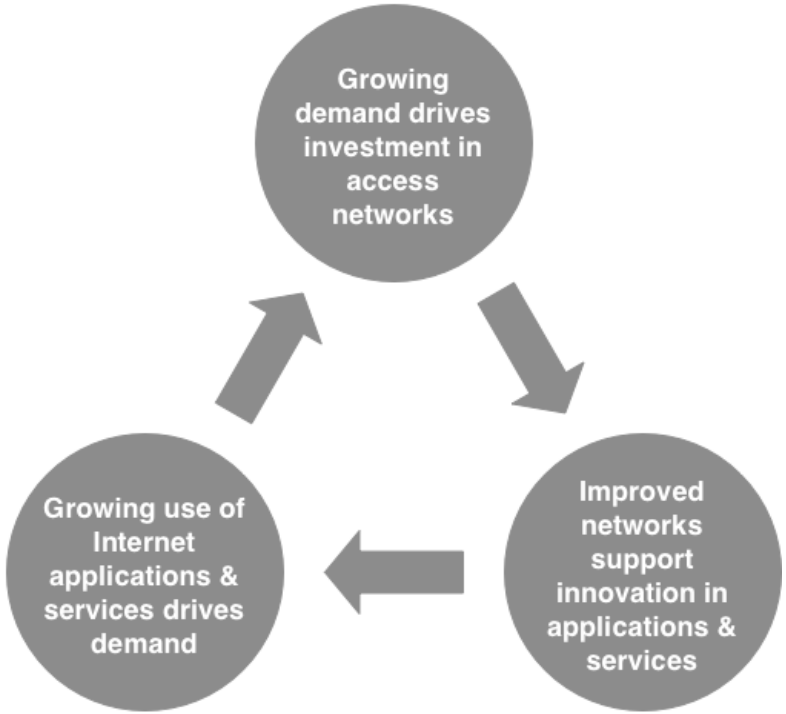
- **Charter**
  - Introduction to the group
- **Accomplishments**
  - Incentive problem white paper ready for member review (Watlington, France Telecom)
  - Consensus achieved on personal broadband vision (Moiin, T-Mobile)
- **Discussion of proposed next steps**
  - Optical network architecture sub-group
  - Solutions to the incentive problem
  - Architectures for personal broadband

Broadband Roadmap Matters Across Value Chain



Broadband Working Group

- **John Watlington, France Telecom, Industry Co-Chair**
  - Industry participants from CFP and CIPS
- **Charter: "Virtuous Cycle" as broadband ideal**
  - Help BB follow Moore's Law
  - Economics, business models, pricing, policy etc. in addition to technology
- **Meeting since November 2004**
  - E-mail list
  - Conference calls ~2x/month
  - In-person workshops ~2x/year
  - http://cfp.mit.edu/groups/broadband/broadband.html



- **Focus topics**
  - Broadband incentive problem: motivates consideration of usage in bb pricing
  - Personal broadband: bb association shifts from "place" to "person"
  - Optical access architectures and components

Context: Disruption from the Edge?

- **San Mateo, CA Public Safety Network**
  - Wi-Fi mesh network
  - All HQ broadband applications now mobile
    - Mug shots, fingerprints , Amber alerts, GIS data, HazMat data
  - New applications easily enabled
    - Real-time video surveillance, VoIP
    - Mobile, tactical broadband networks
- **Low cost**
  - Lower cost than the 19.2Kbps data radio system it replaced
  - “Edge” investments replace recurring costs

