Networks and Growth

R. Preston McAfee

Yahoo! Research
Networks Critical to Growth

- Mail
- Roads
- Canals, trains
- Telegraph
- Radio

- Telephony
- Electric grid
- Television
- Internet

- All of these involve connecting people
- Transport of goods, people, power and information
- Improve gains from specialization
Government Role

• Governments have played large role

• Theoretical
  – High fixed costs: natural monopoly
  – Substantial external effects
  – Multiple equilibria
  – Rights-of-way and holdup

• Transport and communication similar
  – Both facilitate exploitation of scale economies
Economic Growth

• Education
  – Printing press enabled mass education
  – Expensive, requiring skilled human teachers

• Entry
  – Much innovation from entrants
    • Cannibalization
  – Price competition
  – Major growth engine
  – Transition economy evidence
Facilitating Entry

- Varied set of skills needed
- Entrants often lack many
- Incumbents can build internal
  - Entrants rely on market provision
- Smoothly functioning, competitive supply markets facilitate entry
- Information critical input
  - Market conditions, demand
Facilitating Entry, Continued

• Communications have become a critical facilitator of entry
  – Internet-based businesses
  – Reaching customers, marketing
  – Providing service and support
  – Tracking competition
Providing Network Goods

• Public
• Private
• Publically-subsidized private provision
  – Auctions
• Often optimal to purchase from private sector
  – Foster competition
• Antitrust policy
Removing Entry Barriers

• Rights-of-way
• Multi-sourcing
• Antitrust
• Unbundling
Market Design

• Design rules of the game to further social goals
  – Encourage entry, unbundling
• 1996 Mexican Telecom auctions
• Apply to design of government regulation
Principles of Exchange Design

- Expressive easy
- Strategically simple
- Iterative
- Information
- Transparency

- Exchange neutrality
- Exchange earnings
- Mushing
- Price steps
- Tools

- Economics as an engineering discipline
Mexican Microwave Auctions

• Problem: gridlock

• Concerns
  – Lack of spectrum
  – Monopolization
  – New Technology
  – Complicated feasible set
  – No pricing of scarce resource
  – Requirement to auction
    • How to price 1,000,000 unique goods?
What Are Microwaves?

• Microwaves are used for
  – High capacity phone line links
  – Connecting mobile phone towers to the system
  – Line of sight communications
  – Telephone exchange connections
  – Satellite connections
    (non-conflicting use)
Point to Point Connections
Point to Multipoint
Solution: Create a Market

• Microwave links are an ideal candidate for deregulation
  – No serious scale economies
  – Sufficient spectrum available to endow many firms
  – Many major users are natural spectrum administrators
Valuations

• Different bands are imperfect substitutes
  – Propagation distance
  – Scatter (size of cone)
  – Volume of data transmission per MHz
• Other substitutes vary
  – Copper wire
  – Fiber optics
  – Satellite link
## Licenses Offered

<table>
<thead>
<tr>
<th>Number of Licenses</th>
<th>Type</th>
<th>Band</th>
<th>Size</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Point to Point</td>
<td>23 GHz</td>
<td>56 MHz</td>
<td>National</td>
</tr>
<tr>
<td>10</td>
<td>Point to Point</td>
<td>23 GHz</td>
<td>100 MHz</td>
<td>National</td>
</tr>
<tr>
<td>10</td>
<td>Point to Point</td>
<td>15 GHz</td>
<td>56 MHz</td>
<td>National</td>
</tr>
<tr>
<td>5 per region</td>
<td>Point to Multipoint</td>
<td>10 GHz</td>
<td>60 MHz</td>
<td>Regional</td>
</tr>
</tbody>
</table>
Auction Design

- Spectrum caps to limit ownership & insure competition in aftermarket
- Ability to create a national footprint using regional licenses
- Round populations to simplify math
  - Squashing
Outcomes

• 14 winners
• Telinor assembled national license
  – all on the same frequency
• Telmex assembled nine regions
  – all but one on the same frequency.
Outcomes, Continued

• The results suggest that spectrum caps were rarely binding.
• Raised US $100M
• National cheaper than DF
• Market continues to be vibrant
Conclusions

• Keys to growth: education and entry
• Transport and communications are critical infrastructure for development
• Markets are powerful forces
• Outcomes not always satisfactory
• Market design is a new technology for creating good outcomes in markets
• Harness the power of markets yet bend them to accomplish social goals
Conclusions, Soundbite

What running water did for public health, the internet does for the mind. It would be a shame if this revolution in public goods, and the huge increase in worker skills and economic efficiency these public goods promise, was lost for monopoly profits.