Network investments

S-38.041 Networking Business
Investment theory
Basic concepts

• Current (economic) cost vs. future (economic) benefit
  – High cost ⇒ big loan ⇒ long-term financial analysis
  – Value as function of time
    • interest rate of current loans (per market)
    • discount rate of future benefits (per actor)
  – Cash flow analysis (all costs and revenues over time)

• Investment portfolio
  – Comparison with best alternative (opportunity cost)
  – Freedom of arbitrage (no free lunches)
  – Continuous market dynamics ⇒ portfolio recalculation

• Consideration of material vs. immaterial assets
Investment theory

Tools – Without uncertainty

• Net Present Value (NPV)
  – \( NPV = \sum_{n} x_n / ((1+r)^n) \), \( r \) = annual interest rate, \( n \) = years
  – Present value of asset’s future cash flows (= inflow-outflow)
  – Tells the absolute profit (e.g. EUR), but not profitability (%)

• Internal Rate of Return (IRR)
  – IRR is the discount rate \( r \) that yields zero \( NPV \)
  – Tells the profitability, but not speed of cost recovery

• Payback Time (PBT)
  – PBT = Cost of project / Annual cash flows
  – Tells the speed of cost recovery in years
Investment theory
Tools – Under uncertainty

• Uncertainty comes from many sources
  – General market conditions (e.g. stock market bubbles)
  – Technology (e.g. transition to Internet technology)
  – Customer behavior (e.g. changing fashions)
  – Government (e.g. tax laws, competition policy)
  – Competitors (e.g. change of pricing to flat-rate)

• Coping with uncertainty
  – Choice of risk level (risk-averse, risk-seeking, risk-neutral)
  – Risk sharing (e.g. sharing of radio network capacity)
  – Low cross-correlation between expected values of investments ⇒ diversification reduces risk (e.g. Markowitz)
  – Parallel experimentation (ref. real options theory)
Operator investments

Big picture

• Types of large investments
  – Material (e.g. network capacity, distribution channel)
  – Immaterial (e.g. brand marketing, cellular licences)

• Types of funding
  – Risk-averse ⇒ financial loans (e.g. banks, equipment suppliers)
  – Risk-seeking ⇒ equity investments (e.g. governments, utility firms)

• Analysis methods
  – Calculation of incremental business case for service
  – Revenue modeling: accessible market ⇒ market share ⇒ ARPU
  – Cost modeling: network dimensioning ⇒ capacity ⇒ costs
  – Simulation with multiple scenarios (what-if)
## Operator investments

Relative characteristics of selected cellular decision examples

<table>
<thead>
<tr>
<th></th>
<th>Cellular licence</th>
<th>Cellular coverage</th>
<th>Cellular capacity</th>
<th>New service</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Decision mode</strong></td>
<td>One-step</td>
<td>One-step</td>
<td>Incremental</td>
<td>Optional</td>
</tr>
<tr>
<td><strong>Investment size</strong></td>
<td>High or low</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td><strong>CAPEX (%)</strong></td>
<td>High (&amp;low)</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td><strong>OPEX (%)</strong></td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Payback time</strong></td>
<td>Long</td>
<td>Long</td>
<td>Short</td>
<td>Short</td>
</tr>
</tbody>
</table>

- Services are based on other services (e.g. MMS over GPRS)
- Cross-elasticity of services $\Rightarrow$ high common cost $\Rightarrow$ calculation problems
Portfolio analysis

Example (1/2)

- Focus on bottleneck resource (e.g. R&D experts)
- Decide the target period (e.g. 3 years)
- Get the latest estimate of sales, and probability
Portfolio analysis

Example (2/2)
TTONIC Tool
Rough Idea – Linear repeatable simulations

Inputs

Architecture:
• Network elements and their prices

Services:
• penetration and tariff

Business env:
• discount rate, tax rate etc.

Outputs

• Cash flows
• NPV
• IRR
• etc.

Source: EU TONIC project/Nokia Research center, 2002
TTONIC TTOOl

Informmation Flow

Demand for the Telecommunications Services

Services \rightarrow Architectures

Revenues \rightarrow Investments

OA&M Costs

Cash flows, Profit & loss accounts

Year 0 \rightarrow Year 1 \rightarrow Year n \rightarrow ... \rightarrow Year m

NPV \rightarrow IRR \rightarrow Payback Period

Economic Inputs

Geometric Model

First Installed Cost

Life Cycle Cost

Helsinki University of Technology Networking Laboratory
TONGIC Tool

The Shopping List (screen sample)
Tonic Tool
The Economics sheet (screen sample)