Significant Productivity and Efficiency Improvement

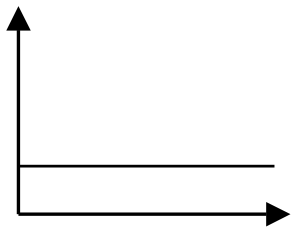
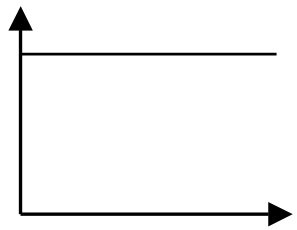
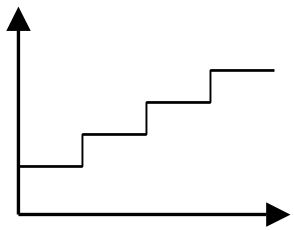
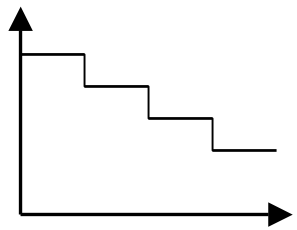
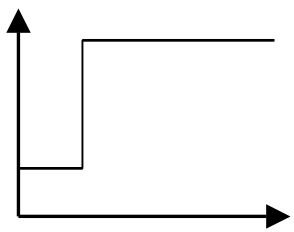
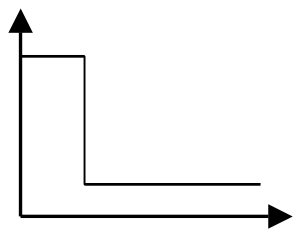
Source: Ron Sege, Tropos

Trend toward Customer Ownership

- **Universities, businesses**
  - Ex. Fiber consortia, Google
- **Hospitals**
  - Ex: NY Presbyterian imaging – recently leased dark fiber for DWDM WAN
  - Saves $151K annually and is easier to expand than previous managed service
- **Cities**
  - Ex: City of Burlington, VT $2.6M internal fiber net, 2002 (Koch Financial, capital lease)
  - Easiest to attack politically
  - Industry support developing (Intel, Dell, Texas Instruments, Earthlink, Microsoft)
- **Ad-hoc networks**
  - Create on the fly from whatever infrastructure is available
    - E.g. wireless access points in a neighborhood
  - Active subject of technical and economic research
  - Can similar approaches be applied in developing country context?

Can't Decide

Scenarios Revisited

	Deployed Access Bandwidth v. time	Price per Mbps v. time	Vote
Broadband Stalls			
Steady Progress			
Disruptive Progress			

Incentive Problem White Paper (Watlington)

Personal Broadband Vision (Moiin)

