Three Futures for Broadband Access

Sharon E. Gillett
MIT CTPID
CFP / CII UK Launch
June 2004
Mass-Market BB Essential to Healthy Communications Value Chain

More sales, deployment of higher-bandwidth infrastructure equipment → More &/or cheaper access bandwidth available

Existing applications more useful + More new bb-enabled apps & services emerge

More sales & usage of end-user equipment & bb-enabled services (“content”) → More users adopt broadband

More demand for bandwidth → More sales & usage of end-user equipment & bb-enabled services (“content”)

Existing applications more useful + More new bb-enabled apps & services emerge

More &/or cheaper access bandwidth available → More sales, deployment of higher-bandwidth infrastructure equipment

More demand for bandwidth → More sales, deployment of higher-bandwidth infrastructure equipment
Three Scenarios for Mass-Market BB

- Broadband Stalls
  - Deployed Access Bandwidth v. time
  - Price per Mbps v. time
  - Vote: Can’t Decide?

- Steady Progress
  - Deployed Access Bandwidth v. time
  - Price per Mbps v. time
  - Vote: Yellow

- Disruptive Progress
  - Deployed Access Bandwidth v. time
  - Price per Mbps v. time
  - Vote: Green
Broadband Working Group Charter

- Conduct research that informs likelihood of alternative broadband scenarios
- Develop models to assess role of government policies
- Facilitate cross-industry discussion
  - Align incentives across the value chain
  - Develop awareness around big opportunities
Why “Can’t Decide”

- Depends where
  - Infrastructure legacy
  - Geography / density
- Depends on gov’t policies
  - Entry, competition, antitrust
  - Spectrum
  - Subsidies
  - Investment incentives
Why “Broadband Stalls” (1)

- More users adopt broadband
- More &/or cheaper access bandwidth available
- Existing applications more useful +
- More new bb-enabled apps & services emerge

Where do new apps come from?

- More sales, deployment of higher-bandwidth infrastructure equipment
- More demand for bandwidth
- More sales & usage of end-user equipment & bb-enabled services ("content")
- More users adopt broadband
Why “Broadband Stalls” (2)

More &/or cheaper access bandwidth available

Existing applications more useful +
More new bb-enabled apps & services emerge

More sales & usage of end-user equipment & bb-enabled services ("content")

More users adopt broadband

More demand for bandwidth but Access + Backhaul cost money!

If no money flows here…
To be specific, users pay appropriate benefit assessments, which are the prices corresponding to the cost, and companies reinvest in improvement of infrastructure. For example, just as postcards and letters require postage, a method to charge a metered rate of e-mail senders can be considered. With this method alone, communication volumes on the Internet could be reduced and a sharp increase of data communications traffic could be slowed. Furthermore, this would lead to profit increases for telecom companies.”

- Jumpei Furuhata, Prediction of Communications Crisis Prompts Japan’s Telecom Ministry to Take Action, Nikkei Electronics Asia Online, February 23, 2004
From Vicious to Virtuous Cycle

More sales, deployment of higher-bandwidth infrastructure equipment

More &/or cheaper access bandwidth available

Existing applications more useful + More new bb-enabled apps & services emerge

More sales & usage of end-user equipment & bb-enabled services (“content”)

More demand for bandwidth: Access + Backhaul

- Vertical integration
- Cross-industry transfer payments
- Alternatives to flat-rate pricing models (CFP Research: Clark)
Why “Steady Progress”

“Carriers see little reason to expect radical change in the communications industry over the next ten years.”

– MIT Communications Technology Roadmap (E. Bruce), Viewpoints from Major Telecommunications Carriers in North America & Europe, May 2003
Why “Steady Progress”

- Get past “stall” problems
- Incremental investment strategy
  - Deeper fiber as applications & demand materialize
- Declining costs
  - Higher performance at lower capex+opex
- Minimal entry & competitive pressure
  - Partly a policy knob
“Steady” = What Rate?

- If Moore’s Law applies
  - Doubling every 18 months
    - ~1 Mbps today \( \Rightarrow \) ~100 Mbps in 10 yrs
  - Edge-based precedent: dialup modems

Source: Wikipedia.org
Why “Disruptive Progress”

<table>
<thead>
<tr>
<th></th>
<th>Incumbent</th>
<th>Entrant</th>
<th>Electric Utility</th>
<th>“Muni” (local gov’t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WiFi</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>WiMax</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>BPL (Sakai)</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>FTTP</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

“Edge” (non-provider-based) models to be discussed in next session

- 1st, 2nd or 3rd(+) pipe?
- Consider developing country contexts (Neto)
- Which adopters will drive dominant architectures, economies of scale?
How Important is Muni Role?
System Dynamics Modeling (FTTP)

- Intrusiveness of regulation
- Competitive intensity
- Fiber-to-the-home component volume
- Fiber-to-the-home market size
- Cost to provide fiber-to-the-home service
- Availability of broadband non-traditional funding
- Towns selecting fiber-to-the-home
- Available content and applications

Non-traditional funding and communities can bootstrap the system

CFP Research: Kelic
Caveats:
- “Munis” are almost entirely Municipal Electric Utilities (MEUs: ~2k out of ~25k U.S. communities)
- Asia more important driver?

