

# Forecasting Return On Investment of Your Cell Sites

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# Introduction

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- Why speak about ROI?
  - Increasing competition in the cellular market
    - Match or exceed the coverage of your competitors?
    - Lower cost base to offer competitive or niche services?
  - Growing demand for email and internet services
    - What data rates and where?
  - Threats and opportunities from alternative wireless technologies
    - GSM EDGE, WCDMA FDD or TDD, cdma2000?
    - Role for Wi-Fi and Wimax?
  - Liberalisation and fixed-mobile convergence
    - Mobile networks able to compete with fixed call tariffs.
    - Telco strategies – concentrate on ADSL or go mobile?
  - ROI the factor for success
    - Effective use of cell sites and other assets.

# Contents

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- Capex and Opex for different configurations & technologies
  - What services are you going to offer?
  - Identifying where the real costs lie
  - How accurately can costs be forecast?
  - Significance of ROI at the cell level
- Achieving a cost effective network
  - Accommodating the needs of coverage, capacity and growth
  - Taking advantage of the local environment and resources
  - Deriving other revenues from your assets
- Business modelling and ROI
  - Estimating usage revenues from population coverage and ARPU
  - Forecasting ROI and cash flow for various scenarios
  - ROI forecasting as a practical tool

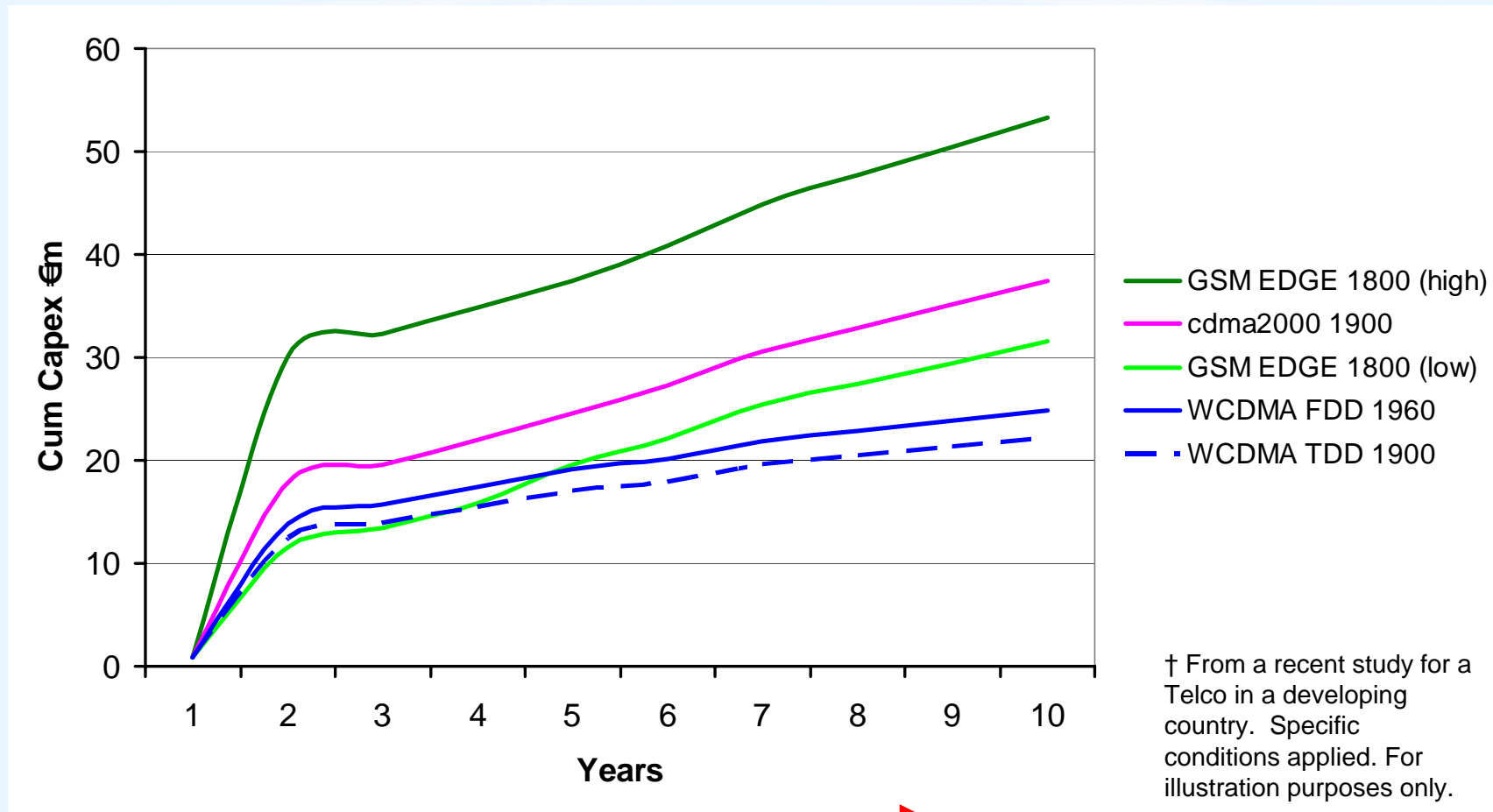
# Choice of Cellular Technology

- Fundamentals show clear difference between technologies
  - Choice dependant on required service and traffic environment
  - 'Typical rates' better comparison than specific link conditions
  - Need to consider per user rates as well as total DL throughputs

Technology	Channel bandwidth	Typical user UL rate	Typical user DL rate (kbps)	Typical DL throughput (for 20 MHz)
GSM EDGE	200 kHz	19.2 kbps	128 -170 kbps (3 - 4 slots)	2.0 Mbps
UMTS FDD HSDPA	5 MHz	56-144 kbps <sup>†</sup>	1100 kbps	12 Mbps
UMTS TDD	5 MHz or 10 MHz	95 kbps <sup>†</sup>	320 kbps or 700 kbps	10 Mbps
CDMA 1X	1.53 MHz	14.4 kbps <sup>†</sup>	80 kbps	7.2 Mbps

<sup>†</sup> for same range as GSM (and similar RF frequency)

## Example Network Capex Including CN Costs



## Example Network Capex for Different Technologies

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- Curves relate to particular network and set of assumptions
  - Capex included CN and site acquisition and construction costs
  - GSM high scenario dimensioned for high data rates at cell edge, GSM low dimensioned for voice at cell edge
  - Study used vendor quoted or contract prices including discounts
- Conclusions
  - BSS equipment pricing is not the main contributor to cost
  - GSM lowest cost in low traffic environments
  - WCDMA clearly lowest cost in high traffic environments
  - cdma2000 only attractive given 450MHz band and for low traffic environments (GSM and WCDMA not available for these bands)
- Other factors have greater influence on choice
  - Ability to support roaming (requires GSM in most markets)
  - Frequency band (spectrum) availability