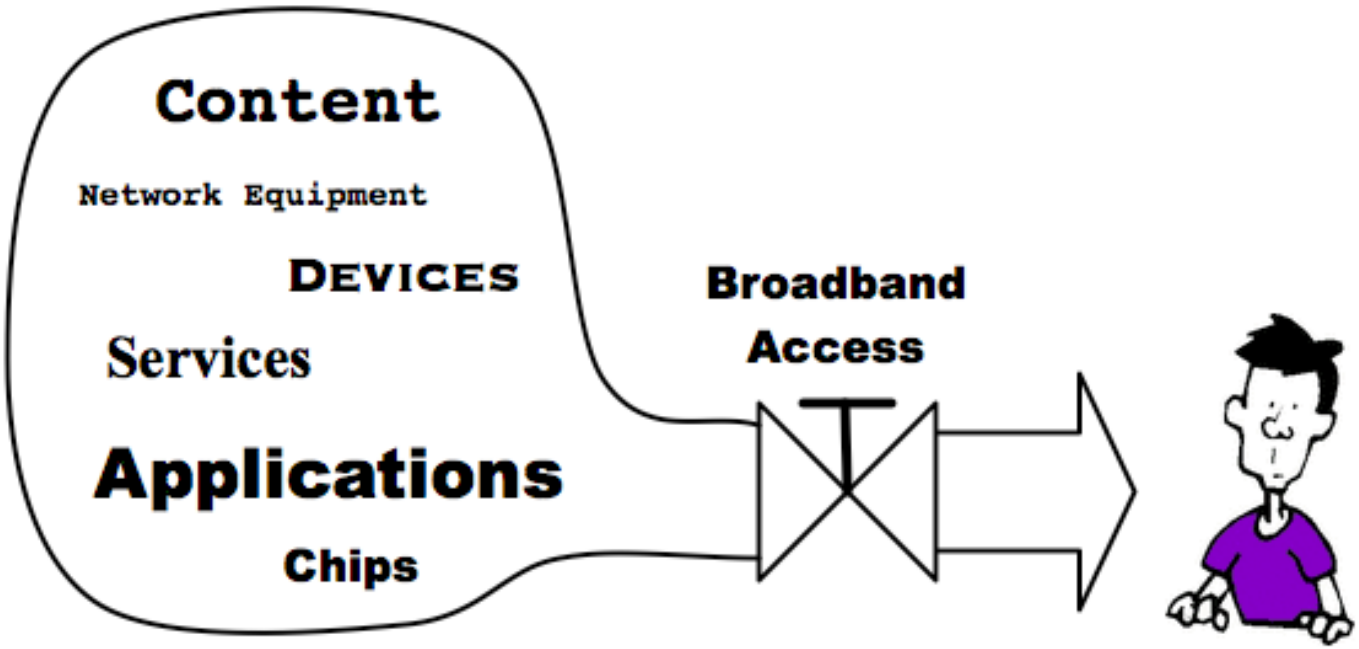
Next Steps

The Broadband Incentive Problem

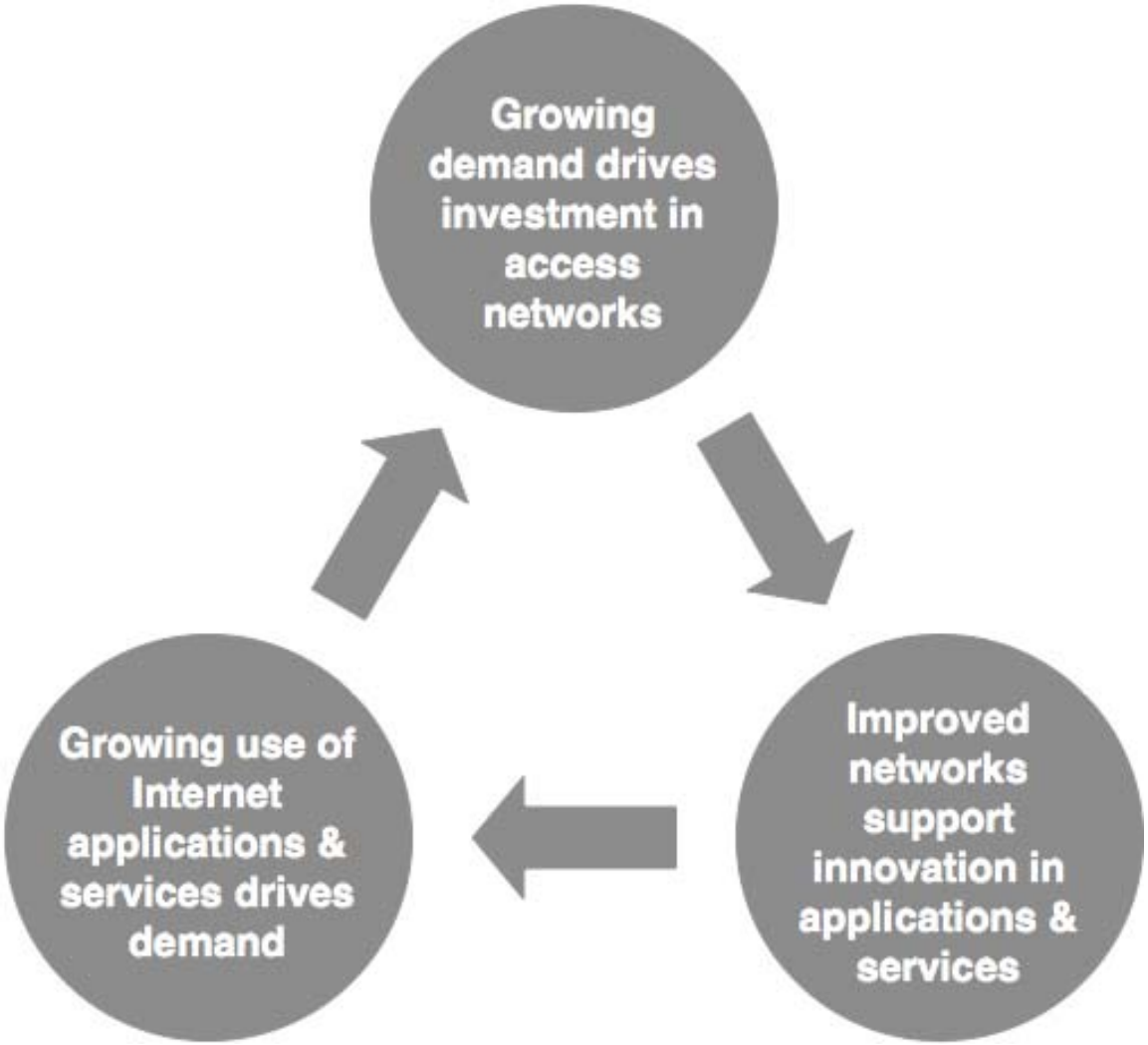
- **Broadband faces a incentive problem derailing future improvements**
- **Broadband operators need more satisfactory responses to this incentive problem**
- **The intent of this white paper is to avert this crisis, by raising consciousness of the problem now, and motivating the industry toward sustainable solutions**

