IBBT

Econ@Tel

A Model for Evaluating the Techno-economic Viability of the Internet Services on Trains

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IBCN intec broadband communication networks

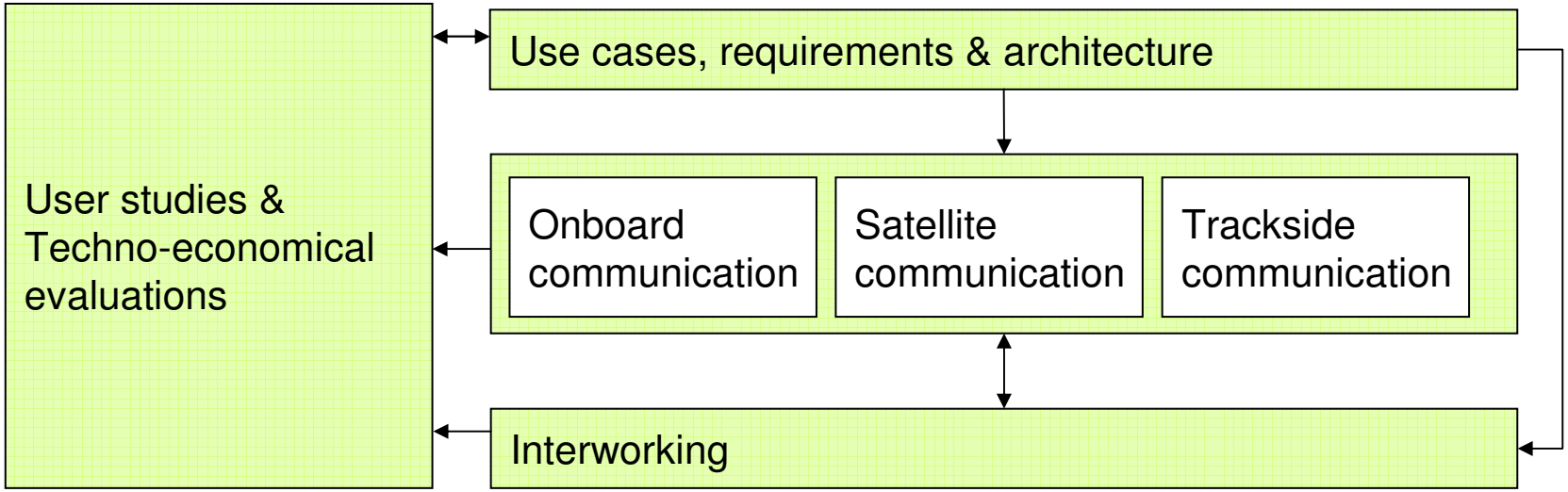
IBBT TR@INS: TRAin IP Network Services

Industrial partners

televic SIEMENS Newtec

Research groups

IBCN PATS MICT Universiteit Gent



Project website: http://www.ibbt.be/en/project/trains

Outline

- **Introduction**
  - What is Internet on the train
  - Technology overview
- **Business modeling**
  - Forecasting & adoption
  - Technology assignment
  - Cost/benefit model
  - Evaluation

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Virtual home, virtual office on the train