# Identifying Where the Real Costs Lie?

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## ■ Capex

- BTS costs (usually small part of the total)
- Fixed links (microwave or leased lines)
- Backhaul (Fibre, microwave, satellite or leased capacity)
- Site acquisition and construction (roof-top or mast sites)
- Power, air-conditioning
- Core network and services

## ■ Opex

- Annual site rental costs
- Electric power
- Transmission
- Maintenance

## ■ Particular costs dependent on network and local factors

## Example: UMTS Site Capital Costs

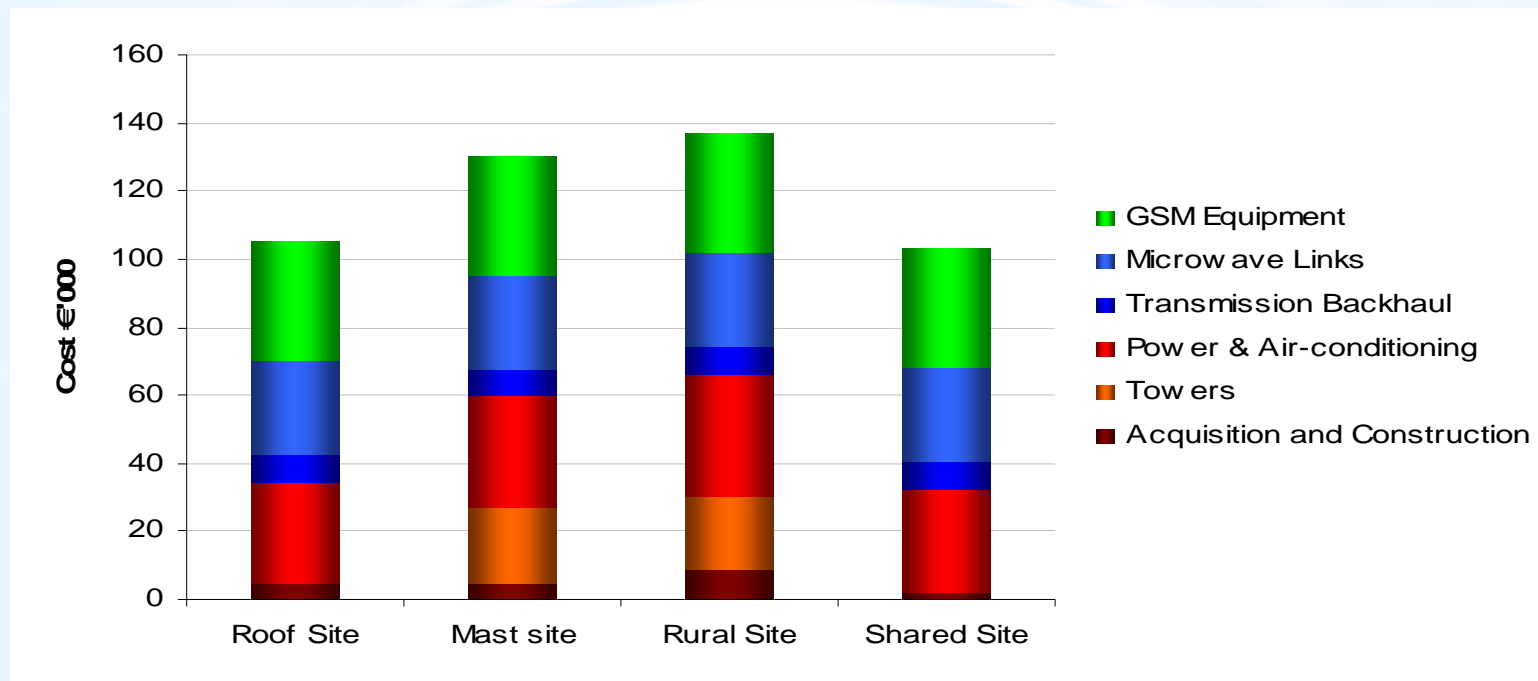
- European operator costs (2004)

	Roof-top site (€ '000)	Mast (€ '000)
UMTS Node B (3 x 1 carrier)	85	85
Transmission links	15	15
Site acquisition costs	12	37
Site construction costs	38	88
<b>TOTAL COST</b>	<b>€150k</b>	<b>€225k</b>
<b>GSM site costs (3 x 1 carrier)</b>	<b>€105k</b>	<b>€185k</b>

Note: Figures include RNC but exclude Core Network costs. Figures include commercial discounts.

## Example: GSM Site Capital Costs

- Developing country operator costs (2006)



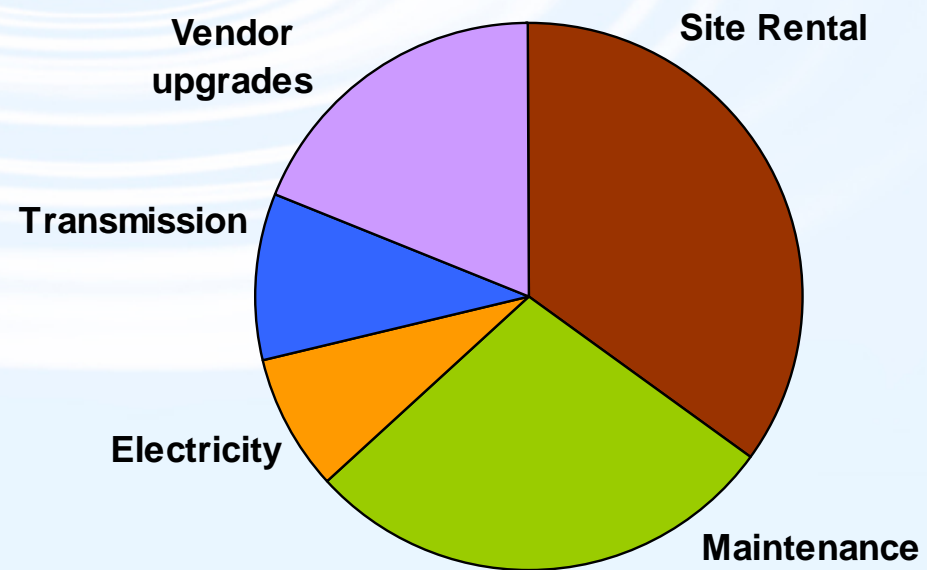
Difficulty is to estimate mix of site types for network expansion

# Operating Expenses

- Operating Expenses need to be defined carefully:
  - Does Technical Opex includes 'site' and 'operating' costs?
  - How should manpower costs be allocated?
  - How are Sales, Marketing and Administration costs accounted?
  - Resulting Opex figure may vary from 5%-30% of Capex or more

- 'Typical' breakdown of site operating expenses?