The Broadband Incentive Problem

- **Growth in industries in the Broadband value chain relies on growth of broadband access**



A Virtuous Cycle ?

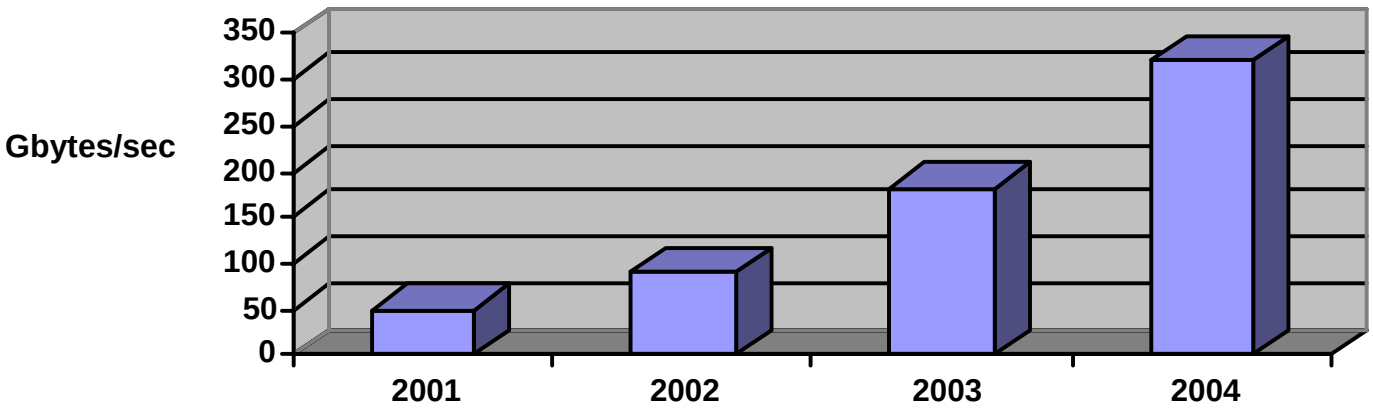


Origins of the Problem: Changing User Behavior

- **Narrowband (dialup) access constrained behavior, both over time and across users**
- **Broadband allows increased difference between peak and average usage**
- **Broadband shows increased variability between users**
- **New applications drive higher broadband usage**