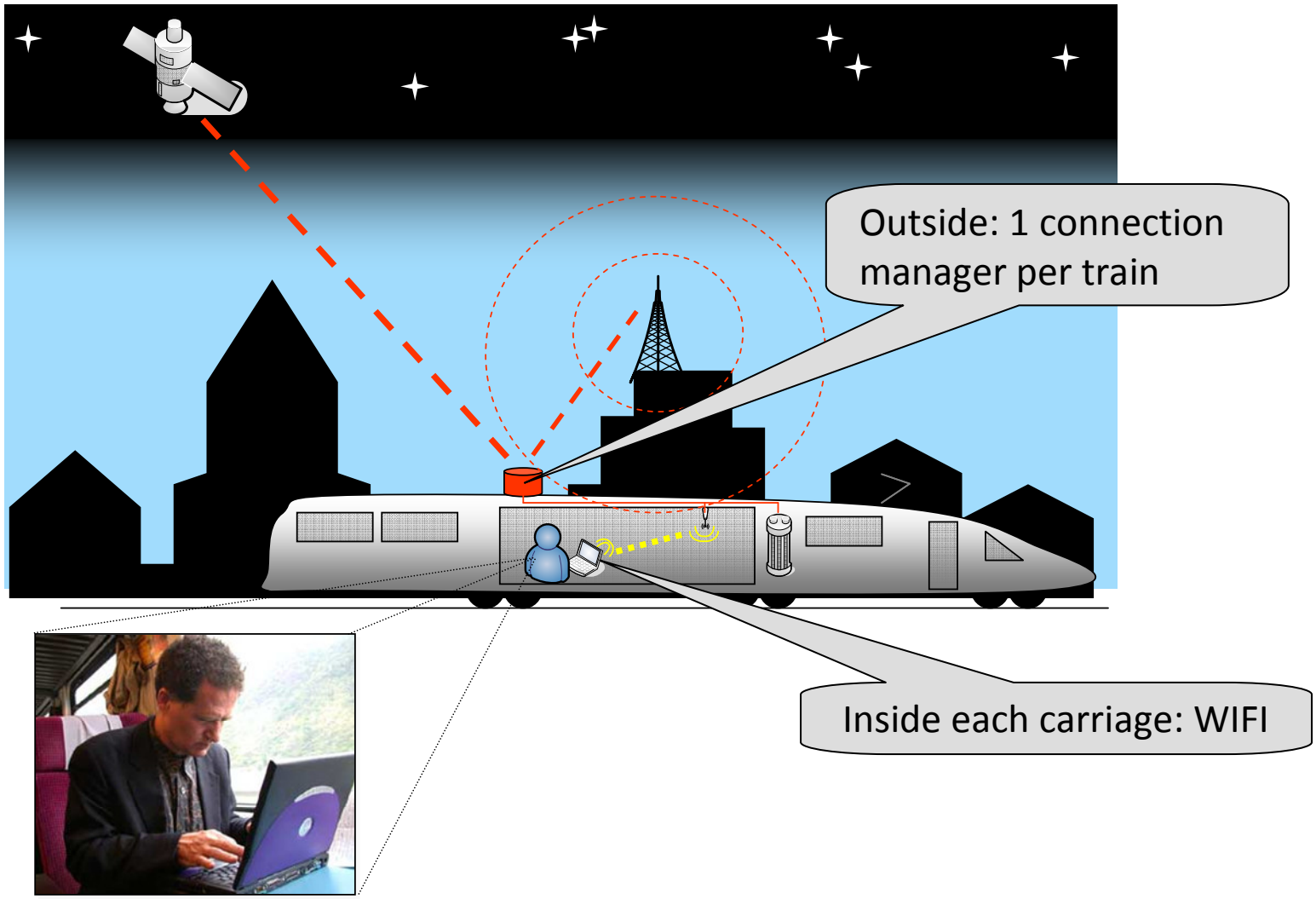
Virtual home

Infotainment
Online gaming
Web surfing
Video on demand
...

Virtual Office

E-mail
Video conferencing
Business applications
...

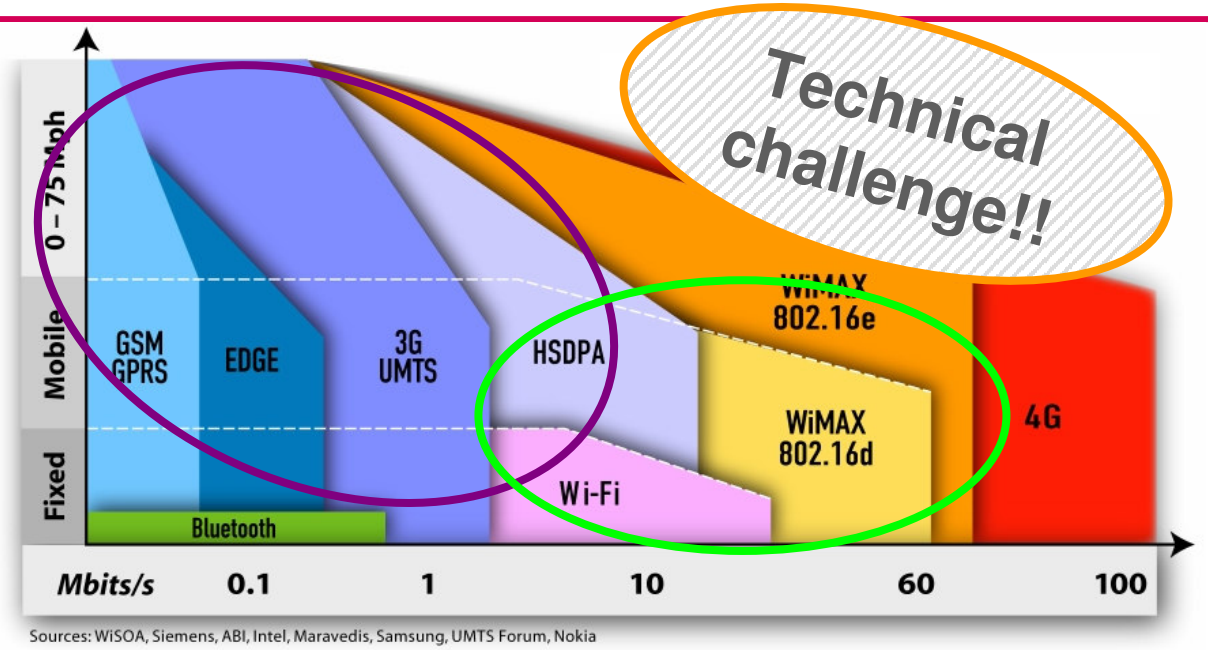
General network architecture



Technological issues

- **Connection between train and ground**
  - Coverage in urban and rural areas
  - Coverage in tunnels
  - High bit rate
  - High speed trains
- **Network connection in the train**
  - Different train types
  - Connection between coaches
  - Power supply
  - Mechanical stability