- Personnel (maintenance) 30%
- Site rental 35% - 38%
- Electricity 8%
- Transmission 10%
- Vendor support 20%



# Vendor Equipment Features Affecting Costs

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- Affecting network capital cost:
  - High power, sensitivity and low losses to minimise coverage cost
  - Features to maximise spectrum efficiency or minimise interference
  - High modularity to facilitate low cost network evolution
- Affecting operating costs:
  - Remote O&M, what does this cover?
  - Cost of HW and SW upgrades
  - Efficient transmission coding to minimise transmission costs
  - Good power efficiency
- These points are not always considered carefully during vendor selection!

# Main Factors Affecting Cost of Sites

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- Site construction especially mast sites (Capex)
  - Can number of mast sites be minimised?
- Site rental (Opex)
  - Merits of site leasing versus own and build?
- Fixed links and transmission (Capex and Opex)
  - Leased line versus microwave links?
  - Satellite for remote locations?
- Provision of power especially in rural areas (Capex)
  - Generators, solar power or batteries required?
  - Cost per kW-hour (Opex)?
- Air conditioning plant and maintenance (Capex and Opex)
  - Maintenance can be a major operating cost and source of unreliability

## Reducing Site Implementation & Rental Costs

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- Detailed planning & modelling of scenarios
  - Based on assumed traffic and realistic cost models
- 'Greenfield' dilemma - whether to use high sites or not?
  - Down-tilt or use as umbrella sites later?
  - Availability of other cellular bands or technologies for traffic growth?
  - Use indoor cells to minimise interference and maximise capacity?
  - Use of Wi-Fi or Wimax for traffic hotspots?
- Site sharing 'own' or competitor sites?
  - Possible 40% saving on site costs, and reduced time to market
  - Use shared sites even if in non-ideal positions, even if this increases overall site budget?
  - Use third party sites (outdoor and indoor) for quick and cost effective roll-out; converts 'Capex' to 'Opex'

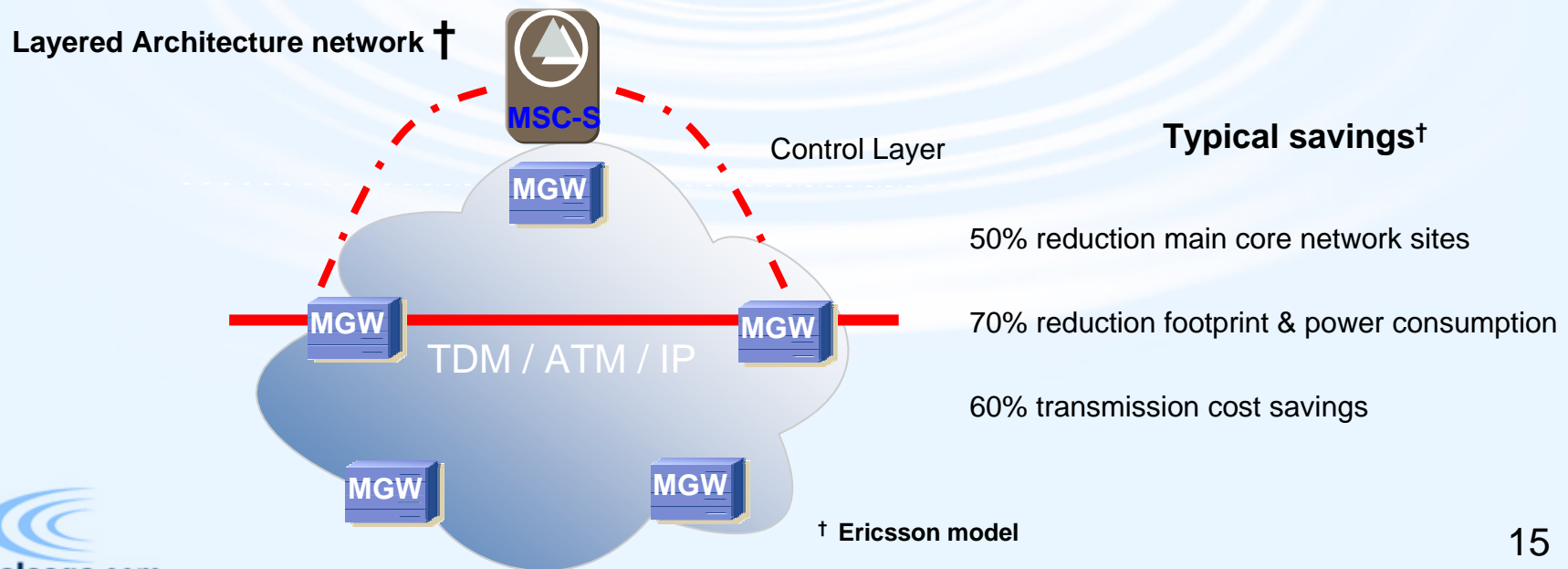
## Site Sharing (European Experience)

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- Site sharing widely practiced in Europe
  - e.g. 66% GSM sites shared in the UK
- Savings for WCDMA operators re-using existing GSM sites:
  - Shared roof-top site typically 20-23% saving
  - Shared mast site typically 45-55% saving
  - e.g. 25-30% saving on UMTS RAN assuming 20% mast sites
- New site costs shared equally between two operators
  - Shared roof-top site typically 10-15% saving
  - Shared mast site typically 25%
  - e.g. saving 15% on UMTS RAN assuming 20% mast sites
- Added benefit for UMTS
  - Shared site minimises adjacent channel interference problems between operators

