An Economist’s Guide to Local Loop Unbundling

- Edmond Baranes
  Creden-laser, university Montpellier I
- Marc Bourreau
  Enst, Paris and Crest-LEI

2008.12.3

Kiwon, Sung
Lenneke, van der Zanden
Contents

1. Introduction
2. Broadband Diffusion and Unbundling
3. Effects on Entry and Investment and Innovation
4. Conclusion
1. Introduction

• **Objective**: Provide us with the recent studies
  - **Effect of unbundling regulation on broadband diffusion**
  - **Impact of unbundling on investment and innovation incentives**
  - **Suggestion for further research**
1. Introduction

- **What is Local Loop Unbundling (LLU)?**
  - Providing the entrant access to the incumbent’s local network
  - Aims to stimulate competition in the local loop
  - Unbundling allows new entrants to enter local markets and win market share more quickly
  - Govn’t regulated: prevents monopoly
1. Introduction

Figure 6: Typical incumbent network architecture with unbundled loop access (Adapted from [29])
1. Introduction

- **Types of Unbundling**
  1. **Full Unbundling** — Access to raw copper
  2. **Line Sharing**
  3. **Bitstream Access** — Wholesale Access
     - Resale of local traffic services
     - Bitstream with collocation
     - Bitstream without collocation
     - Resale of access services
1. Introduction

Figure 7: Full unbundling method (Adapted from [29])
1. Introduction

- The following points should be taken consideration when full unbundling is planned
  
  1. Local loop copper pairs connecting a subscriber to the MDF are leased to a new entrant from the incumbent
  
  2. The entrant manages the copper pairs of the local loop and supplies subscribers with the entire telecommunication services together with voice and data
  
  3. The new entrant can improve the copper wire by adding new technology such as ADL
  
  4. The incumbent maintains ownership of the unbundled loop and is responsible for maintaining it and the relationship between the two operators is regulated
1. Introduction

Figure 8: Line sharing method (Adapted from [29])
1. Introduction

• The following points can be deduced from the line sharing method
  1. The incumbent maintains control of the copper pair
  2. The incumbent provides some services to the subscriber while allowing a new entrant to have part of the copper pair spectrum to provide services to the same subscribers
  3. Consumers obtain broadband service from the most competitive provider w/o installing a second line
1. Introduction

Figure 9: Bitstream access method
1. Introduction

- The following points can be deduced from the bitstream access method:
  1. Different to full unbundling and line sharing, the new entrants can only offer the telecommunication services that the incumbent selects.
  2. New entrants are not permitted to add other equipment.
  3. There is no competition at the physical layer.
  4. There are no encouragements for the incumbent to install new technology.
  5. This method is not preferred by new entrants although it is a preferred choice for ISPs.
1. Introduction

• **Benefit of Unbundling**
  - **Save investment and save time for entrants**
  - **Allow competing entrants to enter competition easily, and compete on the same level as the incumbent**

• **Problem of Unbundling**
  - **Undermine the investment and innovation incentives of both entrants and incumbents**
  - **Could delay competition**
Contents

1. Introduction

2. Broadband Diffusion and Unbundling

3. Effects on Entry and Investment and Innovation

4. Conclusion
2. Broadband diffusion and unbundling

- **Focus of recent research in broadband diffusion**
  - Characteristics of demand
  - Impact of regulation policy and supply condition
  - Interactions between intra-platform and inter-platform competition
2. Broadband diffusion and unbundling

- Socio-cultural and demand factors

  1. Demographic factors
    - Positive relationship between education level and interest in broadband (1996)
    - Revenues and size of households better explain a choice in favor of broadband (2002)
    - Preparedness of populations to use advanced technologies, especially ICTs (2003)
2. Broadband diffusion and unbundling

- Socio-cultural and demand factors

2. Socio-cultural factors
   - Close link between application development and broadband growth (2002)
   - Application development: Driver of demand
   - South Korea vs. Singapore, Japan
   - Social and cultural factors have a greater impact on the development of broadband than demand and traditional economic factors
   - Favorable political climate and dynamism of its Ministry for Information and Communications (MIC)
2. BROADBAND DIFFUSION AND UNBUNDLING

- Which factors make it possible to explain the amazing growth of broadband in South Korea?

Figure 1: Broadband Penetration in OECD Countries (as of June 2001)
2. Broadband diffusion and unbundling

- Which factors make it possible to explain the amazing growth of broadband in South Korea?