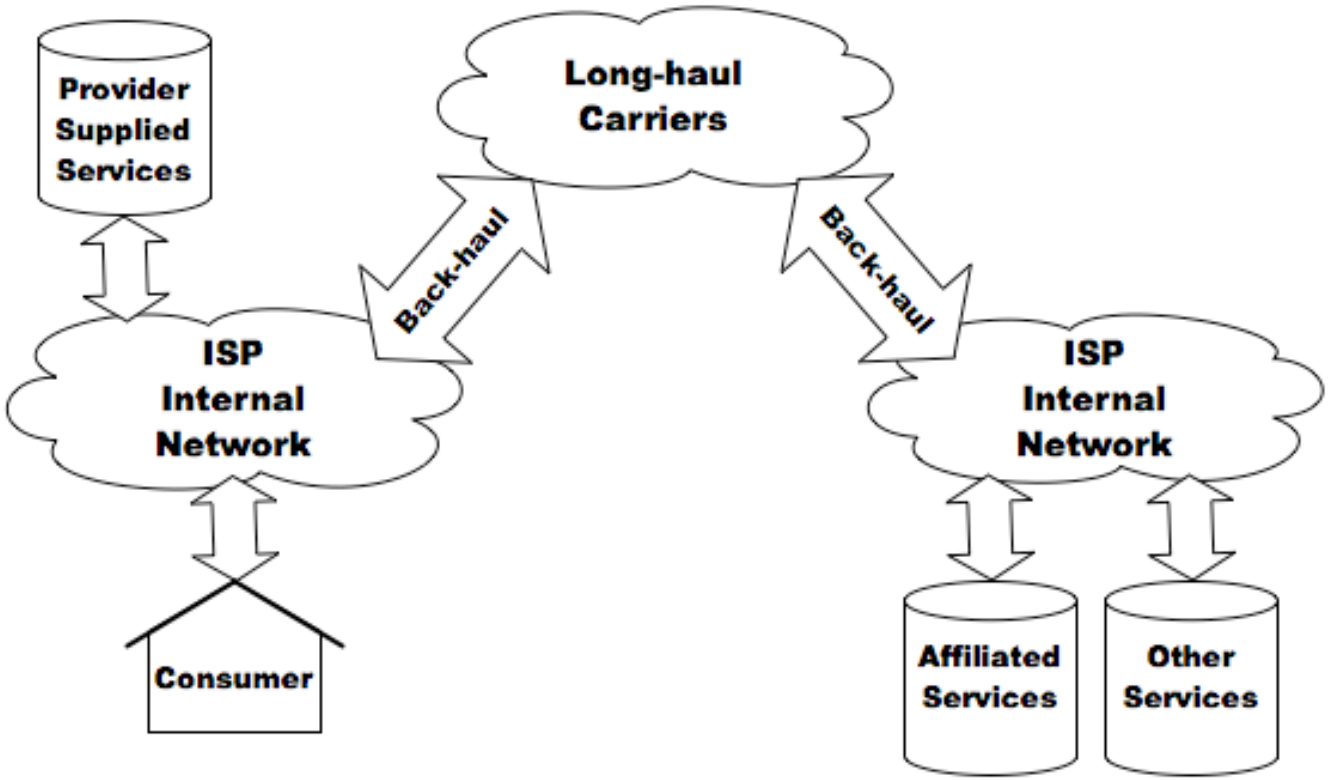
The Korea Telecom Story

- The market is approaching saturation: 80% households, 95% of 20 year-olds, and 88% of 30 year-olds have Broadband
- New subscription growth rates are dropping: 75% in 2000, but only 5% in 2004.
- Network usage has doubled each year since 2000
- 5% of users using 50% of network capacity



How does increased traffic increase Costs ?

- **Increased traffic drives increased investment in internal networks, and in most cases, increased backhaul costs.**



Today's Models: Flat-fee pricing

- **Very appealing to consumers**
- **But:**
  - Motivates the network operators to discourage rather than encourage innovative uses of the network
  - Difficult given variation between users
- **Increasing the flat-rate difficult**
  - Light usage users priced out of the market, or
  - Light usage users may defect to competitors whose pricing better meets their needs.