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>NPV</td>
<td>2000</td>
<td>2001</td>
<td>2002</td>
<td>2003</td>
<td>2004</td>
<td>2005</td>
<td>2006</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>661,259</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>IRR</td>
<td>55.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Investments</td>
<td>100,046</td>
<td>57,396</td>
<td>100,020</td>
<td>135,141</td>
<td>160,337</td>
<td>196,100</td>
<td>169,717</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Running Costs</td>
<td>24,519</td>
<td>40,901</td>
<td>64,729</td>
<td>104,028</td>
<td>162,582</td>
<td>239,132</td>
<td>323,891</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Revenues</td>
<td>69,200</td>
<td>117,257</td>
<td>193,968</td>
<td>300,744</td>
<td>462,729</td>
<td>639,346</td>
<td>606,531</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Cash Flows</td>
<td>-55,364</td>
<td>18,961</td>
<td>28,411</td>
<td>69,575</td>
<td>131,810</td>
<td>204,107</td>
<td>298,123</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Depreciations</td>
<td>10,005</td>
<td>15,744</td>
<td>25,827</td>
<td>39,341</td>
<td>66,175</td>
<td>75,785</td>
<td>94,157</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Profits</td>
<td>34,677</td>
<td>60,612</td>
<td>103,412</td>
<td>165,375</td>
<td>243,973</td>
<td>324,429</td>
<td>387,883</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Taxable Income</td>
<td>34,677</td>
<td>60,612</td>
<td>103,412</td>
<td>165,375</td>
<td>243,973</td>
<td>324,429</td>
<td>387,883</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Taxes</td>
<td>10,403</td>
<td>16,184</td>
<td>31,024</td>
<td>49,613</td>
<td>73,192</td>
<td>97,329</td>
<td>116,305</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Retained Cash Flows</td>
<td>-65,767</td>
<td>777</td>
<td>-2,613</td>
<td>19,963</td>
<td>58,619</td>
<td>106,778</td>
<td>181,818</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Cash Balance</td>
<td>-65,767</td>
<td>-64,990</td>
<td>-67,602</td>
<td>-47,640</td>
<td>10,979</td>
<td>117,757</td>
<td>299,575</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data source: C:\tera16\TeraSample.tdb
Tonic Tool
Sensitivity analysis (example)

IRR sensitivity to Router Capacity

Router capacity / simultaneous users

48% 50% 52% 54% 56% 58% 60%
TONGIC Tool
Risk Analysis

Component Price

Service Penetration

Revenue per customer

NPV Frequency Chart
TONIC Tool
Case 3G & WLAN: Overview

• Comparison of 6 network scenarios (years 2002-2011)
  – Small country with slow roll-out, with/without WLAN services
  – Small country with fast roll-out (3 years, licence fee 2€/inhabitant)
  – Large country with high licence fee (90€/inhabitant), with/without WLAN
  – Large country with lower licence fee

• General assumptions
  – Incumbent operator: GSM $\Rightarrow$ 3G $\Rightarrow$ WLAN
  – WLAN for public indoor hotspots within 3G coverage area
  – Market forecasts based on non-linear S-shaped predictive procedure
  – Customers: 80% consumer, 20% business
  – Discount rate 10%
  – Handset subsidy 300€/new subscriber
TONIC Tool
Case 3G & WLAN: Market forecasts

• Demand forecasts $Y_t = M/(1+exp(\alpha+\beta t)\gamma)$, where
  – $Y_t$: demand forecast at time $t$
  – $M$: saturation level (95% for small country, 90% for large)
  – $\alpha$, $\beta$, $\gamma$: adjustable parameters for S-curve

• Subscribers used rather than subscriptions
• Pre-paid 65-80% and post-paid 20-35%
• Business/consumer usage ratio 2.5
• Total generated capacity demand estimate based on
  – Penetration percentage per service class, per market size
  – Average daily usage time per service class, per user
  – Average bit rate per service class, during usage time
TONGIC Tool
Case 3G & WLAN: Results

• 3G business case positive for all network scenarios with payback time of 7 years assuming long 20 year licence periods
• In small sparsely populated country, 3G network sharing facilitates 14% savings on investments
• Under nominal assumptions for 3G operators, public WLAN hotspots
  – Compliment, rather than compete, with 3G
  – Increase 3G usage by 8%
  – Generate 6% of combined WLAN/3G revenue (large countries)
  – Increase CAPEX by 1-2% and OPEX by 4-5%
  – Increase NPV of 3G operators by 9-18%
TONIC Tool
Case 3G & WLAN: Sensitivity analysis

Delay of 3-4 years in 3G turns the business case negative

Sensitivity of 3G parameters (±50%) with regard to NPV
1. Tariff erosion
2. Megabyte tariff
3. Service usage
4. 3G cell radius
5. Operation, administration and maintenance
6. 3G service penetration
7. Investments

And sensitivity of WLAN wrt NPV (minor compared to 3G)
1. WLAN megabyte tariff
2. WLAN service penetration