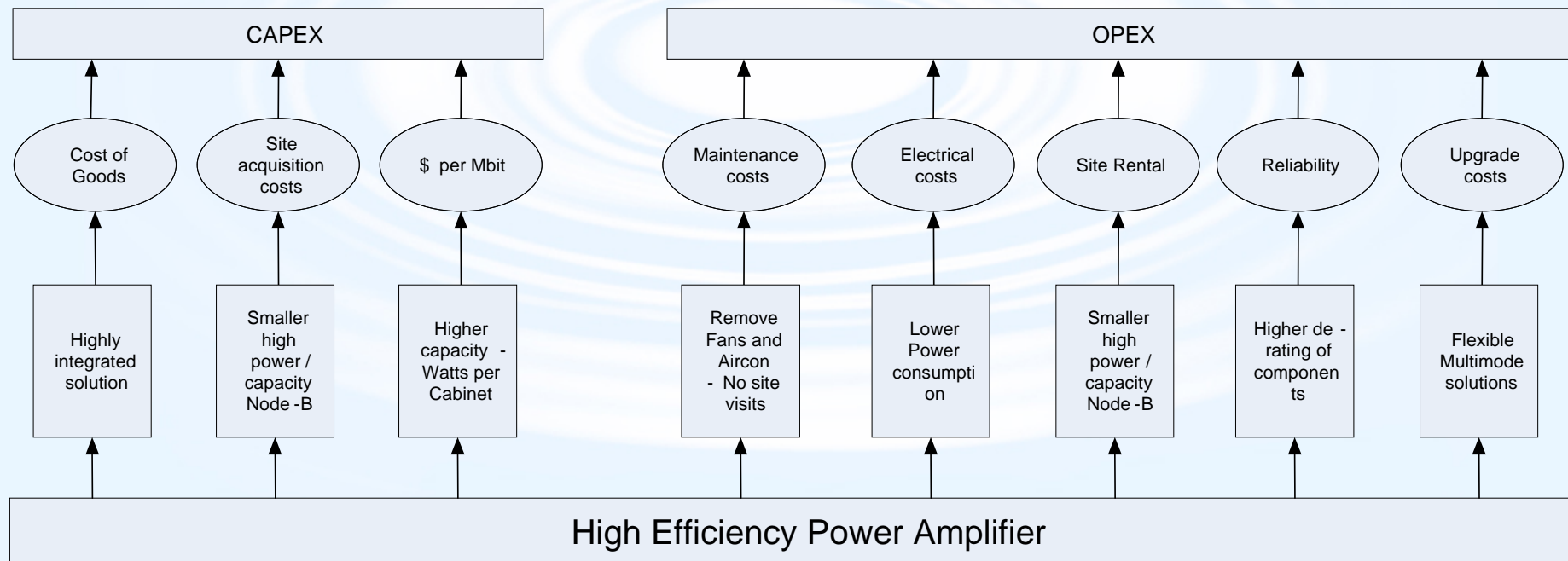
# Reducing Transmission Costs

- Exploit vendor features
  - e.g. use half rate AMR coder or optimised Abis
- 'New Generation Networks' soft-switching
  - MSC-Server and local gateway, IP switching
  - Benefits dependent on network topology and transmission costs
  - Appropriate to network with major cities well distributed†



# Use of High Efficiency Power Amplifiers

- Current wideband (e.g. WCDMA) PA typically 15% efficient
  - Efficiencies now heading past 40% (e.g. Nujira), resulting in reduced power, air-conditioning and maintenance costs
  - High efficiency an essential requirement for all 3G networks!



## Other Ways To Save Costs or Increase Revenues

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- Shared RAN
  - Shared Node B, shared or partitioned RNC
  - 30% savings claimed, not widely adopted?
- Roaming
  - Possible savings 30%-40%, adopted in several countries
  - implemented as Netco, national roaming or MVNO
- Marketing solutions
  - Branded Resellers – where host operator provides billing and switches
  - Own Brands – enables operator to offer niche products without undermining premium mobile product
  - e.g. 'online' account (all transactions by internet), flat rate tariff competing with fixed telephone network, data package etc.
- M2M (Machine to machine) communications
  - in utilities, retail, transport/logistics, property management and healthcare?

# Significance of ROI as a Roll-out Tool

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- Is cell site ROI relevant to planning a roll-out strategy?
  - Does this fit with need to match competitor's coverage?
  - In new networks peak funding more important than ROI
  - Difficulty to predict and attribute revenues
- Conclusions
  - Applicable to individual sites in some cases, e.g. whether to provide coverage in hotel, office or public building
  - More generally applicable to groups of cells, services and applications, e.g. ability to provide high speed data access
  - Essential tool at the level of the business plan
- ROI used to assess competitive threats
  - e.g. Impact of Wi-Fi hotspot providers in capturing voice and data traffic in airport that might otherwise be carried by cellular
  - Potential threat of Wimax 802.16e

# The Effect of ARPU and Subscribers on ROI

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- Subscriber numbers and monthly ARPU (Average Revenue per User) has direct impact on ROI and profitability
- Based on benchmark data modified by local market factors:
  - GDP per population, spend on similar services, current tariffs
  - Market penetration, number of competitors, estimated churn
  - Impact of other services, fixed telephone, ADSL availability & use
- Some example European ARPUs (mid-2005)
  - Range O2 Ireland €62 to Tele2 Sweden €15 per month
  - Mostly in region €25 to €50 per month
  - Germany generally <€30 per month (strong competition?)
  - '3' UK €50 and '3' Austria €59 per month (effect of 3G services?)
  - Most ARPUs fell slightly in 2005 (data not really taken off yet?)
- If revenues difficult to predict, how can we develop robust profitable business plan with good ROI?