Today's Models: Pricing Tiered by Peak Rate

- **May be effective at market segmentation**
- **But**
  - They don't protect operators from high-usage users
  - This problem gets worse with higher access speeds
- **Peak-rate tiered pricing may also discourage innovation (and overall revenues) through limiting adoption of applications requiring high peak rates**

Today's Models: Pricing Tiered by Volume

- **Has the potential to allow operators to recover their costs**
- **But improvements in volume-based pricing are needed:**
  - User perception of their network usage is not clear, and getting worse
  - How to differentiate between "normal" and "extraordinary" usage (especially as new applications emerge)
  - Need for closer alignment of user willingness to pay with costs

Today's Models: Vertical Integration

- **Using revenues from complementary services is a familiar model (e.g. television, telephony)**
- **Vertical integration can benefit from economies of scope**
- **But:**
  - Revenues may not offset growing bandwidth costs, either because of competition or regulation
  - Some applications may not have an associated revenue generating service
  - Innovation may be stifled through throttling of non-operator services

Engineering a network to reduce traffic costs

- **Maybe this problem will never appear ?**
  - Bandwidth exhibits economies of scale
- **If the cost of bandwidth drops faster than demand for bandwidth increases there is no problem**
- **A study conducted by one member showed that in most plausible models for future demand, the rate of trafic growth outstrips the rate of price decline**
- **Likely to be part of the solution, but not enough by itself**

Conclusions

- **Growth in usage combined with “all you can eat” pricing creates incentives to block additional traffic**
- **This situation is damaging to other members of the value chain, and eventually damaging to the network operators themselves**
- **Good solutions neeed to realign the incentives**

Vision of Personal Broadband

Proposal for
Broadband Working Group,
Communication Futures Programme
Version 0.4

Optical Broadband Working Group

Sub-group of Broadband Working Group

Focus on the impacts of optical components and access architectures on broadband services and economics

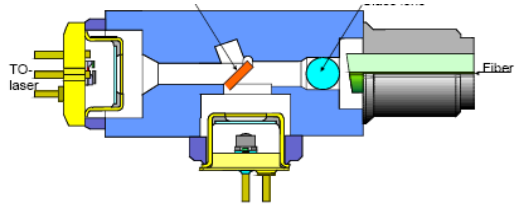
Members:

Rajeev Ram (MIT)
Randy Kirchain (MIT)
Fred Leonberger (MIT)
Dave Payne (BT)
Jeff Burgan (Comcast)
Ilari Welling (Nokia)
Dan Grossman (Motorola)
(FT)
Others ?

(JDSU)

Optical Broadband Working Group

White Paper Proposals:



How do optical components enable broadband services ?

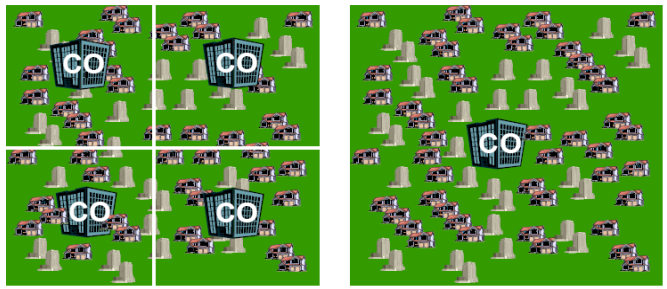
example: triplexers for CATV vs diplexers for IPTV

example: WDM-PON enables gigabit bandwidth on demand

How do optical components enable broadband architectures ?

