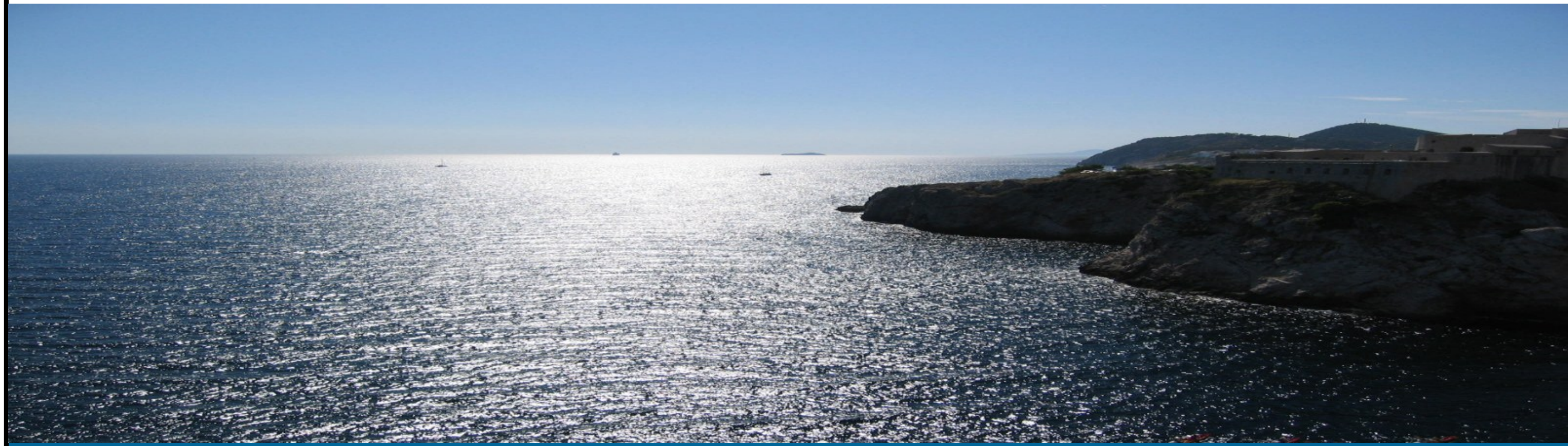


Economic Aspects and Costing of NGNs

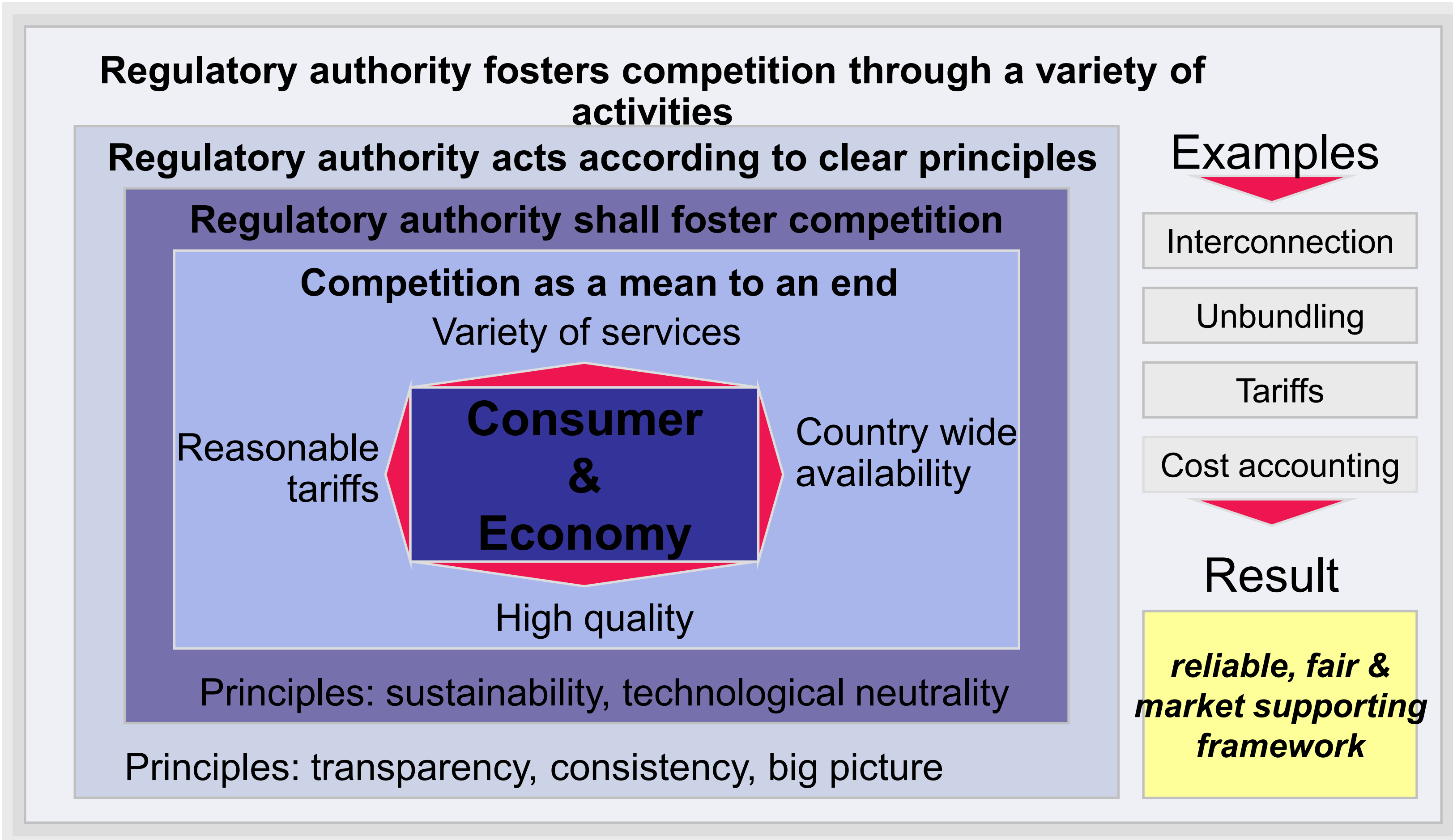
Cotonou, Benin 8-9 May 2012

Agenda

- Cost modelling purpose and concepts
- The impact of NGN on cost modelling
- Key areas of discussion – NGN cost estimates
- Recommendations

Cost modeling purpose and concepts

Cost Modelling Happens within a strategic context



Source: ITU

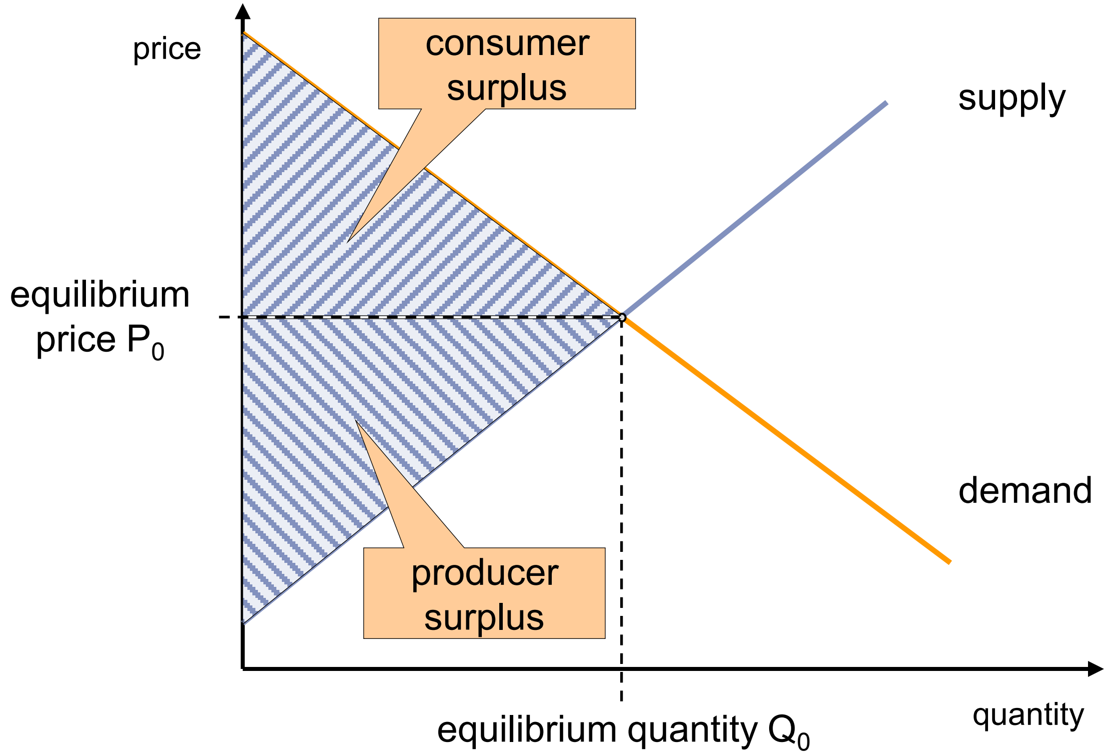
Development of service cost estimates is a means to an end – to facilitate development of competition in a sector characterised by large investments, scale effects and barriers to entry.

Cost Modelling Purpose

- Cost = resource quantity (labour, capital) * price
- The valuation of the price component depends on the purpose of cost accounting!
- Aim is to encourage economically efficient investment and sustainable competition to promote the long term interests of end users.
- Cost accounting can be utilised for different – often incompatible – purposes:
  - Efficient use of existing infrastructure
  - Investment in new infrastructure by incumbents and new entrants
  - Regulation of access services is required where there is potential market failure
  - Without infrastructure based competition - ongoing regulation will be necessary.

Development of service cost estimates is a means to an end – to facilitate development of competition in a sector characterised by large investments, scale effects and barriers to entry.

Cost Modelling Purpose



Source: RTR

Competition:

- Maximisation of the total surplus.
- Maximisation of welfare.
- Minimisation of input factors.
- Efficient production.