## Practical Example - ROI & Business Planning

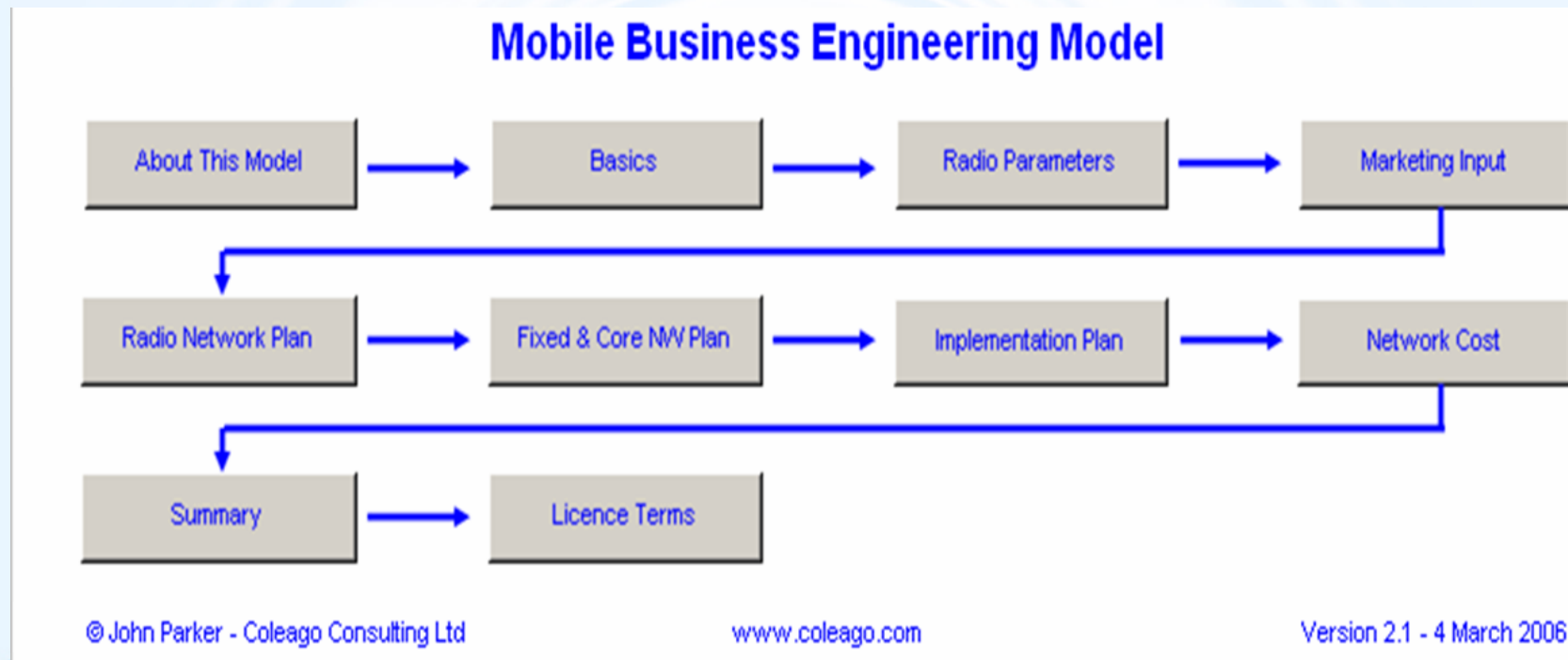
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- Example based on modelling for new GSM network
  - Built from existing engineering and financial modules
  - 12 man-weeks to customise model for particular network & market conditions
  - Historic data included costs for site acquisition and build, transmission and interconnect
- Particular issues for customer
  - How to build successful business as third operator
  - Optimum roll-out strategy for best ROI and lowest peak funding
  - Availability and cost of backhaul transmission network
  - Exploiting existing sites and other assets
  - Sensitivity of business plan to market assumptions

# Linked Engineering and Financial Models

## ■ Engineering Model

- Detailed model of network rollout, topology, dimensioning and costs
- Input and output connected to Marketing and Finance model
- Can be used to investigate different technical options

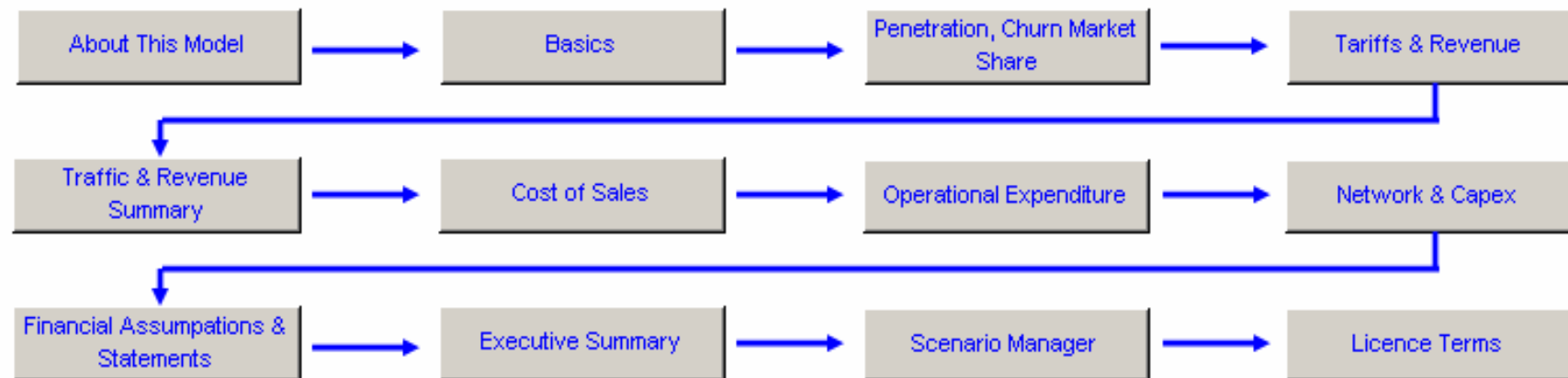


# Linked Engineering and Financial Models

## ■ Market and Finance Model

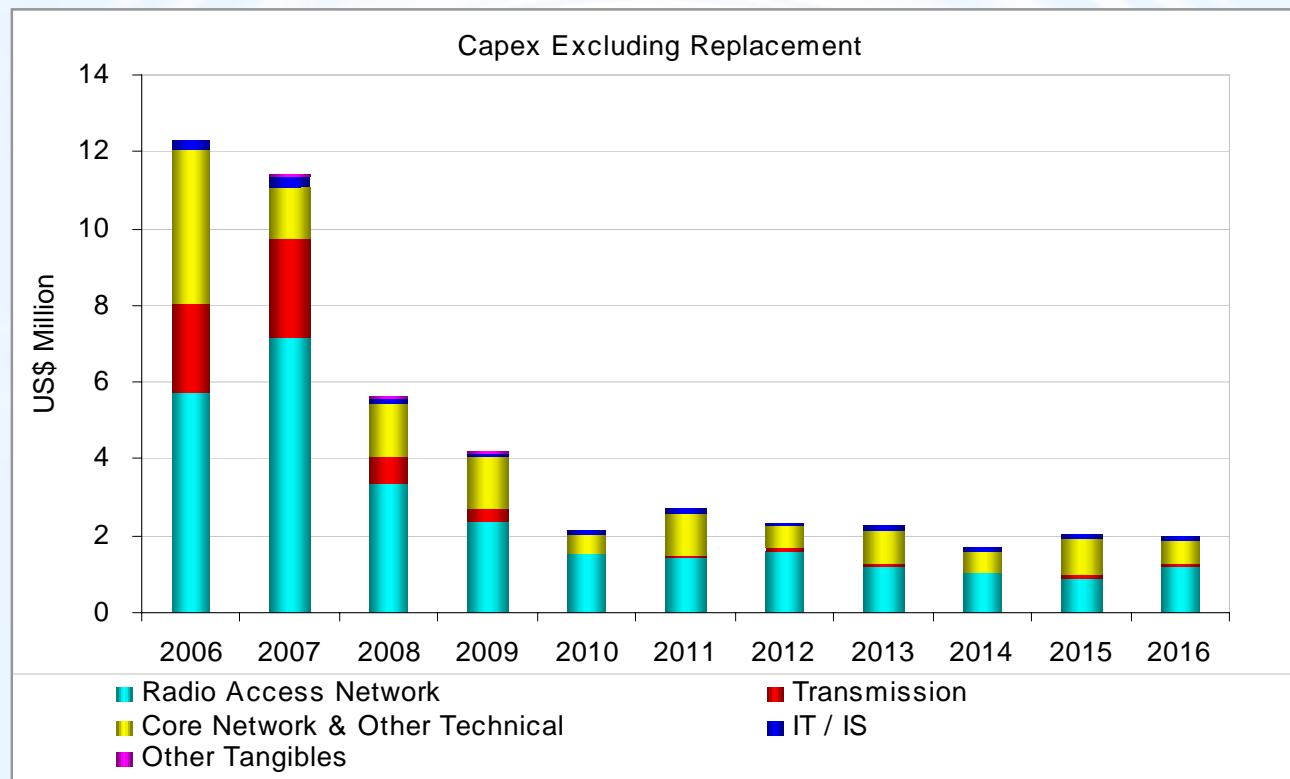
- Includes all overheads, fees, cash flows and finance costs
- Closed loop with Engineering Model for scenario development
- Contains Monte Carlo Modelling to test sensitivities to assumptions