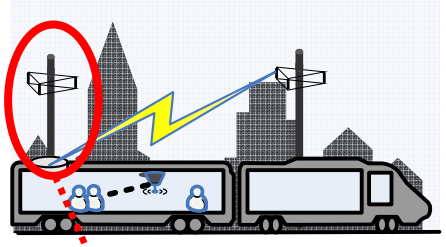
Used outdoor technologies



Satellite

1. *Inherent delay: RTT ca. 500 ms*
2. *LOS required*

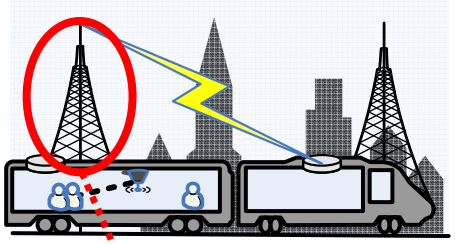
1. Mobile networks



GPRS / UMTS / HSDPA

Network from mobile operators

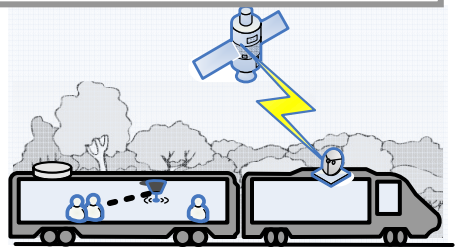
2. Wireless data networks



WiFi / WiMAX / Flash-OFDM

Dedicated network for Internet on the train

3. Satellite networks



DVB-S2 / DVB-RCS

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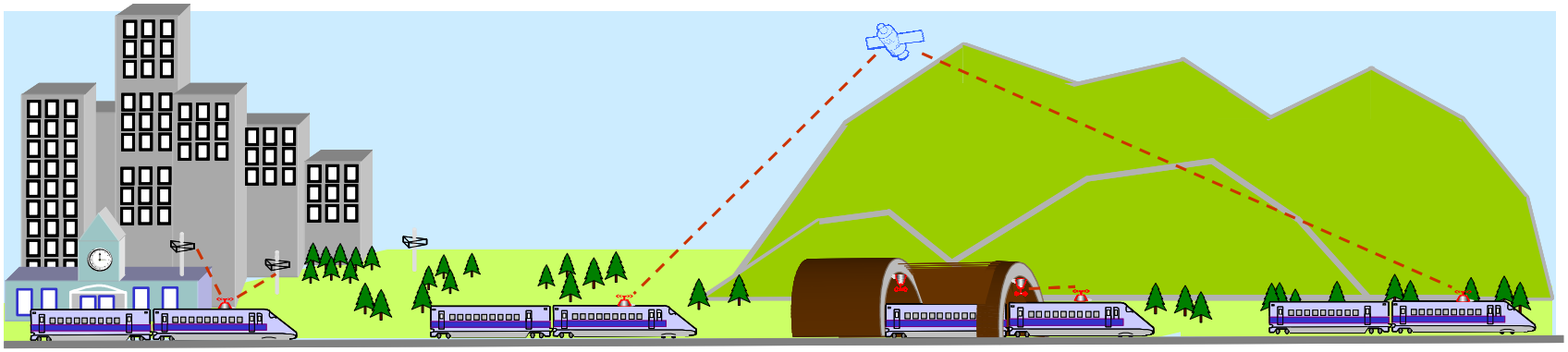
Outdoor technologies: general comparison

Technology	Pro	Contra
Mobile networks **GPRS / UMTS / HSDPA**	Reuse of existing infrastructure Lowest cost Better GSM coverage	Bandwidth limited No general UMTS coverage Handovers required
Wireless data network **WiFi / WiMax / Flash-OFDM**	Long term solution Higher QoS possible	Handovers required Slow rollout *High CapEx*
Satellite network **One or two-way satellite**	No trackside equipment Fast deployment No handover required	Line of sight required High delays *High OpEx*

Potential coverage problems



Networks	URBAN	TUNNELS	RURAL
Mobile network	+++	++	+
Wireless data network	++	++	++
Satellite network	+		+++

Combined technical scenarios

Technology	Pro	Contra
Combined solution	Full coverage Optimized rollout & business case	Handovers between different technologies
Satellite + mobile **Satellite / GPRS / UMTS / HSDPA…**	No trackside equipment Fast deployment Mobile techn. as gap filler	Double antenna system High OpEx cost
Wireless data + mobile **WiMAX / Flash-OFDM / GPRS / UMTS / HSDPA…**	Gradual rollout of wireless data networks	High CapEx cost