example: Low cost TxRx at 10Gbps and 100km could eliminate COs

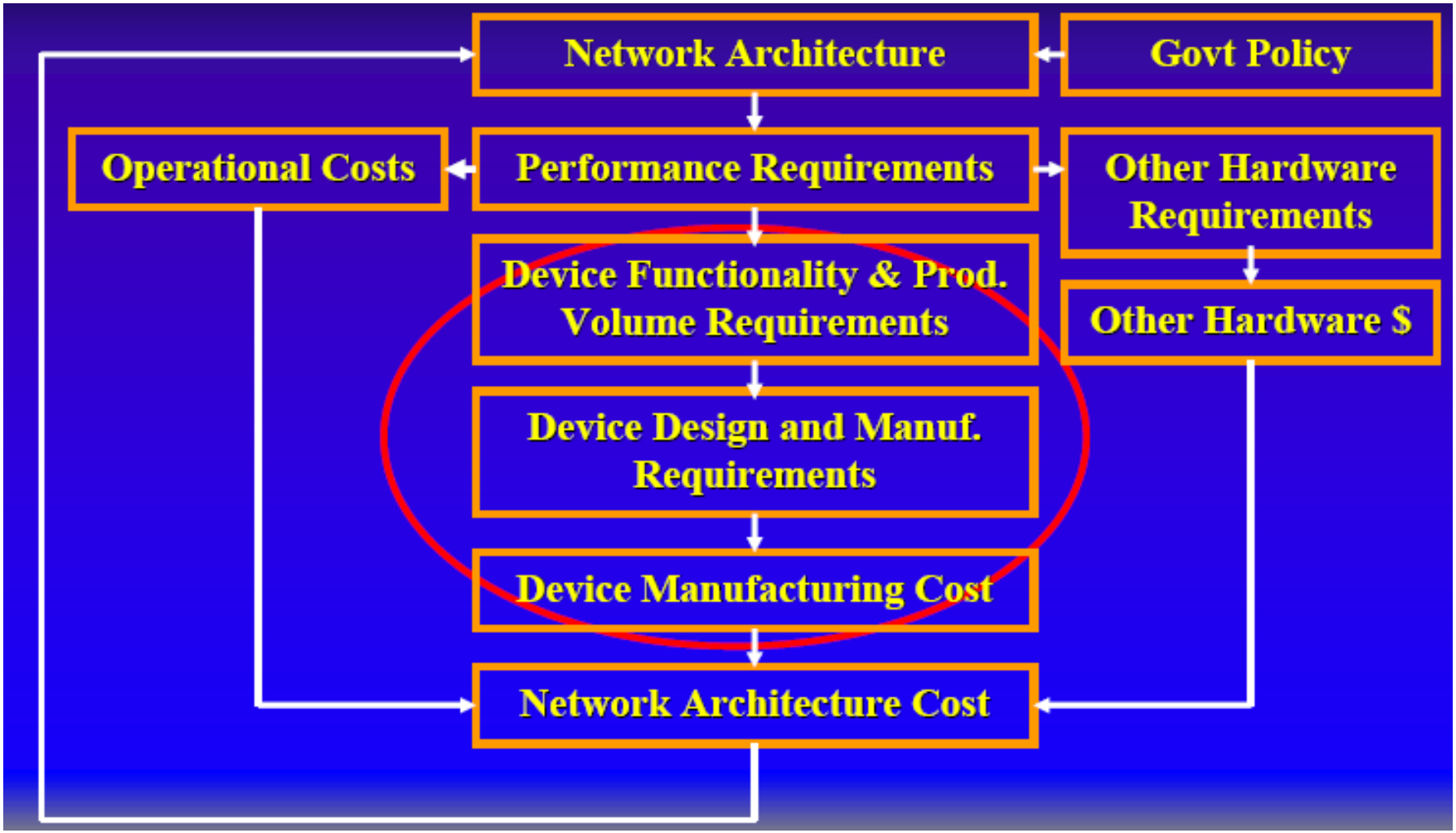
example: WDM-PON vs. GPON architectures. WDM as upgrade path.



What are the opex issues surrounding FTTH ?

example: Relative cost of power? cooling? repair? upgrade?