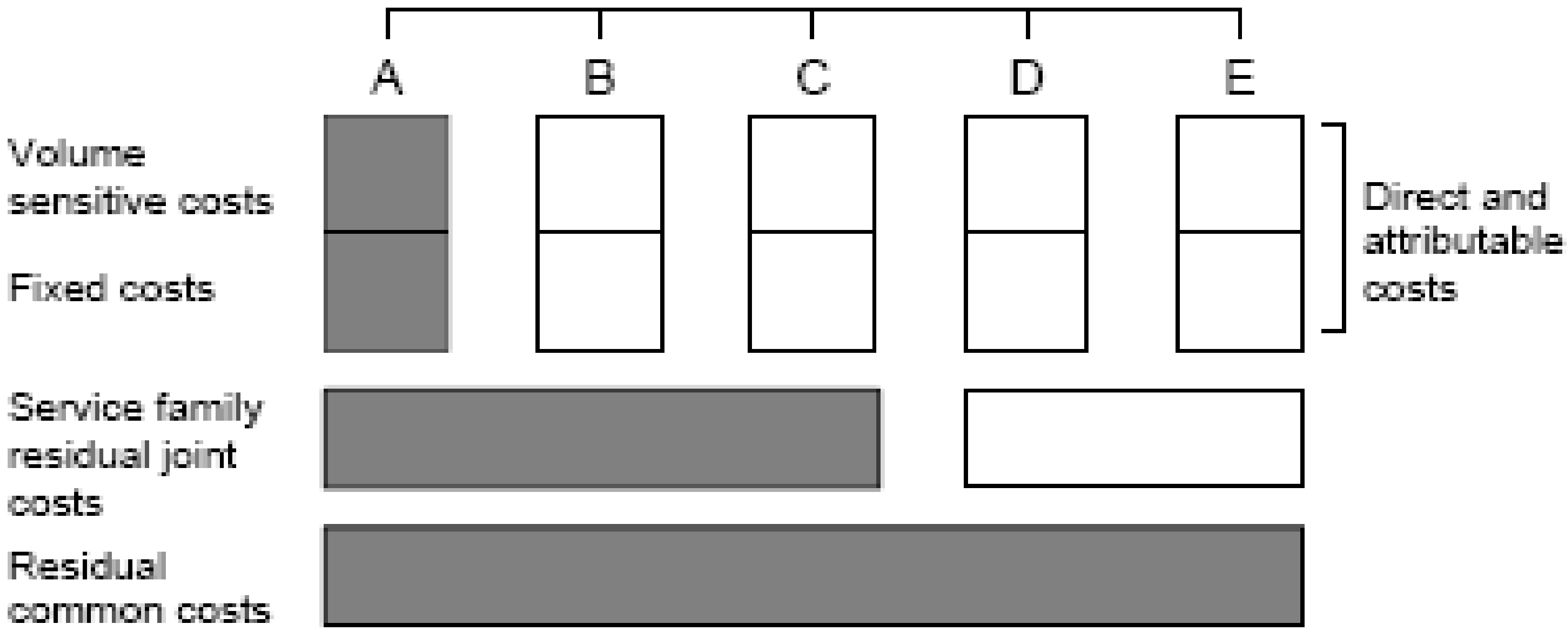
Cost models aim to emulate the outcome of a fully efficient market and the efficient allocation of resources that such markets produce.

Cost Modelling Concepts

- Variable cost - Component of the total cost whose magnitude changes to some degree when output changes. In the long run these costs include investment costs.
- Fixed cost - Cost which must be incurred if any non-zero quantity is supplied. Even in the long run fixed costs do not become (volume) variable.
- Sunk cost - Outlay that is committed for some considerable period of time. Within this period (maybe of indeterminate duration) the firm cannot withdraw its commitment
  - Economists define the long run implicitly in terms of sunk cost, not as some fixed time interval,
    but as the shortest period of time necessary for all the current sunk cost become variable
- Marginal cost (MC): Cost caused by the provisioning of one additional unit of service.

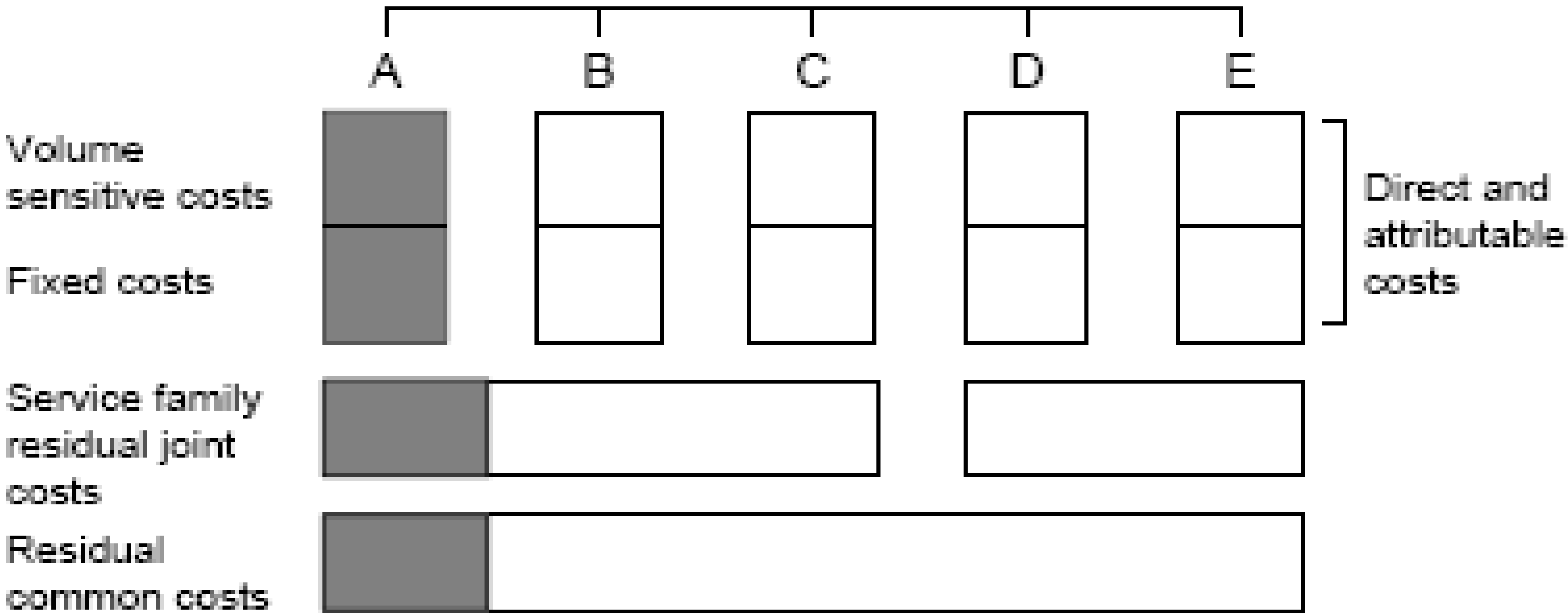
These cost modelling concepts are important in both traditional and NGN cost modelling exercises.