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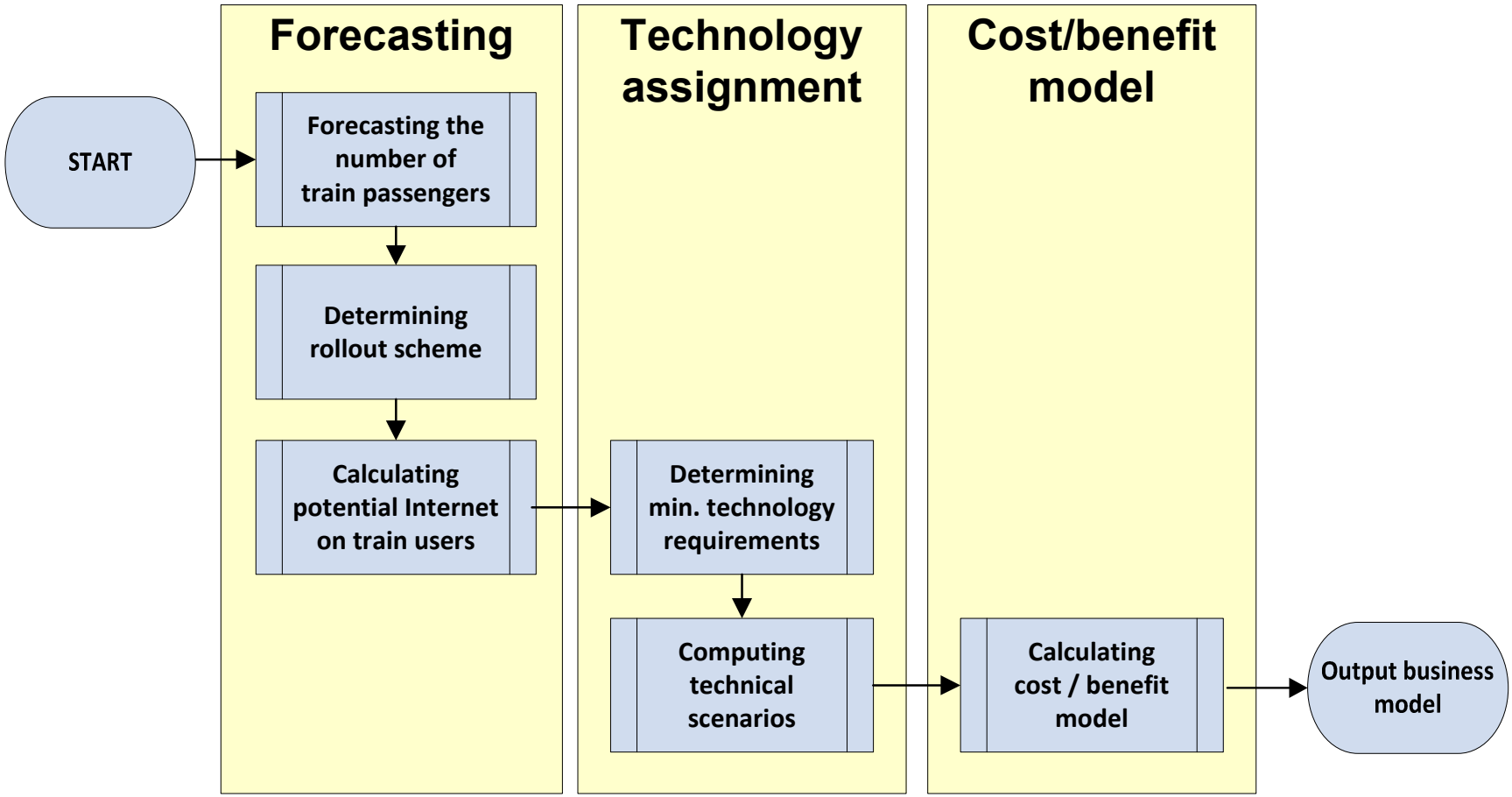
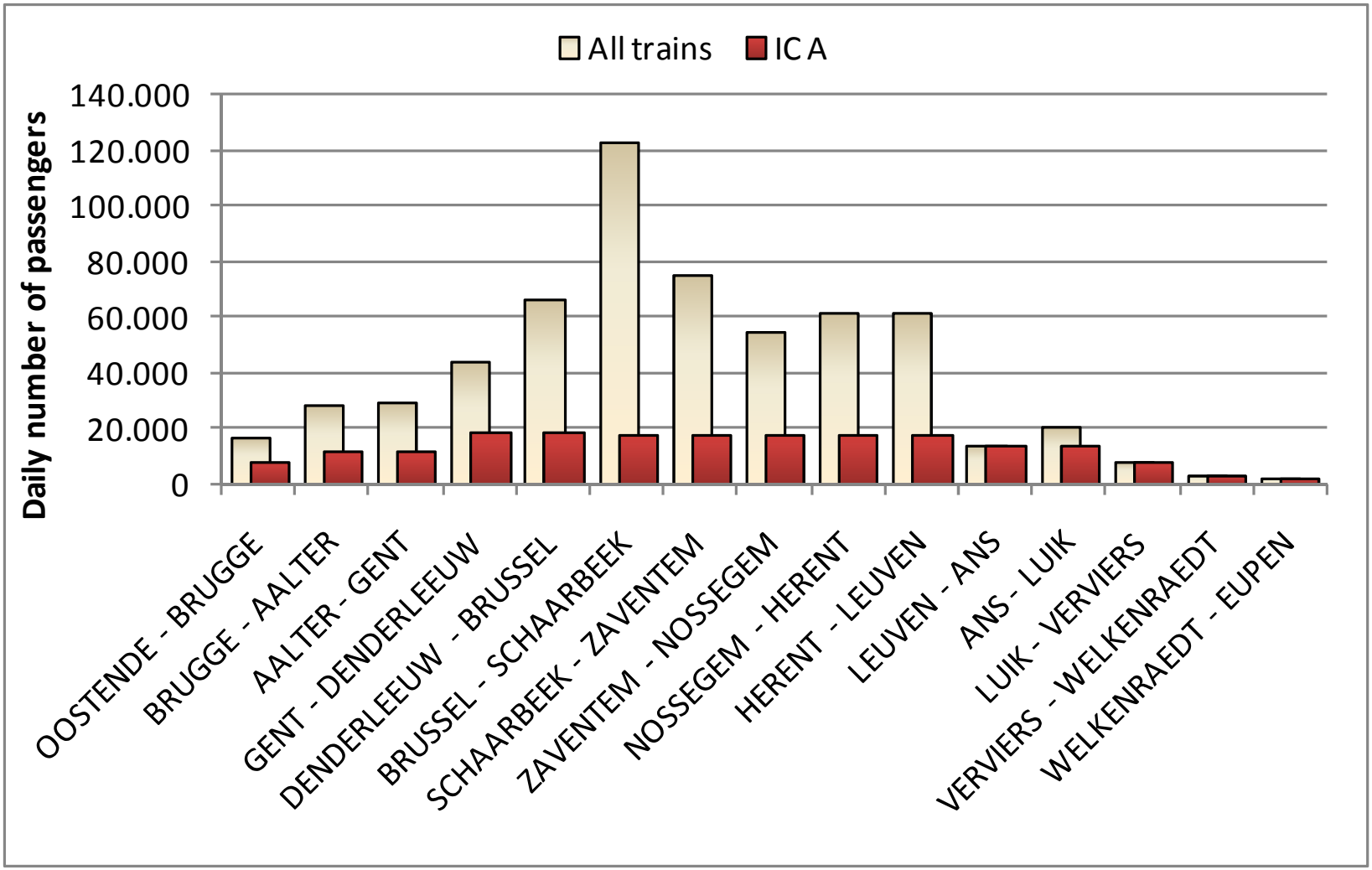
Flowchart business model