Figure 2: Internet Households Connecting via Broadband (Source: NetValue, 2001a)
## 2. Broadband diffusion and unbundling

### Which factors make it possible to explain the amazing growth of broadband in South Korea?

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Nation</th>
<th>Household penetration (Subscribers per household)</th>
<th>Speed (Average download speed in Mbps)</th>
<th>Price (Lowest monthly price per Mbps) (US $ purchasing power parity)</th>
<th>Composite Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>South Korea</td>
<td>0.93</td>
<td>49.5</td>
<td>0.37</td>
<td>15.92</td>
</tr>
<tr>
<td>2</td>
<td>Japan</td>
<td>0.55</td>
<td>63.6</td>
<td>0.13</td>
<td>13.03</td>
</tr>
<tr>
<td>3</td>
<td>Finland</td>
<td>0.61</td>
<td>21.7</td>
<td>0.42</td>
<td>12.20</td>
</tr>
<tr>
<td>4</td>
<td>Netherlands</td>
<td>0.77</td>
<td>88.5</td>
<td>1.90</td>
<td>11.77</td>
</tr>
<tr>
<td>5</td>
<td>France</td>
<td>0.54</td>
<td>17.6</td>
<td>0.33</td>
<td>11.59</td>
</tr>
<tr>
<td>6</td>
<td>Sweden</td>
<td>0.54</td>
<td>16.8</td>
<td>0.35</td>
<td>11.53</td>
</tr>
<tr>
<td>7</td>
<td>Denmark</td>
<td>0.76</td>
<td>4.6</td>
<td>1.65</td>
<td>11.44</td>
</tr>
<tr>
<td>8</td>
<td>Iceland</td>
<td>0.83</td>
<td>6.1</td>
<td>4.93</td>
<td>11.20</td>
</tr>
<tr>
<td>9</td>
<td>Norway</td>
<td>0.68</td>
<td>7.7</td>
<td>2.74</td>
<td>11.03</td>
</tr>
<tr>
<td>10</td>
<td>Switzerland</td>
<td>0.74</td>
<td>2.3</td>
<td>3.40</td>
<td>10.78</td>
</tr>
<tr>
<td>11</td>
<td>Canada</td>
<td>0.65</td>
<td>7.6</td>
<td>3.81</td>
<td>10.61</td>
</tr>
<tr>
<td>12</td>
<td>Australia</td>
<td>0.59</td>
<td>1.7</td>
<td>0.94</td>
<td>10.53</td>
</tr>
<tr>
<td>13</td>
<td>United Kingdom</td>
<td>0.55</td>
<td>2.6</td>
<td>1.24</td>
<td>10.30</td>
</tr>
<tr>
<td>14</td>
<td>Luxembourg</td>
<td>0.56</td>
<td>3.1</td>
<td>1.85</td>
<td>10.25</td>
</tr>
<tr>
<td>15</td>
<td>United States</td>
<td>0.57</td>
<td>4.9</td>
<td>2.83</td>
<td>10.25</td>
</tr>
<tr>
<td>16</td>
<td>Germany</td>
<td>0.47</td>
<td>6.0</td>
<td>1.10</td>
<td>10.17</td>
</tr>
<tr>
<td>17</td>
<td>Belgium</td>
<td>0.57</td>
<td>6.3</td>
<td>3.58</td>
<td>10.17</td>
</tr>
<tr>
<td>18</td>
<td>Portugal</td>
<td>0.44</td>
<td>8.1</td>
<td>1.24</td>
<td>10.15</td>
</tr>
<tr>
<td>19</td>
<td>New Zealand</td>
<td>0.42</td>
<td>2.5</td>
<td>1.05</td>
<td>9.68</td>
</tr>
<tr>
<td>20</td>
<td>Spain</td>
<td>0.49</td>
<td>1.2</td>
<td>2.27</td>
<td>9.68</td>
</tr>
<tr>
<td>21</td>
<td>Italy</td>
<td>0.41</td>
<td>4.2</td>
<td>1.97</td>
<td>9.34</td>
</tr>
<tr>
<td>22</td>
<td>Austria</td>
<td>0.45</td>
<td>7.2</td>
<td>4.48</td>
<td>9.37</td>
</tr>
<tr>
<td>23</td>
<td>Ireland</td>
<td>0.46</td>
<td>2.1</td>
<td>4.72</td>
<td>9.01</td>
</tr>
<tr>
<td>24</td>
<td>Greece</td>
<td>0.18</td>
<td>1.0</td>
<td>1.41</td>
<td>8.26</td>
</tr>
<tr>
<td>25</td>
<td>Hungary</td>
<td>0.29</td>
<td>3.3</td>
<td>4.67</td>
<td>8.22</td>
</tr>
<tr>
<td>26</td>
<td>Poland</td>
<td>0.23</td>
<td>7.9</td>
<td>6.47</td>
<td>7.83</td>
</tr>
<tr>
<td>27</td>
<td>Czech Republic</td>
<td>0.30</td>
<td>2.0</td>
<td>9.70</td>
<td>7.03</td>
</tr>
<tr>
<td>28</td>
<td>Slovak Republic</td>
<td>0.22</td>
<td>3.5</td>
<td>9.38</td>
<td>6.77</td>
</tr>
<tr>
<td>29</td>
<td>Turkey</td>
<td>0.23</td>
<td>2.0</td>
<td>15.75</td>
<td>5.25</td>
</tr>
<tr>
<td>30</td>
<td>Mexico</td>
<td>0.20</td>
<td>1.1</td>
<td>18.41</td>
<td>4.41</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>0.51</td>
<td>9.2</td>
<td>3.77</td>
<td>10.00</td>
</tr>
</tbody>
</table>
2. Broadband diffusion and unbundling