Cost Methodologies – Stand-alone Costs



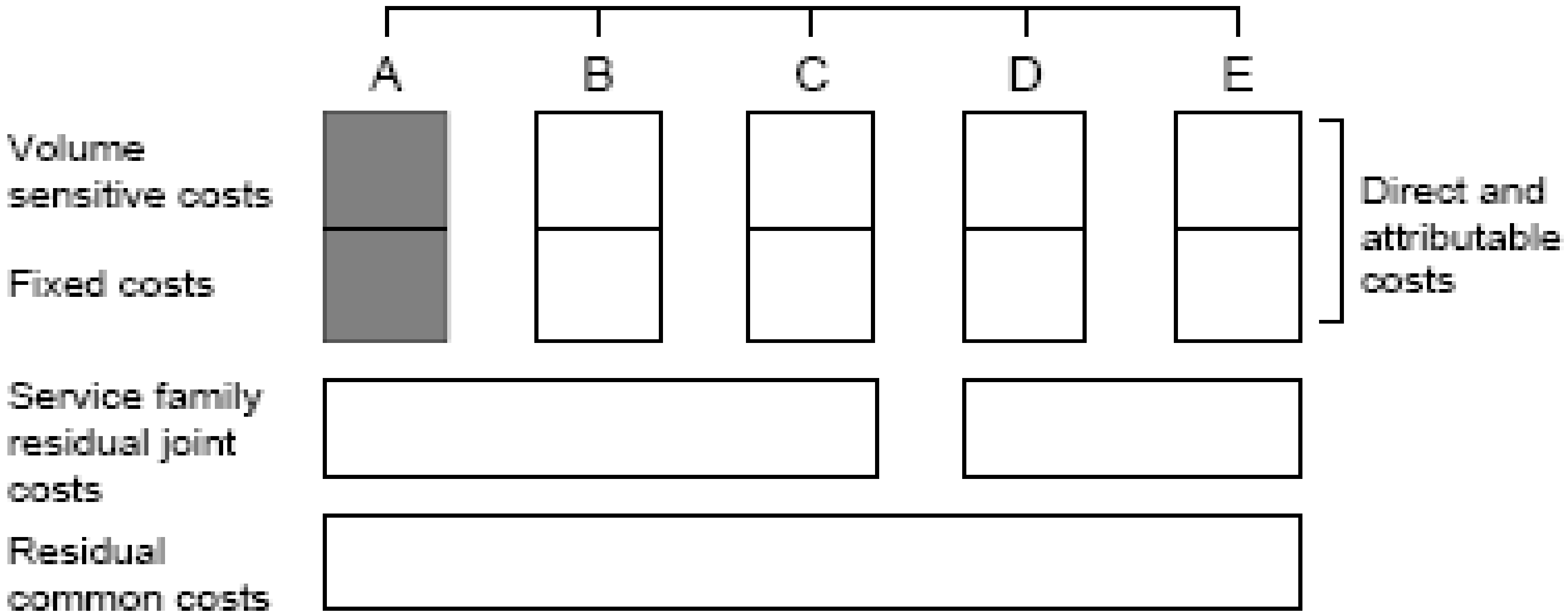
With stand-alone costs (SAC) all joint and common costs get allocated to a single service i.e. the assumption is that the regulated company produces a single service.

Costing Methodologies – Fully Allocated Cost



With fully allocated costs (FAC) all costs get allocated to all services. This concept is often used in top-down models.

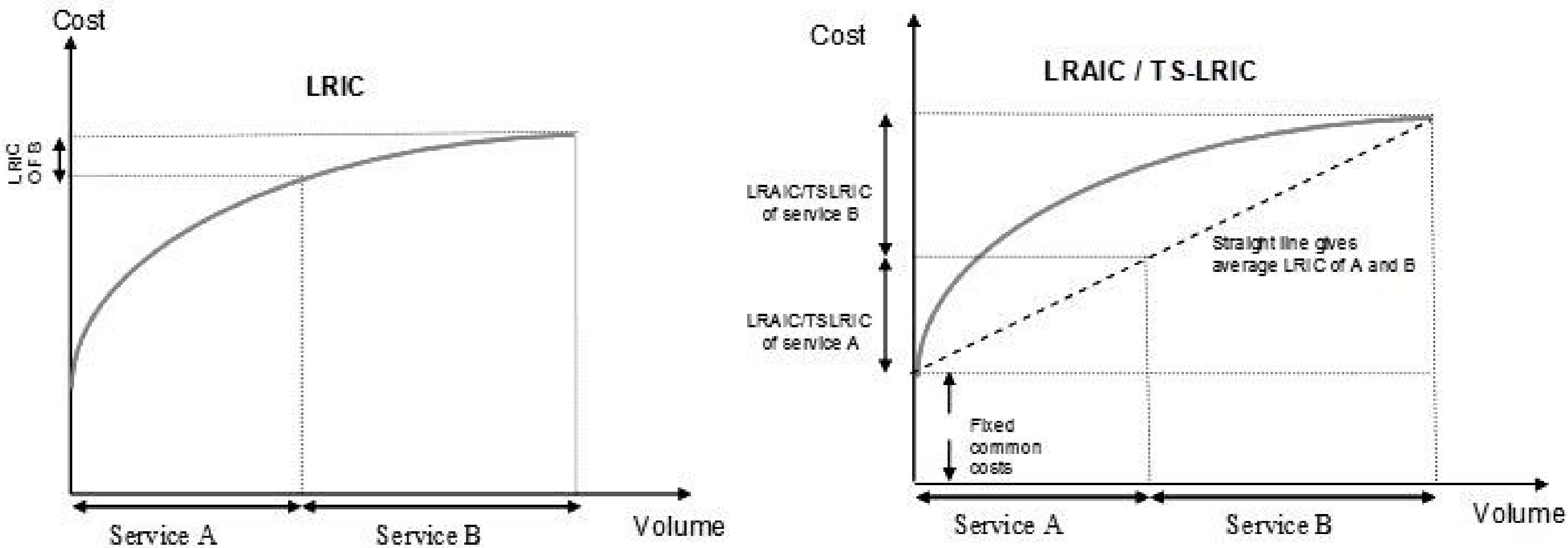
Costing Methodologies – Incremental Costs