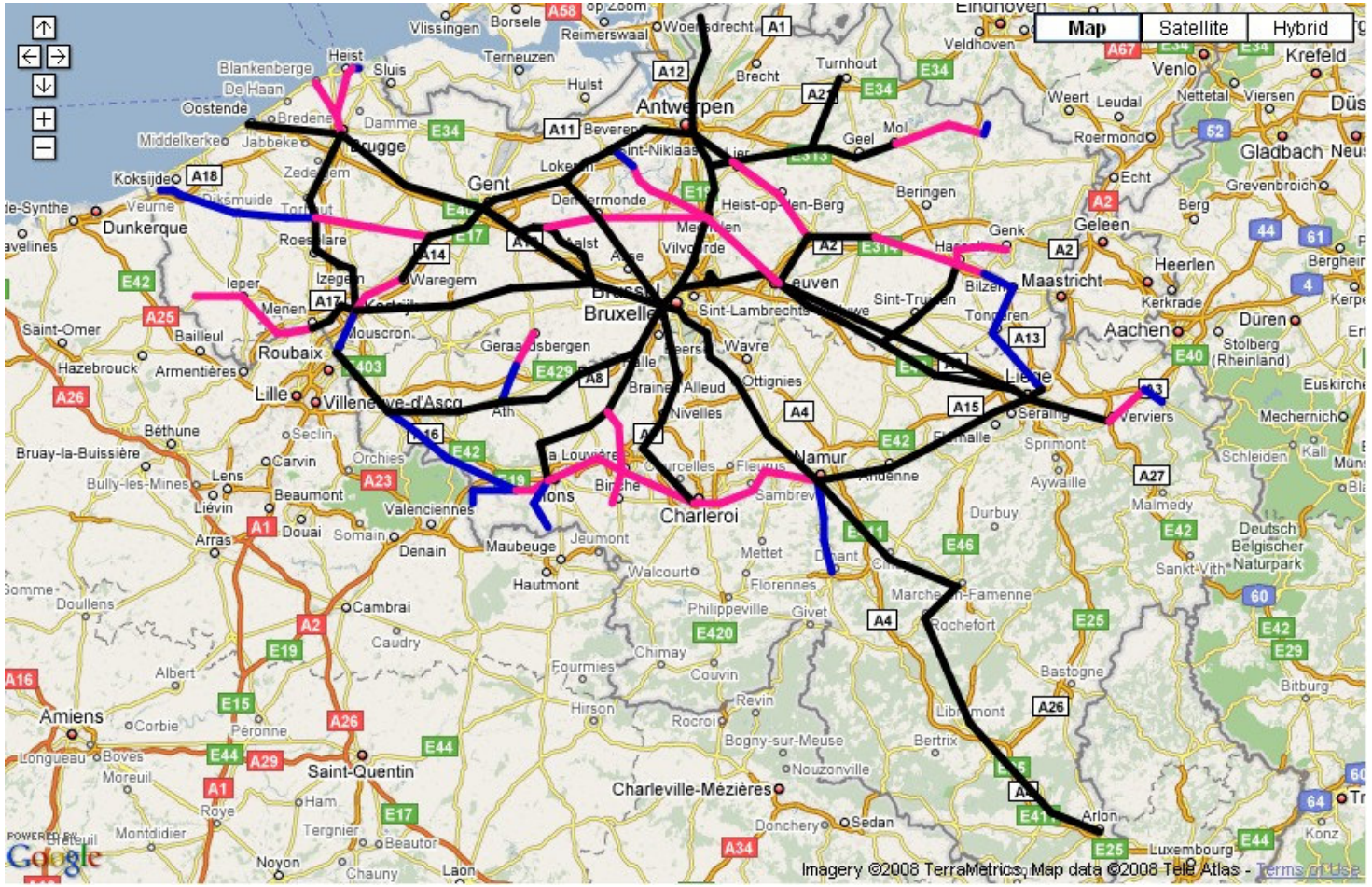


Forecasting the number of train passengers



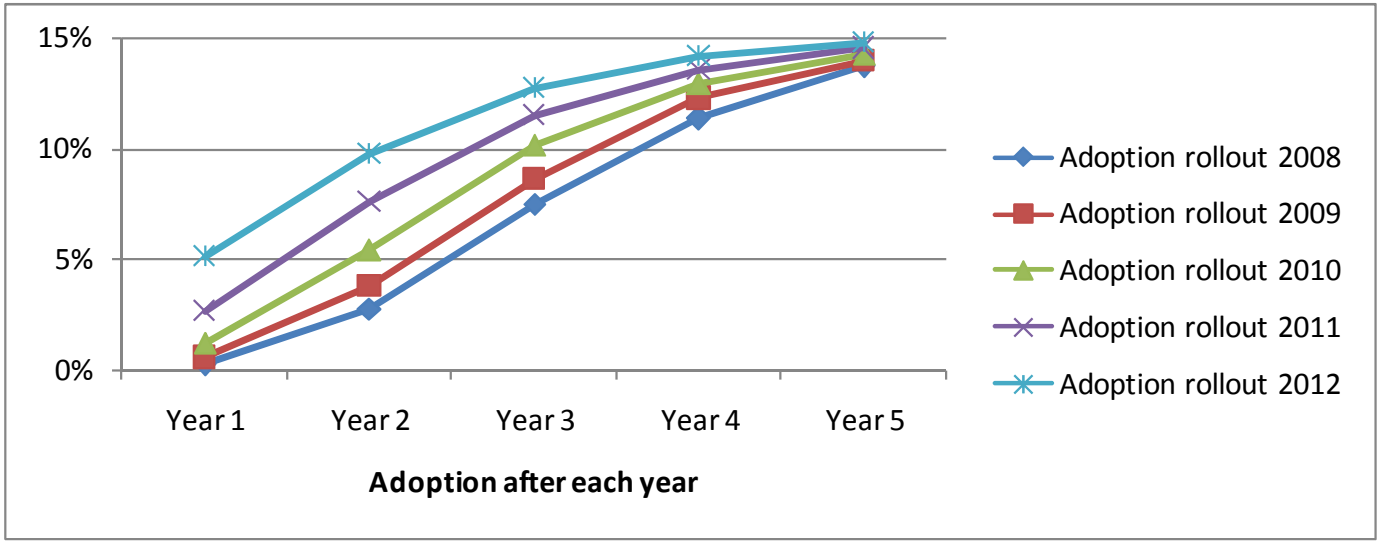
Network rollout (2008-2012)