• Which factors make it possible to explain the amazing growth of broadband in South Korea?

1. Economic timing
   - The government has encouraged Internet ventures by offering tax benefits and low rate loans since 1998 financial trauma

2. Housing patterns
   - In Korea, apartments account for 47.8 percent of the total housing stock (11.5 million)
   - 93% of the population live within 4km from telephone office
   - The concentration of high density dwellings in urban areas made the installation of broadband services relatively easy
2. Broadband diffusion and unbundling

- Which factors make it possible to explain the amazing growth of broadband in South Korea?

3. Cultural Characteristics
   - Koreans are susceptible to a social pressure to keep up with their neighbors. This tendency is further fuelled by a competitive enthusiasm for children’s education, which is considered to be the highest in the world
   - Confucian heritage: They satisfy the urge for social interaction and the need to belong to a group on the Internet
2. Broadband diffusion and unbundling

• Supply conditions and traditional regulation

1. Supply conditions
   - Teledensity positively effects penetration
   - Cost of routing traffic towards backbones adversely effects penetration
   - Cost depends on regulatory conditions
2. Broadband diffusion and unbundling

• Supply conditions and traditional regulation

2. Traditional Regulation

Three main channels whereby public policies can influence broadband penetration

- Direct tools for promoting growth (tax breaks, lending programs)
- Direct regulation of broadband access prices
- Regulation of basic services
  • Rate of return vs. Price cap
  • Rate of return: Averch-Johnson effect
  • Price cap: Low price of unbundling induced lowers the profitability of DSL
2. Broadband diffusion and unbundling

- **Intra-platform and Inter-platform competition**
  - **What is Intra/Inter-platform competition?**
  - **Intra-platform competition**: DSL vs. DSL
  - **Inter-platform competition**: DSL vs. Cable
  - *Inter-platform competition significantly influences broadband penetration (more effective than intra)*
  - *But, it does not compensate for the losses due to the duplication of infrastructure costs resulting from the upgrading of cable networks*
  - *The degree of relative concentration on the two platforms is not too high*
2. Broadband diffusion and unbundling

**Intra-platform and Inter-platform Competition (HHI indexes)**

- Degree of competition between DSL firms (intra-platform):
  \[ HHI_{\text{intra}}(n, m) = \sum_{i=1}^{n} \frac{q_i^2}{Q^2}, \quad 0 < HHI_{\text{intra}} < 1 \]

- Degree of competition across platforms (inter-platform):
  \[ HHI_{\text{inter}}(n, m) = \frac{Q^2}{BB^2} + \frac{Y^2}{BB^2}, \quad \frac{1}{2} < HHI_{\text{inter}} < 1 \]

A look at the data:

<table>
<thead>
<tr>
<th></th>
<th>HHI_{\text{intra}}</th>
<th>HHI_{\text{inter}}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>01q2</td>
<td>02q4</td>
</tr>
<tr>
<td>AT</td>
<td>0.58</td>
<td>0.68</td>
</tr>
<tr>
<td>BE</td>
<td>0.68</td>
<td>0.73</td>
</tr>
<tr>
<td>DE</td>
<td>1.00</td>
<td>0.89</td>
</tr>
<tr>
<td>DK</td>
<td>0.51</td>
<td>0.69</td>
</tr>
<tr>
<td>ES</td>
<td>0.78</td>
<td>0.64</td>
</tr>
<tr>
<td>FI</td>
<td>0.59</td>
<td>0.68</td>
</tr>
<tr>
<td>FR</td>
<td>0.82</td>
<td>0.59</td>
</tr>
<tr>
<td>IE</td>
<td>0.68</td>
<td>0.67</td>
</tr>
<tr>
<td>IT</td>
<td>0.51</td>
<td>0.57</td>
</tr>
<tr>
<td>LU</td>
<td>1.00</td>
<td>0.93</td>
</tr>
<tr>
<td>NL</td>
<td>0.94</td>
<td>0.58</td>
</tr>
<tr>
<td>PT</td>
<td>0.91</td>
<td>0.70</td>
</tr>
<tr>
<td>SE</td>
<td>0.93</td>
<td>0.63</td>
</tr>
<tr>
<td>UK</td>
<td>0.68</td>
<td>0.60</td>
</tr>
</tbody>
</table>

In most countries: \( dHHI_{\text{intra}} < 0 \); sign of \( dHHI_{\text{inter}} \) ambiguous
Contents

1. Introduction
2. Broadband diffusion and unbundling
3. Effects on entry and investment and innovation
4. Conclusion
3. Effects on Entry and Investment and Innovation

- **Two kinds of decisions made by incumbents and entrants**
  - **Entry decisions**
    - The number of entrants, i.e., whether or not to enter
    - Entry strategies, whether entrants enter the market by alternative access networks (facility-based) or by leasing loops (service-based)
  - **Investment and innovation decisions**
    - Investment and adoption decisions of the entrant
    - Investment and innovation decisions of the incumbent
3. Effects on Entry and Investment and Innovation

• Why entrant decisions matter
  – Entry will increase competition in the market
  – Entry will enhance consumer welfare by lowering prices and by increasing the range of available service offerings
  – Entry can place pressure on firms to be more efficient, which may lead to further consumer gains

• Not all entry is the same
  – The long-run benefits to consumers from facilities-based entry, generally significantly exceed those from non facilities-based entry (Maldoom et al, 2005)
3. Effects on Entry and Investment and Innovation

• Unbundling affects entry decisions
  – The number of entrants
    • Whether entrants decide to enter depends on terms of entry: The lower the rental rate and/or the lower the fixed cost of unbundling, the higher the entry rate
    • In terms of social welfare there is a trade-off between the benefits of an additional entrant (increase in competition, variety of service) and the cost (caused by the duplication of fixed entry costs and inefficient entries)
3. Effects on Entry and Investment and Innovation

- Unbundling affects entry decisions
  - The entering strategies
    - Facility-based competition
      - Occurs when an entrant builds its own network
    - Service-based competition
      - Entering firm provides service to consumers over an incumbent's network
  - Entrants face a trade-off:
    - The flexibility and scalability provided by access-based entry
    - The ability to set service-characteristics by infrastructure investment
3. Effects on Entry and Investment and Innovation

- **Unbundling affects entry decisions**
  - Building infrastructures gives fine control over the characteristics of the service offered:
    - **Cost,**
      - and hence retail price
    - **The service mix,**
      - e.g. ability to offer voice and/or video services cost effectively
    - **Bandwidth,**
      - incl. its allocation between upstream and downstream links
    - **Latency,**
      - e.g. delay that may affect specific applications such as VoIP and video conferencing
    - **Availability and service quality guarantees** (Maldoom et al, 2005)
3. Effects on Entry and Investment and Innovation

• Unbundling affects entry decisions
  – However, making an infrastructure investment entails substantial commitments:
    • Difficult to change characteristics of the service when the investment is already made
    • The option to wait and see if better technological solutions become available may be lost
    • Assets are likely to be largely sunk and their costs are unlikely to be recovered if the service is discontinued or if demand is not as great as originally forecasted
    • Investment in capacity may only be possible in lumps and subject to significant lead times, making it difficult to respond to unexpectedly high consumer demand