With incremental costs only variable costs and service-specific fixed costs get allocated to services. If joint and common costs get allocated through mark-ups, LRIC starts to resemble FAC.

Costing Methodologies – Incremental Costs

Pure LRIC versus LRAC+



Pure LRIC:

- Uses narrow increment definitions (i.e. call termination) resulting in small LRICs
- Excludes fixed common costs
- Does not allocate all service specific costs to increments

There are many variations on LRIC, mostly relating to differences in increment definition and treatment of common costs.

When to use LRIC standards

Pure LRIC	LRIC+
• Includes only costs incremental to the service • Fixed common and joint costs are presumed to be recovered through other services – in particular retail services. • This creates cross-subsidies between services to recover fixed common costs across the service portfolio.	• Includes costs incremental to the services **plus** mark-up for fixed common and joint costs. • Cross-subsidies therefore not needed. • LRIC+ is the appropriate approach in the majority of cases where cost-plus based tariffs are needed.

There are many variations on LRIC and their use will be dictated by specific circumstances.

When to use LRIC standards

Methodology	Application
Pure LRIC	• Vertically integrated providers • Call termination services only
LRIC+/FAC	• Stand-alone wholesale providers • Other wholesale services than termination not prospectively competitive – particularly passive access
Other approaches – stand-alone, retail minus	• Prospectively competitive services • Access to active infrastructure.

There are many variations on LRIC and their use will be dictated by specific circumstances.