UMTS – HSDPA – WiMAX

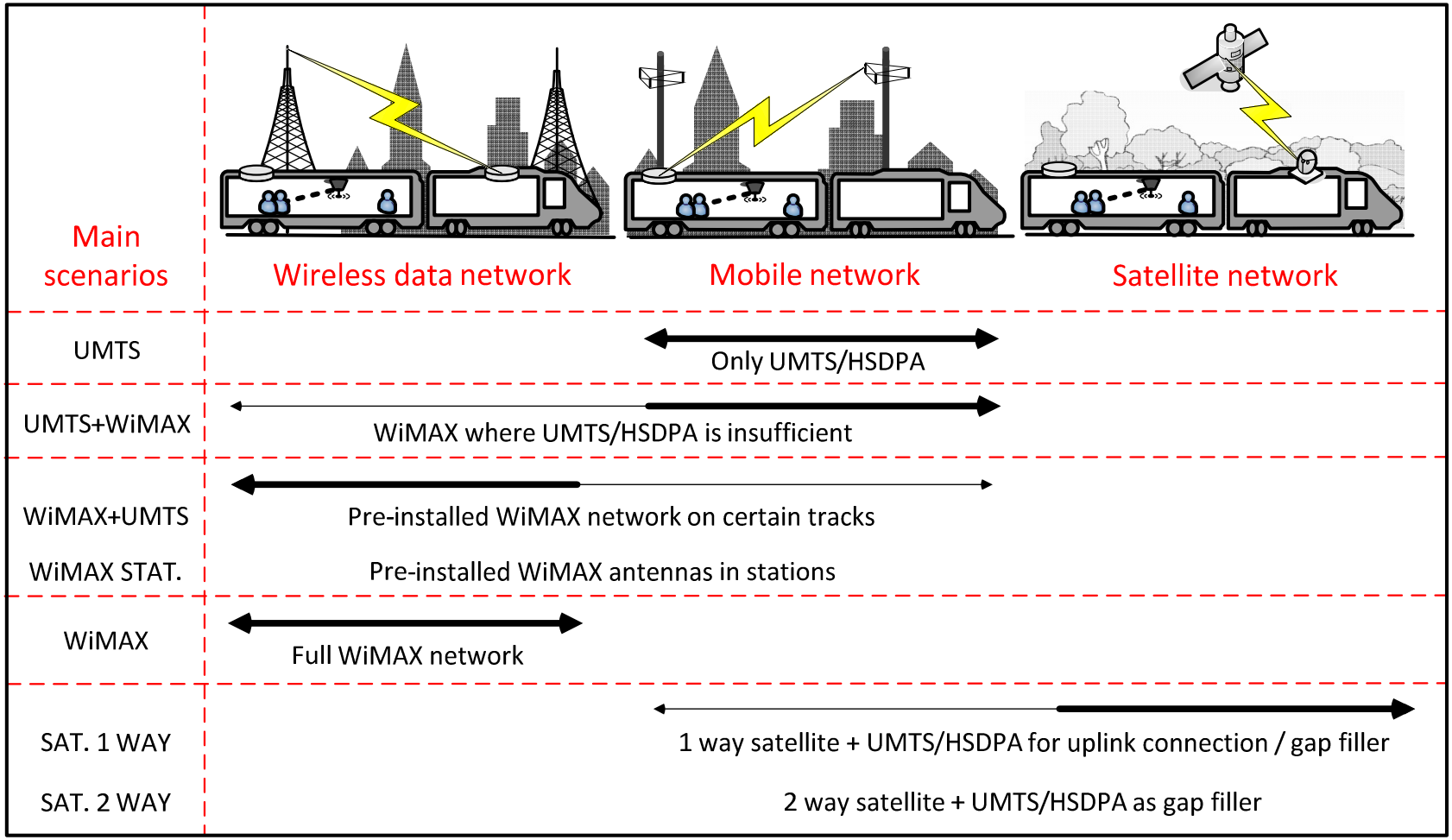


Adoption model

- **Gompertz adoption model**
- **Adoption after 10 years**
  - 1st class: 15%
  - 2nd class: 7,5%
- **Faster rollout in the latter years**



Technical scenarios



Cost parameters

			Wireless data networks	Mobile networks	Satellite networks
CapEx	Train equipment	▪ Outdoor antenna ▪ Indoor network	+	+	+++
	Network equipment	▪ Trackside network ▪ NOC	+++	+	+
OpEx	General costs	▪ Helpdesk ▪ Sales (billing) ▪ Marketing	++	++	++
	Operations	▪ Maintenance and repair ▪ Network management ▪ License costs	+++	+	++
	Network connection	▪ Outdoor link	+	+++	++

