Network investments

S-38.041 Networking Business

Investment theory
Basic concepts

- Current (economic) cost vs. future (economic) benefit
  - High cost $\Rightarrow$ big loan $\Rightarrow$ 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 the best alternative (*opportunity cost*)
  - Freedom of *arbitrage* (no free lunches)
  - Continuous market dynamics $\Rightarrow$ portfolio recalculation
- Consideration of material vs. immaterial assets

1

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 the 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, competion 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 $\Rightarrow$ *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 $\Rightarrow$ *financial loans* (e.g. banks, equipment suppliers)
  - Risk-seeking $\Rightarrow$ *equity investments* (e.g. governments, utility firms)
- Analysis methods
  - Calculation of incremental business case for service
  - Revenue modeling: accessible market $\Rightarrow$ market share $\Rightarrow$ ARPU
  - Cost modeling: network dimensioning $\Rightarrow$ capacity $\Rightarrow$ costs
  - Simulation with multiple scenarios (*what-if*)

Operator investments
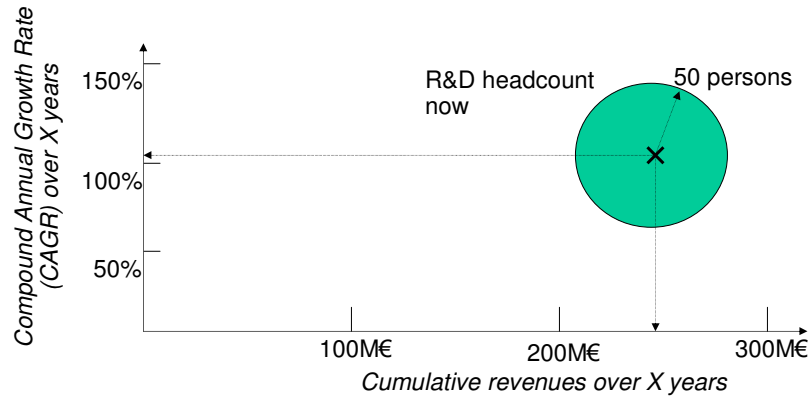### Relative characteristics of selected cellular decision examples

	Cellular licence	Cellular coverage	Cellular capacity	New service
Decision mode	One-step	One-step	Incremental	Optional
Investment size	High or low	High	Medium	Low
CAPEX (%)	High (&low)	High	Medium	Low
OPEX (%)	Low	High	Low	Medium
Payback time	Long	Long	Short	Short

- Services are based on other services (e.g. MMS over GPRS)
- Cross-elasticity of services $\Rightarrow$ high common cost $\Rightarrow$ calculation problems
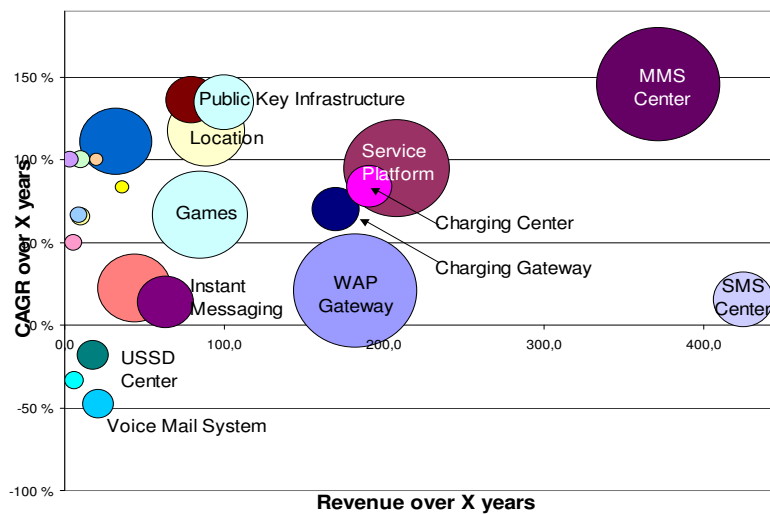
Portfolio analysis
Example (1/2)

Compound Annual Growth Rate (CAGR) over X years

R&D headcount now

50 persons

150%

100%

50%

100M€   200M€   300M€

Cumulative revenues over X years

$$CAGR = \left(\frac{Ending\ Value}{Beginning\ Value}\right)^{\left(\frac{1}{\#\ of\ years}\right)} - 1$$

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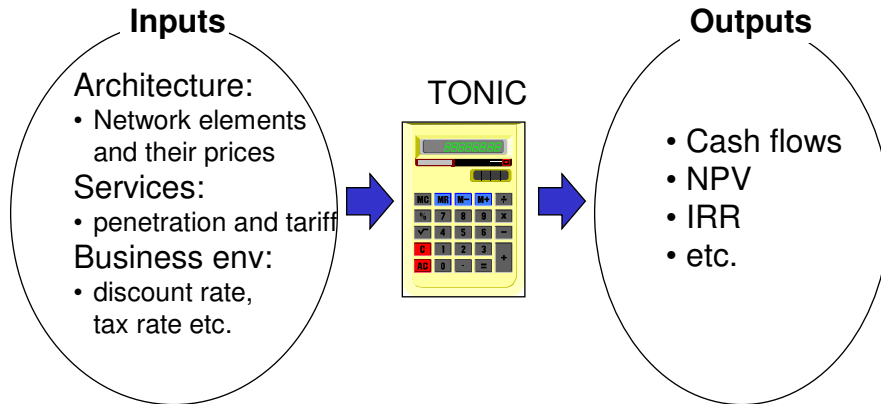- Get the latest estimate of sales, and probability

Portfolio analysis
Example (2/2)

CAGR over X years

150 %

100 %

50 %

0 %

-50 %

-100 %

Public Key Infrastructure

Location

Games

MMS Center

Service Platform

Charging Center

Charging Gateway

Instant Messaging

WAP Gateway

SMS Center

USSD Center

Voice Mail System

0,0   100,0   200,0   300,0   400,0

Revenue over X years

4

TONIC Tool
Rough Idea – Linear repeatable business case simulations

Inputs

Architecture:
- Network elements and their prices

Services:
- penetration and tariff

Business env:
- discount rate, tax rate etc.