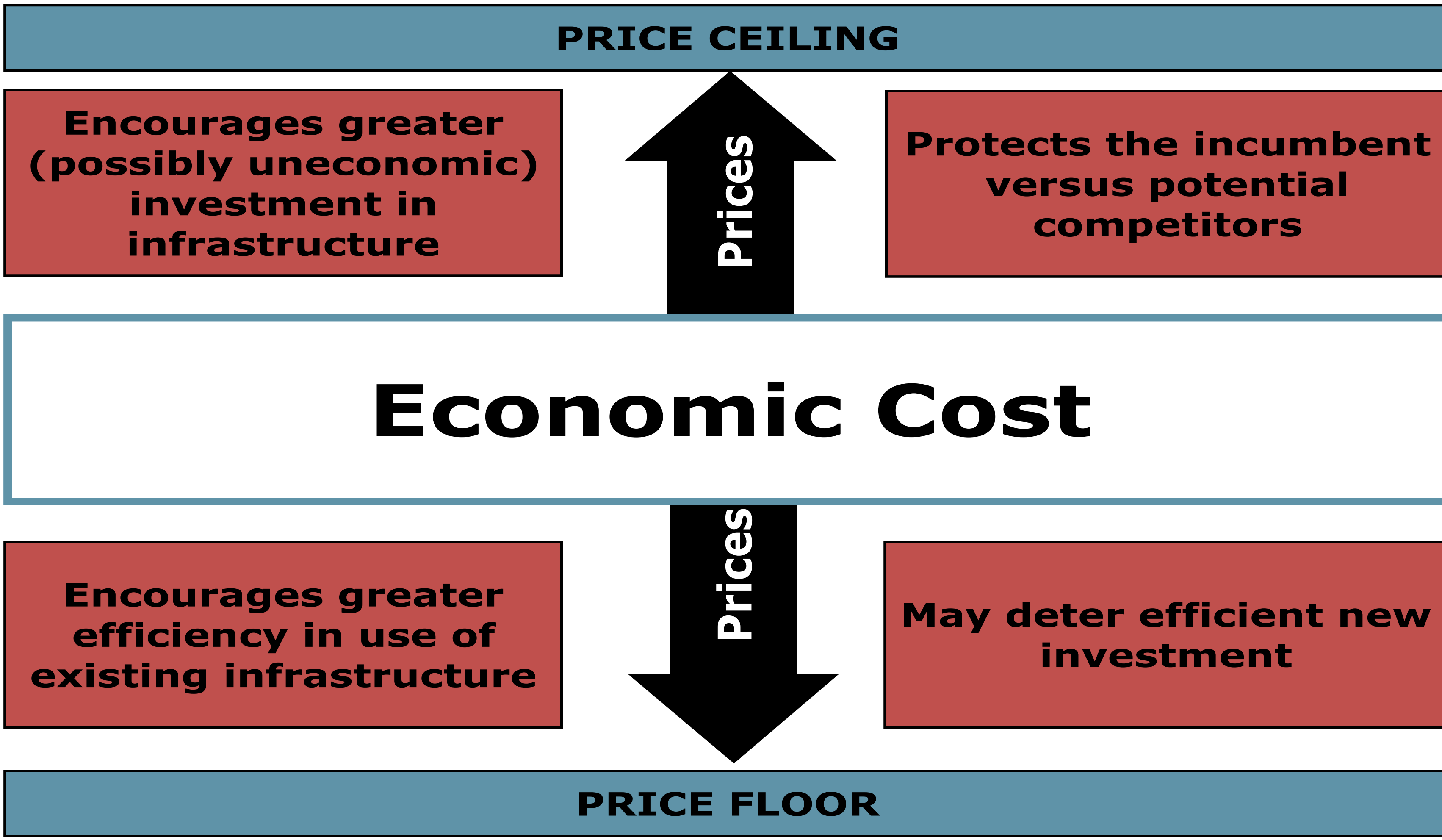
Top-down versus bottom-up models

	Methodology	Benefits	Drawbacks
Top-down	• Begin with historical accounting cost levels and forecast on the basis of observed output / cost relationships	• Helps ensure that relevant historical costs are not omitted • Most straightforward	• Limited forecast accuracy in the presence of significant volume changes / new cost types • Should consider any current inefficiencies
Bottom-up	• Identify granular components of cost and define cost-causal relationships to link the quantity of each of these with output, based on practical and theoretical evidence	• Gives improved understanding of cost drivers • Copes with larger volume fluctuations / new asset types • Does not lock in cost inefficiencies	• May overlook some efficiently incurred costs • Increased complexity
“Hybrid”	• Combine both approaches; develop a bottom-up model which is calibrated to reach the same total cost levels as historical accounting data	• Combines all of the advantages above	• Most complex

Source: OFCOM

For NGN cost models, bottom-up models are currently the preferred solution – the relative immaturity of services and technologies requires forward-looking capabilities.

Balancing access charges



The level of wholesale broadband prices can influence infrastructure investment and competitive entry.

The impact of NGN on cost modeling

What is the rationale behind NGN?

NGN Drivers

Reduce Costs

Typical: 30-40% with NGN.

Achieved through:

- Efficiencies in service creation
- Efficiencies in service distribution
- Automation of service provisioning and maintenance
- Fewer networks and systems carrying more services
- Closure of legacy networks and systems
- Costs are centred in the access and the backhaul

Enable New Services

Innovative services

Interactive multimedia services:

- Video telephony,
- White boarding, …
- Collaborative interactive communication services
- Multimedia
- File and application sharing,
- e-learning
- gaming
- Messaging services (e.g. IM)
- Content delivery (e.g Video) and Push services
- Fight FMS and VoIP (enterprise)

Protect Realm

High Investments required

- Altnets deploying only parts of the NGN architecture
- Dependence on incumbents for access to customers and service enablers
- Interoperability will take some time to become widely available
- Incumbents investing in NGN might benefit from a ‘market reserve’ for a period of time.

NGN drives efficiency gains but also adds uncertainty to forecasts due to the immaturity of some of the business models for new services.

Traditional Cost Modelling

- Separation of access and core networks
  - Volume-based traffic costs and fixed access charges
- Scorched node models:
  - A fixed network architecture with modern equivalent assets (MEA)
- Core network cost allocation via service routing tables
  - Routing tables define network element usage by service
  - Cost volume relationships determined for each network element [CVRs implicitly linear in TD model and routing table, by technical formulae in BU, sometimes complex CVRs in TD model (BT)]
- Separation of Fixed Common and Joint Costs (FCJC)
  - Recovered via a (usually!) relatively small mark-up

There is extensive international experience with cost modelling of services over PSTN and 2G mobile networks – using both top-down and bottom-up models.

NGN Cost Modelling

- Purpose remains the same
  - Regulate access and ensure other operators have access to non-replicable assets
  - Incumbents have SMP by means of their size and because they are the only ones with the ability to create true national NGNs. Also, they have the unique ability to vertically integrate services and have customer data/control
- Need to ensure inter-working is allowed - standards or open interfaces - if SMP operator attempts to restrict others
- Need peering of applications to allow inter-working and not simply network interconnection. This means access to higher-level functionality (IT peering) and access to customer information.

The basic purpose remains the same, but the implementation of existing costing methodologies gives some quite different results.

Model development – approach for mobile services

Stage 1: Capacity Planning

1. Subscriber forecasts

2. Traffic forecasts/Service

Outputs:
- Capacity requirements by year in agreed capacity units (mins, MB etc)

Stage 2: Network Planning

3. Driver analysis (coverage definition and capacity plan)

4. Network dimensioning rules (NGN/2G/3G)

Outputs:
- Network design
- Network dimensioning
- Equipment planning

Stage 3: Network Costing

5. Capital costs
   - ROCE (WACC)
   - Economic Depr.

6. Operational expenditures

Outputs:
- Total network capital costs
- Total network OPEX

Stage 4: LRIC estimates

7. Unit costs
   - Routing factors
   - Service usage

8. LRIC estimates (with and w/o Mark-ups)

Outputs:
- Unit service costs
- Scenarios/sensitivities based on various LRIC definitions

The steps to develop a bottom-up LRIC model for mobile services are presented in the above graphic.