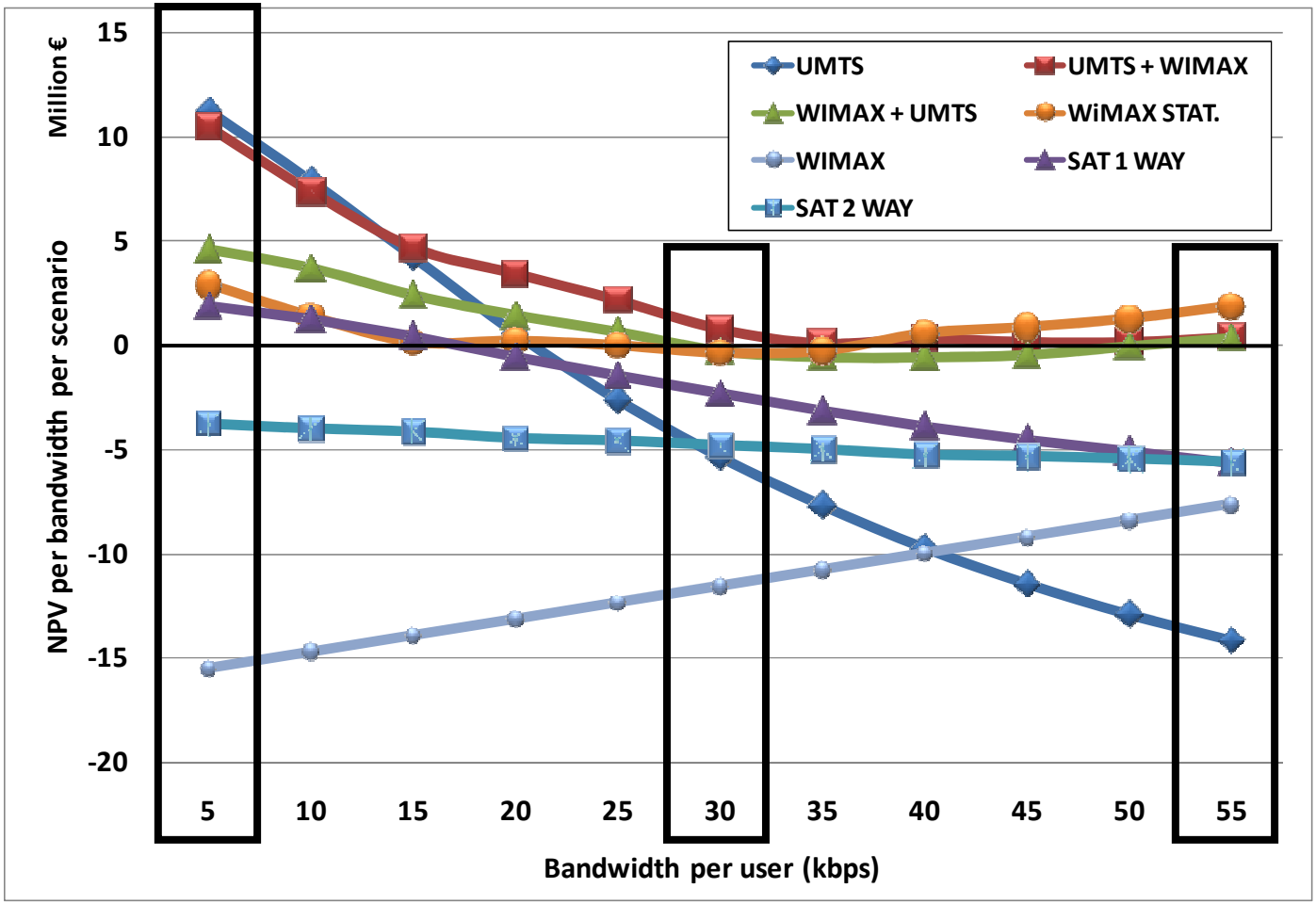
Revenue model

- **Two revenue schemes**
  - All passengers pay
  - First class free service, second class passengers pay

  !!! Modal switch: 2nd class → 1st class

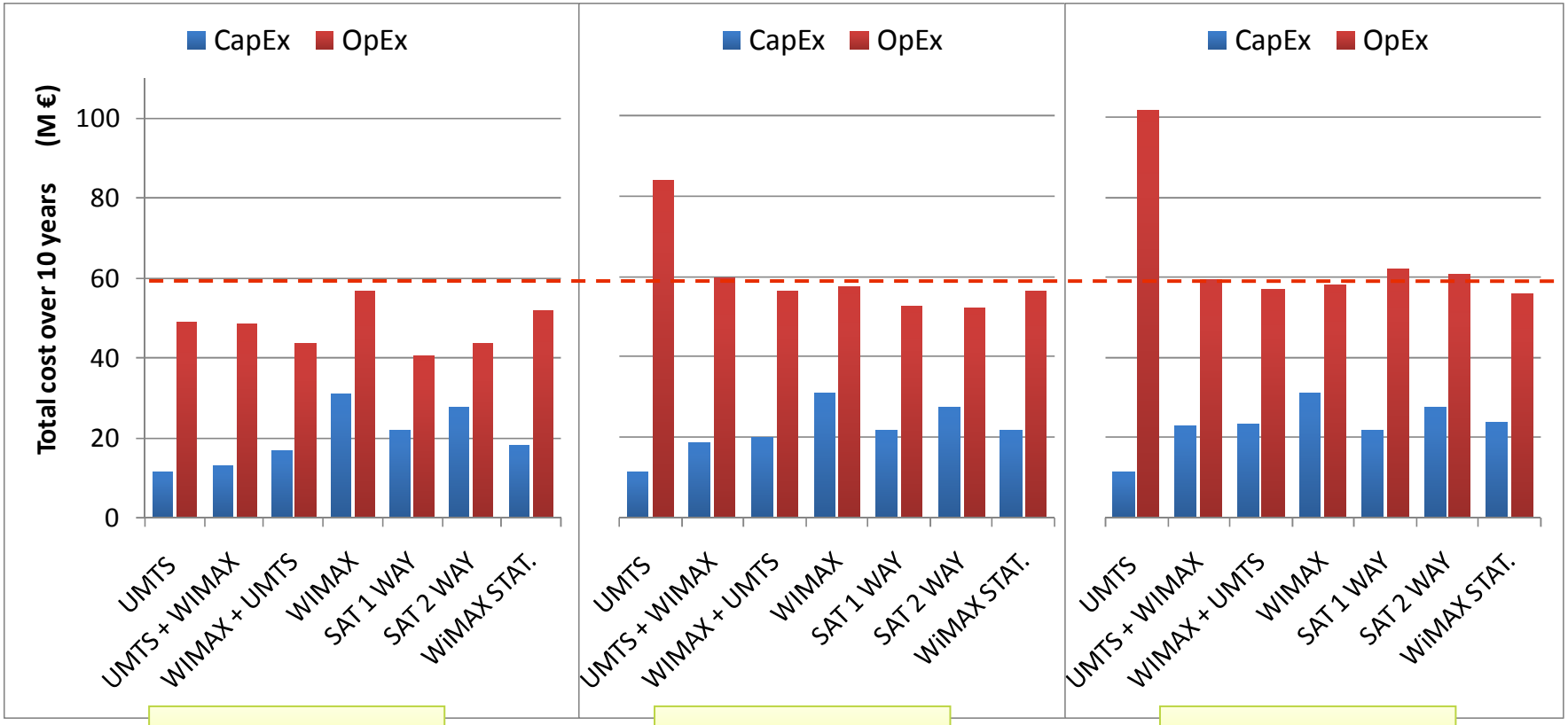
- **Tariffs ≈ offered bandwidth**
  - Prepaid cards: 3,5 – 4,5 €/month
  - Subscriptions: 17,5 – 22,5 € /month