Source: Corning (primarily from RHK, Render Vanderslice)
Data About MEUs

Municipal Electric Utilities Providing Communications

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>300+</td>
<td>300+</td>
<td>450</td>
<td>511</td>
<td>569</td>
</tr>
</tbody>
</table>

- **Internal Services**
  - Utility communications (e.g. AMR, SCADA)
  - Data communications for municipal government

- **External Services**
  - **To businesses**: dark fiber, leased lines
  - **To consumers**: CATV [95], ISP (dialup & broadband [62]), telephony

Source: APPA
## Why MEUs Offer External Services?

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology push</strong> – Do external services build on internal?</td>
<td><strong>Very strong.</strong> Economies of scope, e.g. fiber, expertise. Suggests progression among MEU communities over time.</td>
</tr>
<tr>
<td><strong>Local autonomy</strong> – Does nature of power vested in local government matter?</td>
<td><strong>State prohibitions significant; Dillon’s vs. Home Rule not.</strong> Recent Supreme Court ruling pushes battle to each state.</td>
</tr>
<tr>
<td><strong>Competition</strong> – Do MEUs act when private-sector alternatives lacking?</td>
<td><strong>Mixed.</strong> MEUs less likely to act – and esp. to serve consumers – in presence of private cable modem service. But DSL goes other way. May reflect later DSL entry, but can’t tell from data.</td>
</tr>
<tr>
<td><strong>Demographic controls</strong> – How important are cost and demand-related factors that generally influence telecoms entry?</td>
<td><strong>Mixed.</strong> Demand factors (income, education) not very significant. But rural, remote location strong deterrent to MEUs, just like private sector. MEUs committed to local economic development, but also face high backhaul costs.</td>
</tr>
</tbody>
</table>

*CFP Research: Osorio, Gillett, Lehr*
Prognosis for MEU-BB Growth

• Progression
  – Homeland security & energy efficiency motivate more SCADA, AMR
  – No communications → internal → external

• Increased use of wireless
  – Organizational economy of scope
  – Dramatically (~10x) lower cost than wired
  – Mostly WiFi and proprietary MAN technologies today, with potentially big impact from WiMax standards
  – Key role of unlicensed spectrum
MEU Wireless Example:
City of Ellaville, Georgia

- Population <2,000
- 3 antennas on City’s main water tank
  - 2.4 GHz LOS (Alvarion) + 900 MHz N-LOS (WaveRider) – trees!
- $200,000 upfront cost
- Users pay for service (~1 Mbps @ $30-45/mo), modem ($200) + antenna ($100-150)
- 1.5 Mbps backhaul (ouch)

Small Cities Serve Their Own
June 25, 2002

www.epride.net
Beyond MEU Communities

• The other 23,000 Census “places” in U.S.
• Economies of scope with municipal fiber?
  – Can’t be realized with cableco-provided I-nets
• Wireless more likely
  – Drivers: Unlicensed spectrum & low costs
  – Emerging public-private partnership models
  – Disruptive (3rd pipe), or “fill-in” technology?
Scenarios Revisited

- Broadband Stalls
- Steady Progress
- Disruptive Progress

Deployed Access Bandwidth v. time

Price per Mbps v. time

Vote

Can’t Decide
In Ten Years…
How Likely, Desirable, Important?

• An additional facilities-based competitor will be sustainable in most markets
• Users will demand 2 orders of magnitude more access bandwidth than today
• Half of developing world’s population will have broadband access

Understand WiMax economics, robustness
Understand emergence of new apps, growth of old
Understand how provided
Additional slides
MEUs stratified in mid-sized communities; Those doing telecoms are larger, pioneers
Two Distinct Phenomena?

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Where Most Often Found</th>
<th>Potential Rationales for Local Gov’t Involvement</th>
</tr>
</thead>
</table>
| Business / wholesale  | Larger Communities     | • Coordination of physical infrastructure when competition abundant  
                         |                        | • Economies of scale and scope on municipal fiber |
| Consumer              | Smaller Communities    | • Lack of privately provided service  
                         |                        | • Poor service quality / lack of competition |
Public-Private Partnership Models

• Private operators, public antenna sites
  – Competitive implications?
• Leverage governmental networks? How real?
  – Wireless ISPs ride on top of government nets
    • Planned for Allconet (inter-agency wireless net in rural western Maryland) and Burlington, Vermont fiber net
  – K-12 school nets -> WISP
    • Pennsylvania’s “BRAIN” (BB Rural Access Info Network)
  – Public safety nets
    • Interoperability thru unlicensed wireless standards
    • Emerging wireless VPN technologies

More info: see Matt Barranca, “Unlicensed Wireless Broadband Profiles: Community, Municipal & Commercial Success Stories,”
http://www.newamerica.net/Download_Docs/pdfs/Pub_File_1547_1.pdf