Model development –approach for fixed services

Stage 1: Capacity Planning

1 Subscriber forecasts

2 Traffic forecasts/ service

Outputs:
- Capacity requirements by year in agreed capacity units (mins, MB, lines etc)

Stage 2: Network Planning

3 Driver analysis (access definition and capacity plan)

4 Network dimensioning rules (NGN/NGA)

Outputs:
- Network design
- Network dimensioning
- Equipment planning

Stage 3: Network Costing

5 Capital costs
- ROCE (WACC)
- Economic Depr.

6 Operational expenditures

Outputs:
- Total network capital costs
- Total network OPEX

Stage 4: LRIC estimates

7 Unit costs
- Routing factors
- Service usage

8 LRIC estimates (with and w/o Mark-ups)

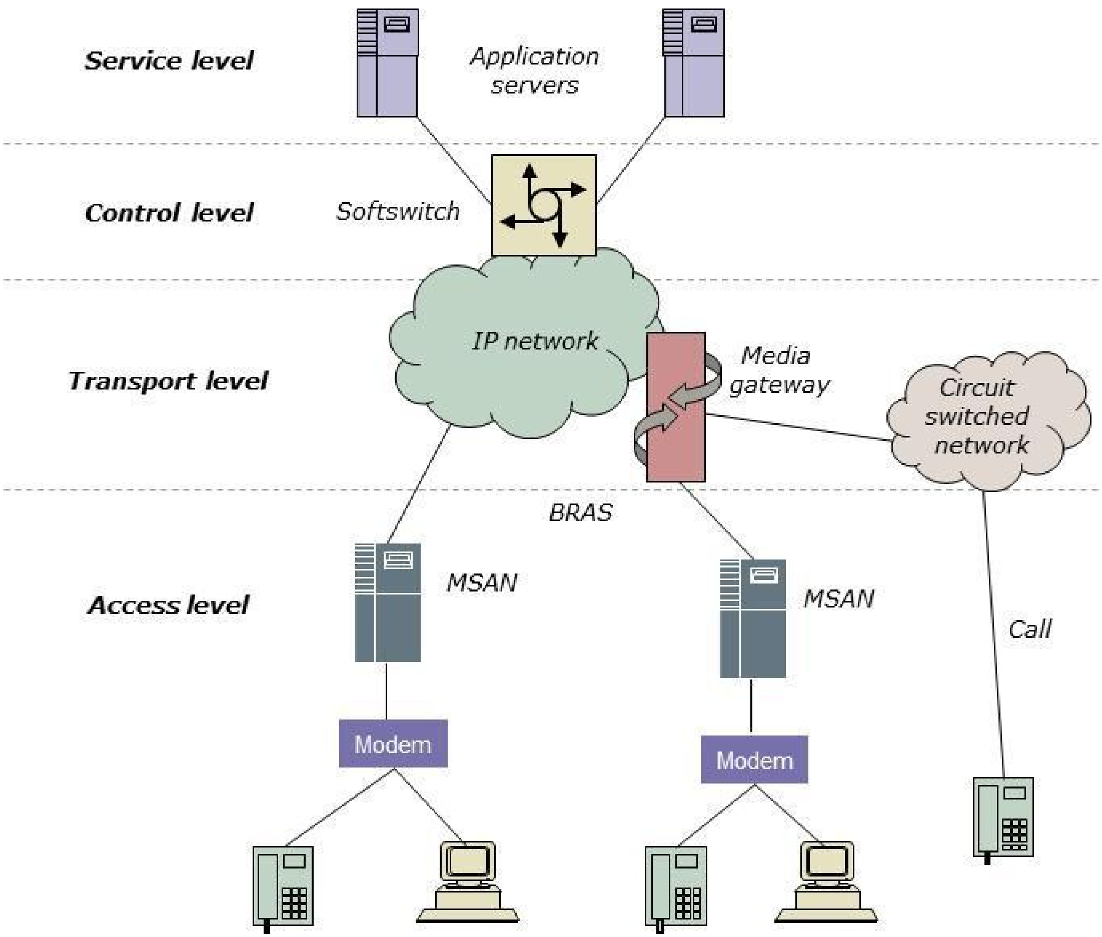
Outputs:
- Unit service costs
- Scenarios/sensitiviti es based on various LRIC definitions

The steps to develop a bottom-up LRIC model for fixed services are presented in the above graphic.

What is NGN – fixed core network

Generic NGN infrastructure

- A multi-layer architecture
  - Services
  - Control
  - Transport
  - Access
- Session controls and switching functions are separated
- Traditional switches are replaced by media gateways and soft switches.



The basic network structure for an NGN core model based on a simple 'all IP' approach, potentially augmented with some traditional TDM networks.

What is NGN – fixed core network

IP Core Network Design

- Single IP core network, interconnected with an optical fibre-based SDH transmission network
- Network hierarchy in the model will principally consist of:
  - Core Routers
  - Edge Routers
  - Aggregation Routers
  - MSANs including telephony and xDSL cards
  - Media Gateways to provide interconnection with other operators
  - Softswitches
- The Aggregation Routers, Edge Routers and Core Routers are assumed to be installed in pairs for resilience.