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Outputs

- Cash flows
- NPV
- IRR
- etc.

Source: EU TONIC project/Nokia Research center, 2002

TONIC Tool
Information Flow

Demand for the Telecommunications Services

Services → Architectures

DB

Geometric Model

Revenues

Investments

First Installed Cost

OA&M Costs

Life Cycle Cost

Economic Inputs

Cash flows, Profit & loss accounts

Year 0   Year 1   Year n   . . .   Year m

NPV   IRR   Payback Period
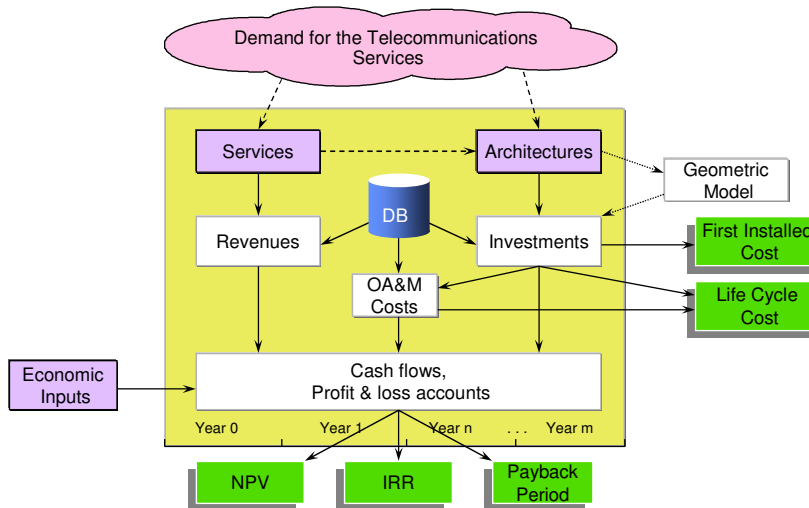
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The Shopping List (screen sample)
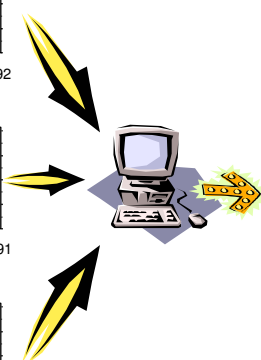

TONIC Tool
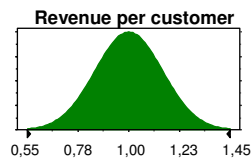
The Economics sheet (screen sample)

6

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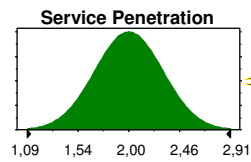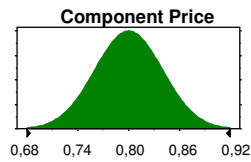Sensitivity analysis (example)

IRR sesitivity to Router Capacity
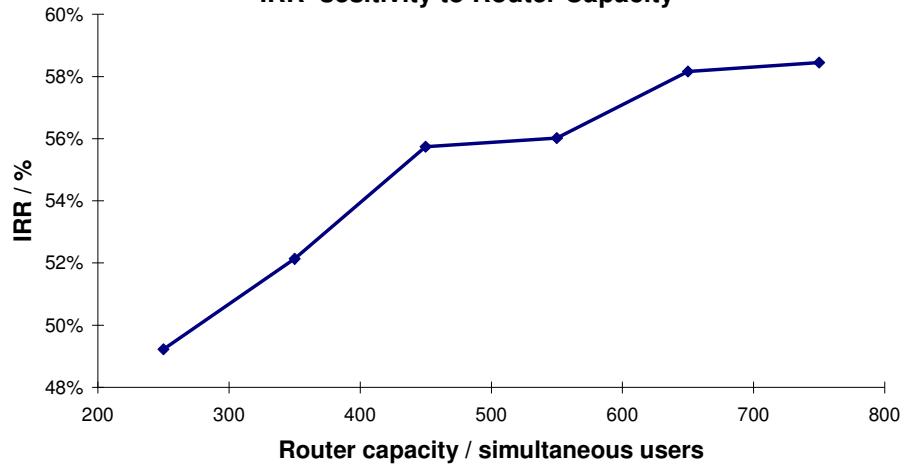
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Risk Analysis
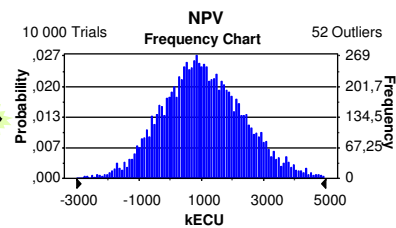
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Case 3G & WLAN: Overview

- 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

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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)
  - α, β, γ : 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

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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%

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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