(Maldoom et al., 2005)
3. Effects on Entry and Investment and Innovation

• **Unbundling affects entry decisions**
  
  – **An access-based strategy:**
    
    • **Makes little commitment to the market** (costs are largely scaleable and economies of scale much smaller than with infrastructure operations)
    
    • **Provides the ability to respond rapidly to unexpected increases or decreases in consumer demand**
    
    • **Is not tied to a particular technology**
    
    • **Maintains the option to make an infrastructure investment when technology choices are mature and consumer demand is known**

(Maldoom et al, 2005)
3. Effects on Entry and Investment and Innovation

- **Unbundling affects the investment and adoption decisions of the entrants**
  - Mandatory unbundling encourages entrants to delay facilities-based investment (2002)
  - The more favourable the terms of unbundling, the lower the incentives for the entrant to build its own infrastructure, rather than leasing the incumbent’s facilities (2003, 2004)
  - An incumbent facing the effective threat of facility-based competition can strategically delay facility-based entry by providing attractive terms of access to its facilities (2005)
  - The type (quality) of technology to be adopted may also suffer distortion (2005)
  - When unbundling rates are averaged, the incentives for an entrant to build its own infrastructure are higher in urban (low cost) than in rural (high cost) areas (2005)
3. Effects on Entry and Investment and Innovation

- **Unbundling affects the investment and adoption decisions of the incumbent**
  - Mandatory unbundling decreases the incumbent’s incentives to upgrade and maintain its existing network
    - Incumbent cannot appropriate the excess return due to increased efficiency
    - Incumbent cannot gain any cost advantage over entrants, as entrants have access to the efficiency gains of the incumbent (2000)
  - Mandatory unbundling reduces the incentives to invest in new and risky technologies (2000)
3. Effects on Entry and Investment and Innovation

- Unbundling affects the investment and adoption decisions of the incumbent
  - Incentives of the incumbents to upgrade their loops depend on unbundling requirements
    - Upgrade improves the quality of service provided via the copper loop, and the incumbent can charge a higher rental price
    - Increase in the incumbent’s profit flows during service-based competition
    - Delays technology adoption, since entrant has smaller quality advantage when it builds its own facility (2005)
1. Introduction
2. Broadband Diffusion and Unbundling
3. Effects on Entry and Investment and Innovation
4. Conclusion
4. Conclusions

- Summary
  - Relationship broadband diffusion and unbundling
  - Effects of unbundling on entry and investment decisions
4. Conclusions

• **Suggestions for research**
  
  – **Public initiatives and broadband**
    • Effects of public investment on the power of the market
    • Effects of type of finance
  
  – **Regulation of different levels of unbundling**
    • Not only consider an “all or nothing” type of choice by the entrant
    • In reality there is a far wider range of options
4. Conclusions

• **Our conclusion**
  – **Different categories of competition in broadband**

(MALDOOM ET AL, 2005)
4. Conclusions

- **Our conclusion**
  - **Economies of scale and high sunk costs could impair competition in network industries.**
  - **These factors can lead to monopolistic bottlenecks and should be regulated in the initial market opening-up phase.**
  - **Market opening-up started in all EU countries with a very high market share of the incumbent (>90%).**
  - **As newcomers successfully entered the market, the market share of the incumbent eroded and the need for regulation reduced.**
4. Conclusions

• Our conclusion
  – With prices set by the regulator there remained some uncertainty whether sufficient investment incentives in expanding the network would be generated.
  – With the existence of competing networks and strong potential nowadays, there is no need for the regulator to interfere in new markets.
  – Finally, the regulator would impose a bias in terms of technology if only the situation in the traditional fixed-line network was considered (think about the innovation toward hybrid network) (Welfens, 2008)
4. Conclusions

• Our Conclusion
  – The opinion of a branch research is summarized by Crandall et al. (2002):

“We believe that there is little economic justification for regulation any broadband services, including those provided by incumbent local exchange carriers. There is no basis for assuming that monopoly power will develop in the delivery of these services, but there is every reason to believe that regulation will reduce the incentive of carriers to invest in infrastructure and broadband content.”

(Wernick, 2007)
References

• Kyounglim Yun, (2002), “The growth of Broadband Internet Connections in South Korea: Contributing Factors”, pp. 18-19
Q&A
Thank You