### Mobile Business Planning & Scenario Model



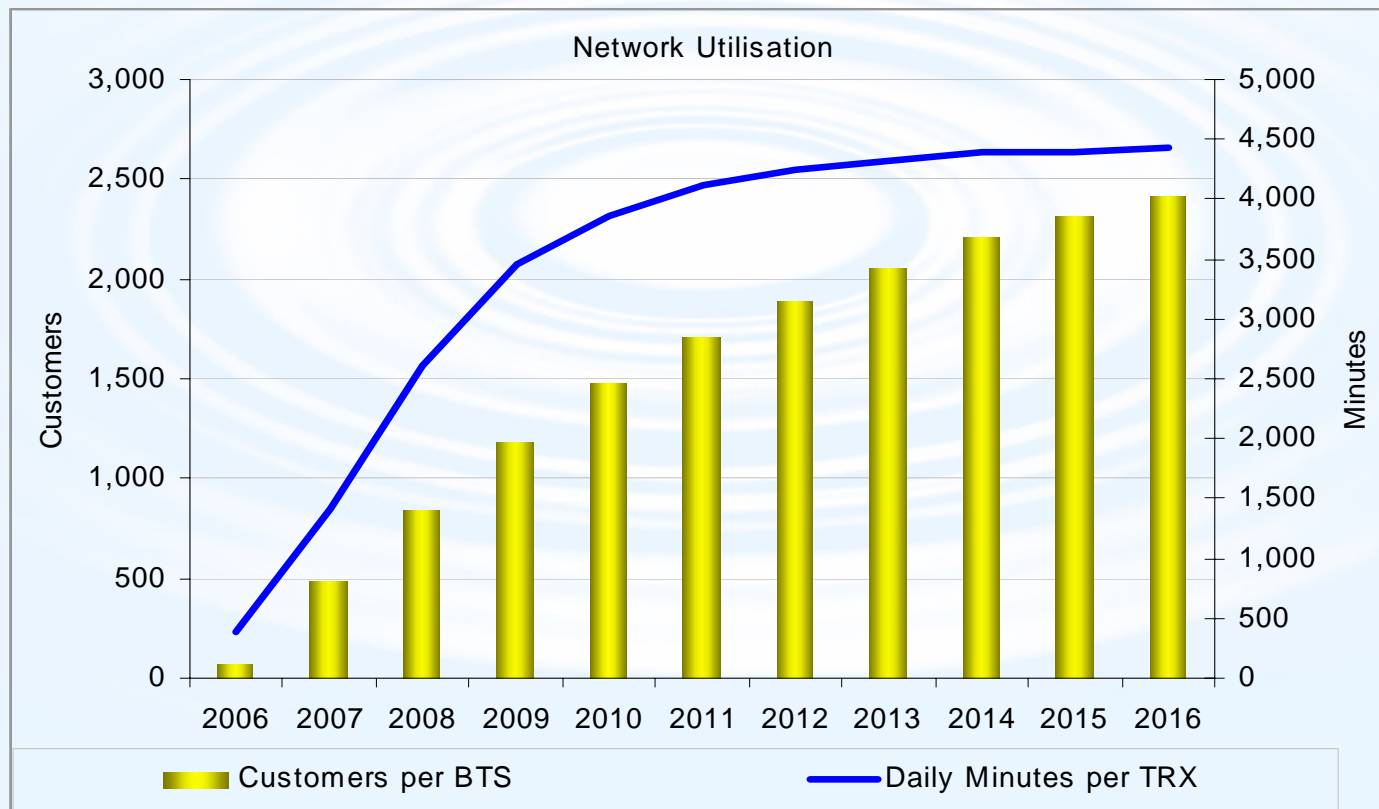
## Annual Capex for Required Coverage and Traffic

- RAN (including all site costs) is major cost contributor
  - Model included realistic estimate of mast-, roof-top and shared sites
  - Roll-out phased to match transmission roll-out and minimise costs