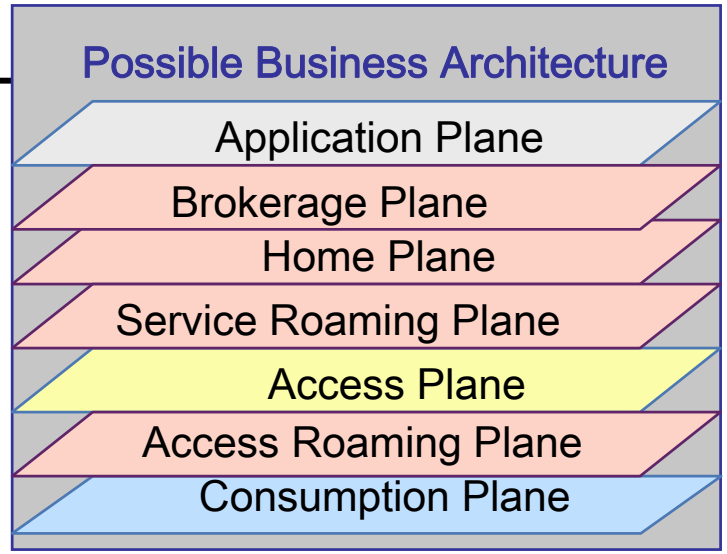
Interplay of Components, Architectures, and Services

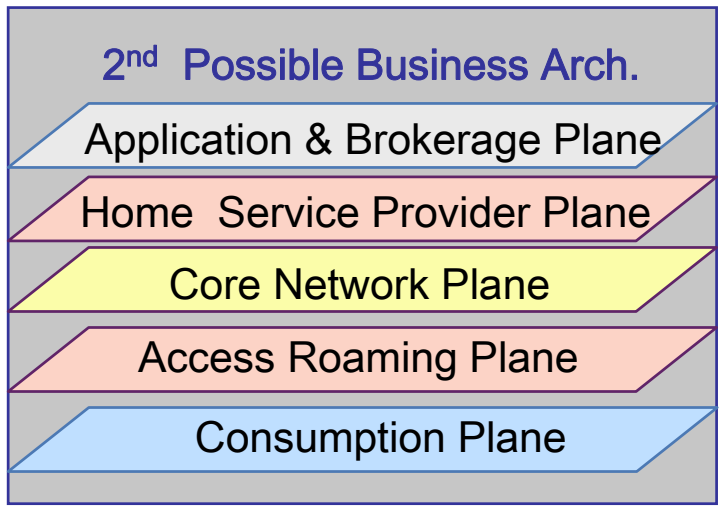


Toward Solutions to BB Incentive Problem

Personal BB Architecture: Roles and Responsibilities

- **Independent planes**
  - Not necessarily layered
  - Independent & multiple providers for each plane
- **Roaming Planes**
  - Pass context through from users to higher levels and vice versa
  - Allow for user choice among multiple providers
  - Access: Establish trust (if necessary) b/w access provider & user
  - Service: Establish trust (if necessary) b/w access provider & home provider
- **Home Plane**
- **Brokerage Plane**
  - Part of the broader vision
  - Where user information (identity, charging, entitlements, profile, history, etc) are kept
  - Responsible for optimization of user experience & session management
  - Could be a commercial or non-commercial provider, or be self-provided by the user
  - Creation of complex (sync, async, and semi-sync) personal services from basic blocks
  - Establish trust (if necessary) b/w application & home providers





2nd is an evolution of the existing industry structure, but both are merely used to put PBB in context

FYI…Additional Study in Progress

- **Measuring Broadband's Economic Impact**
  - Move from forecasts to attempted observations in historical data
  - MIT (Gillett, Lehr, Osorio) and Carnegie Mellon University (Prof. Marvin Sirbu)
  - Co-sponsored by U.S. Department of Commerce
  - Builds on localized broadband data developed in previous projects at MIT, sponsored by industry (ITC) and National Science Foundation
  - Results expected August 2005
- **Econometric Analyses**
  - Regression: Test changes in economic development indicators against number of years since broadband available, plus suitable controls
  - Difference-in-Differences: Compare changes in economic development indicators, in communities that stimulated bb vs. matched sample that didn't