Business model: NPV results (10y analysis)



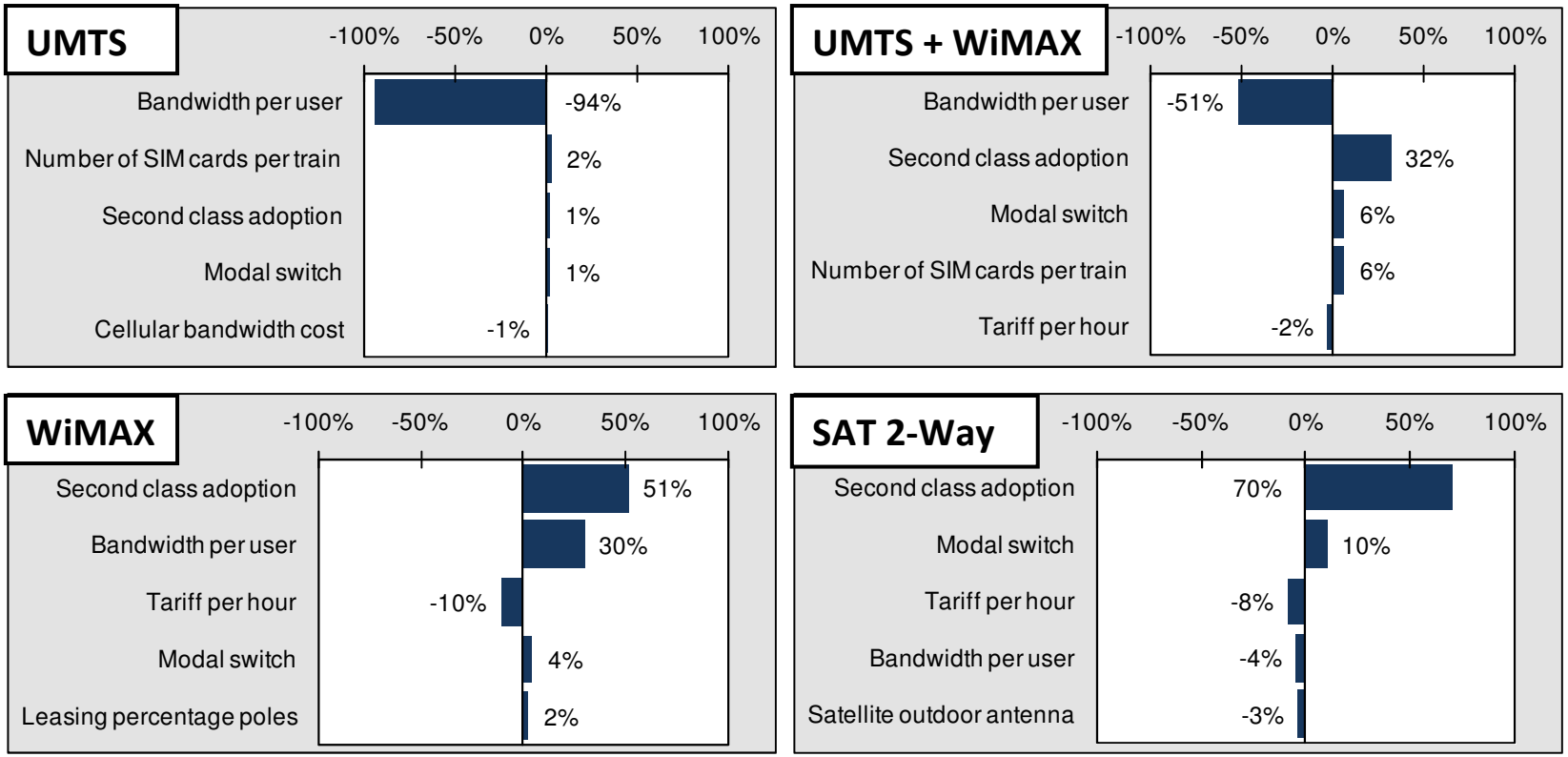
25 kbps per individual user ≈ users experience of ± 1 Mbps

Business model: Cost comparison (10y analysis)



OpEx: bandwidth cost decisive parameter
CapEx: less dependent of the offered bandwidth

Sensitivity analysis



➔ Bandwidth per user
➔ Second class adoption

Business case conclusions

When more bandwidth is guaranteed to the customer:

- **UMTS cases**
  - Only UMTS: Problems → No QoS
  - Combination with WiMAX: QoS can be guaranteed
  - Pre-installation WiMAX: more optimized network rollout
- **WiMAX case:**
  - Only interesting for large bandwidth
- **Satellite cases:**
  - UMTS as gap filler: bandwidth problems
  - 1Way Satellite: uplink bandwidth problems (UMTS)
  - 2Way Satellite: less dependent of bandwidth

Thank you for your attention !

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