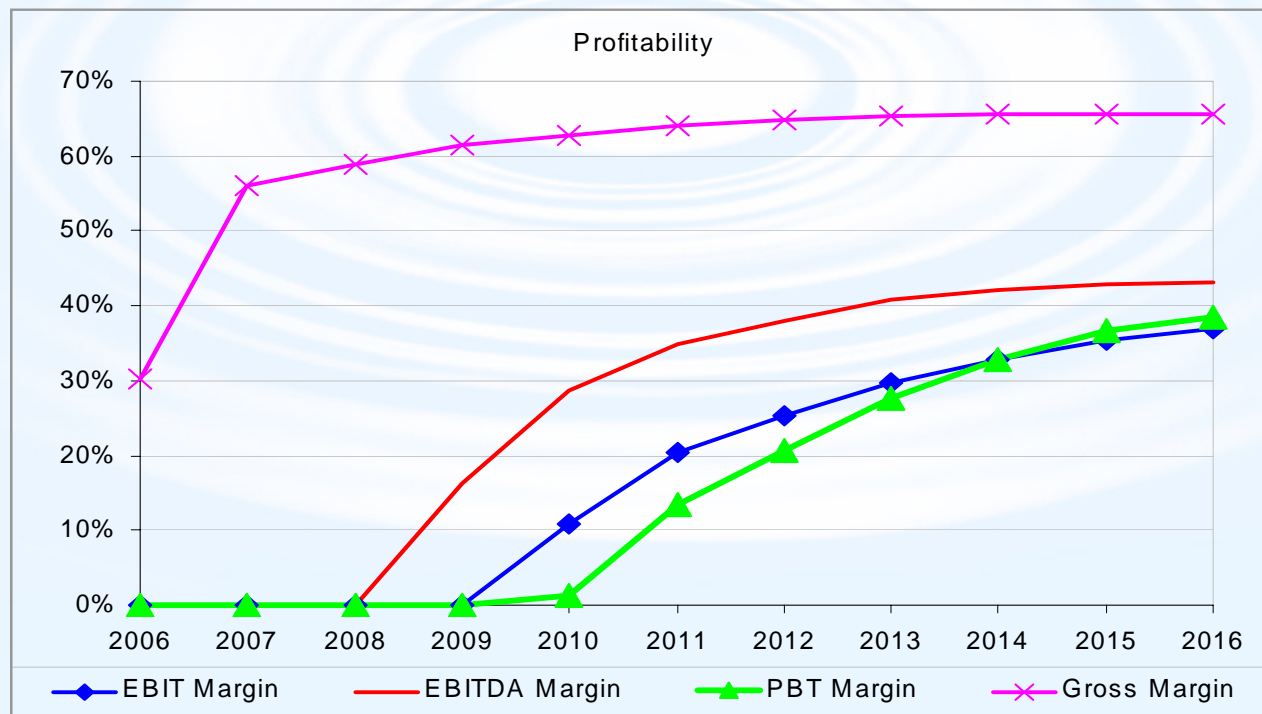
# Use of Benchmarks to Assess Efficiency

- Particular example shows utilisation of BTS and TRX
  - Other aspect of the plan can also be benchmarked



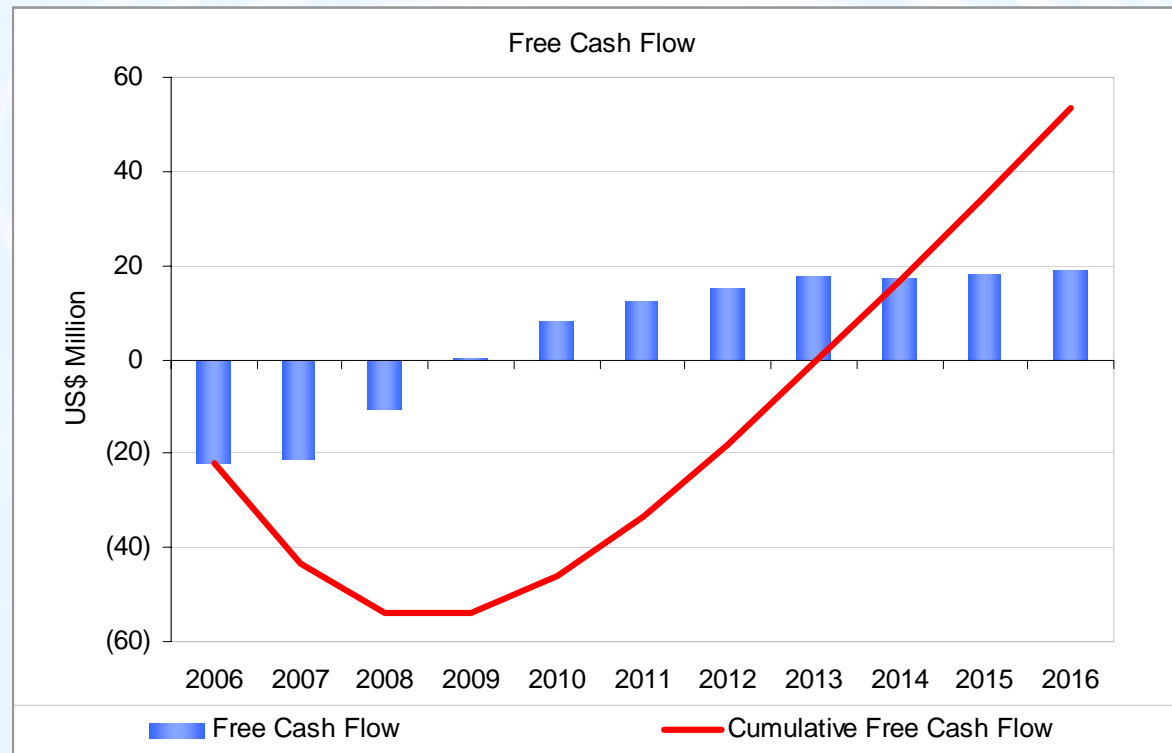
# Profitability Provides Measure of ROI

- Model enabled various market and roll-out scenarios
  - Allowed impact of including or excluding groups of cells to be seen
  - ROI for individual sites or cells not examined but model provides necessary inputs for such an exercise



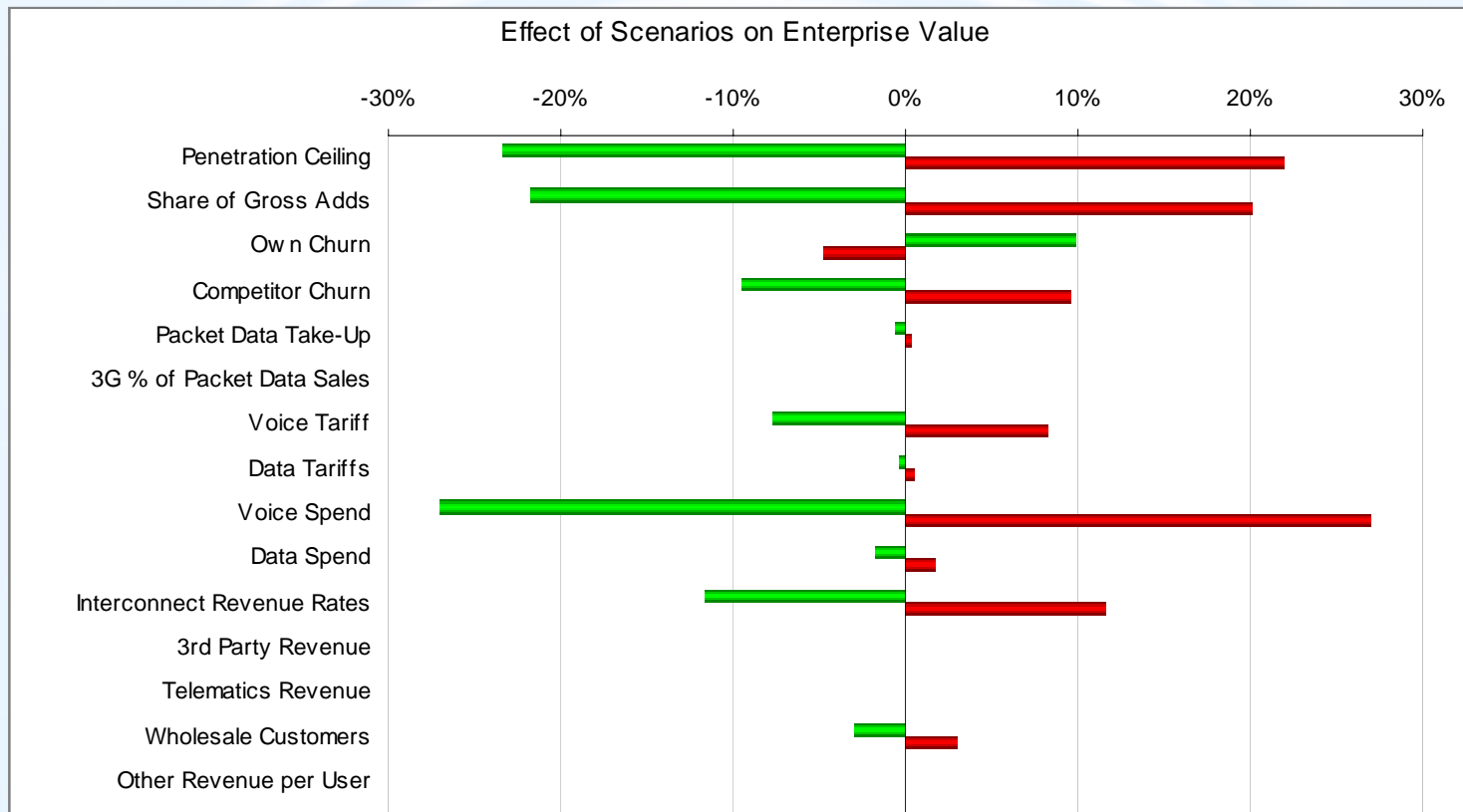
# Cash Flow and Peak Funding

- For most operators, peak funding requirement is key factor
  - Different roll-out strategies can have a large impact on capital needed but also on long term market share and profitability



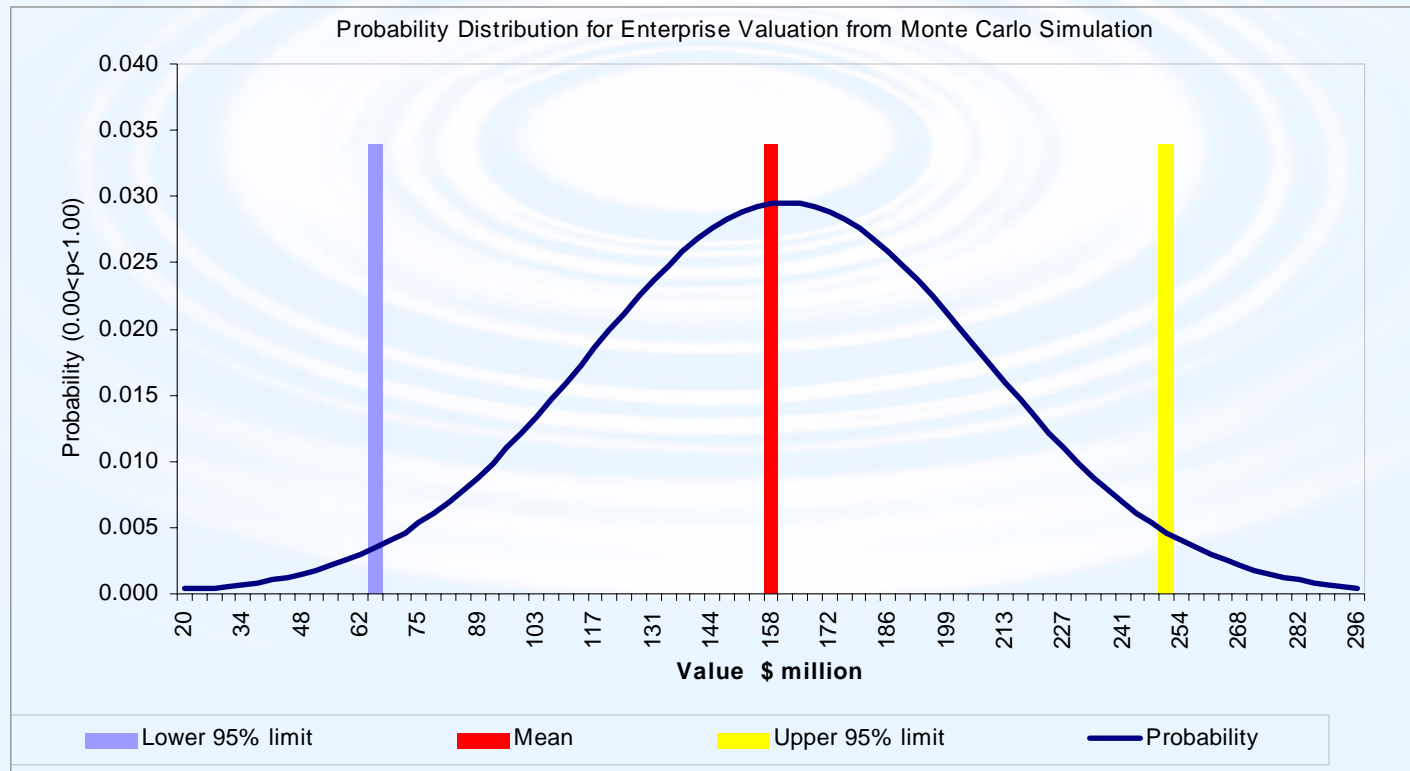
# Sensitivity to Market Assumptions

- Model enables sensitivity to key market assumptions to be evaluated (here for  $\pm 10\%$  change in individual variables)
  - Provides reassurance in case of major unknowns)



# Monte Carlo Modelling

- Monte Carlo modelling provides realistic view of 'best' and 'worst' case scenarios given variation in all key variables
  - e.g. low subscriber growth will lower revenue and costs



# Conclusions

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- Different technologies have strengths and weaknesses
  - but equipment pricing is not the main issue
- Main cost factors depending on local conditions
  - site construction, power and air-conditioning, transmission
  - high efficiency PA will result in significant cost savings
- ROI at cell-site level can be a useful tool
  - but need to ensure modelling takes all costs into account
- ROI planning at business plan level is essential
  - can be used investigate various scenarios
- Subscribers and ARPU are most difficult to identify
  - modelling of sensitivities will ensure business plan is robust

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# Thank you!

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References:  
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