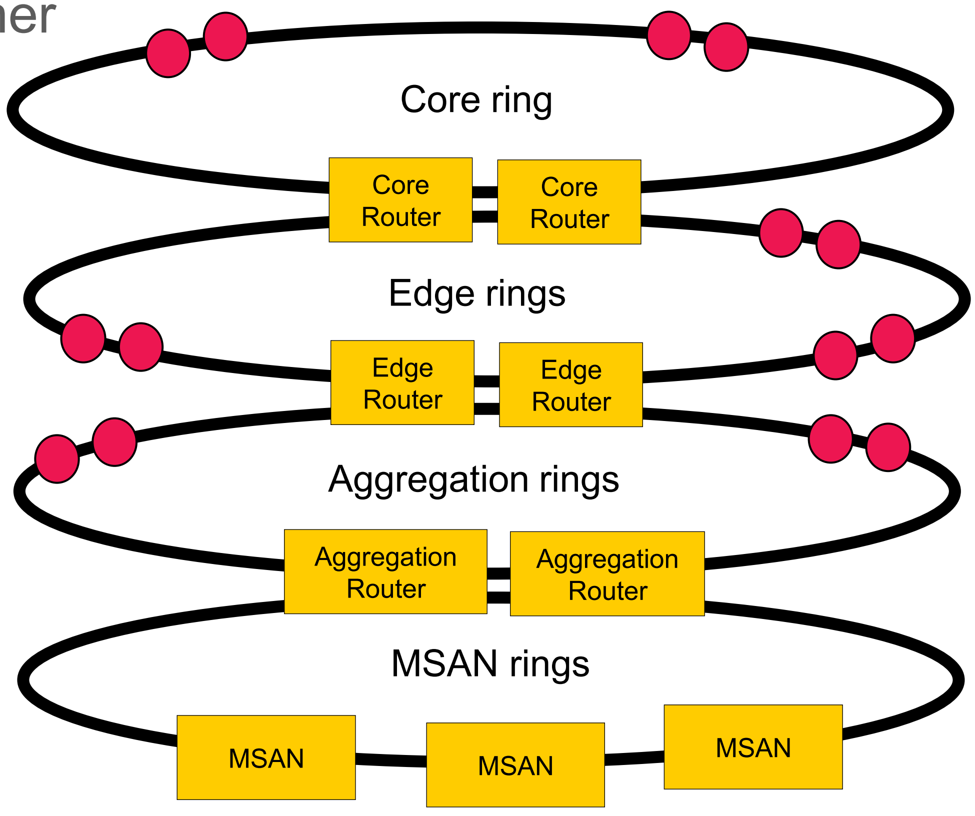
The basic network structure for an NGN core model based on a simple 'all IP' approach, potentially augmented with some traditional TDM networks.

What is NGN – fixed core network

IP Core Network Design

- Routers will be connected together into 4 layers of fibre rings.
  - Local MSAN rings, which connect MSANs to their parent router
  - Local aggregation rings which connect together aggregation routers into logical rings.
  - Regional edge rings which connect together edge routers into logical rings.
  - National core rings which connect together core routers into a logical ring.

IP Network topology



The models typically assume ring structures for redundancy and efficiency although star structures have also been used.

What is NGN – fixed core network

Core Network Dimensioning

- Line cards and related parts of MSANs will be dimensioned based on the number of subscribers.
- Network cards of MSANs, higher level routers and (if modelled) SDH transmission equipment will be dimensioned based on expected traffic in the busy hour:
  - Covers all services – on-net calls, outgoing calls, incoming calls, transit calls, internet access, IPTV, leased lines, data services
  - Busy hour traffic of all services will be covered to common units (like Mbyte or Mbps) and added together
  - Expected traffic in busy hour will be multiplied with routing factor
  - Result will be the busy hour traffic demand per network element
- Softswitches will be dimensioned based on busy hour traffic of call services and number of subscribers of telephony services.
- Cables, ducts, joints, manholes etc. will be dimensioned based on network topology (number and length of connections between nodes) as well as trenches, which will be split by area type (urban, suburban, rural) to allow for more detailed planning.

Generally speaking, a higher proportion of costs will not vary with traffic volumes in NGN versus PSTN>

What is NGN – fixed core network

NGN Cost Models – new challenges

- Demand – levels and patterns uncertain for both new and innovative services and services in decline
- Busy hour – unknown and changing for data, video and interactive services
  - Delivery of QoS
  - Issues associated with net neutrality
  - Will best efforts be acceptable to business customers?
- Pure LRIC costs will be even lower – increments lower
- Changed policies for key functions – Interconnect might become BAK, more like the internet interconnection between peers
- Routing tables to be determined but likely simple
- Network topology - key uncertainty – capacity of equipment and equipment relationships
- Asset costs and economic lives – emerging and changing.

One of the key areas of uncertainty relates to the development of demand, sometimes for services that do not yet exist.

What is NGN – fixed core network

General considerations

- NGN will reduce costs in long run
- Past investments, reasonably incurred by efficient operators, must be recovered. Q: how to deal with write-downs?
- If the traditional PSTN network is considered as sunk assets and was fully paid for by cash then its costs might be ignored. Dangers: investors do not get a return
- If NGN “simply” makes “old PSTN” a stranded asset, it is still a real investment cost to recover
   - NGN costing must consider migration costs. Very hard to estimate
   - Using NGN as the MEA in a BU model implies that NRAs are smarter than the incumbents – but if it was right to deploy NGN, they would surely have used it. Can we claim to know better?
- If capabilities were equal, a commercial business would continue to use a service-able PTSN switch and avoid the capex on NGN, [until NPV of (NGN capex + its opex) < (NPV of PSTN opex)]. Even this “simple” decision is tilted by other factors such as new services features and technology risk. These are very hard to model and factor in

The assumptions in an NGN cost model cannot be seen in isolation from reality on the ground.

Key areas of discussion – NGN cost estimates

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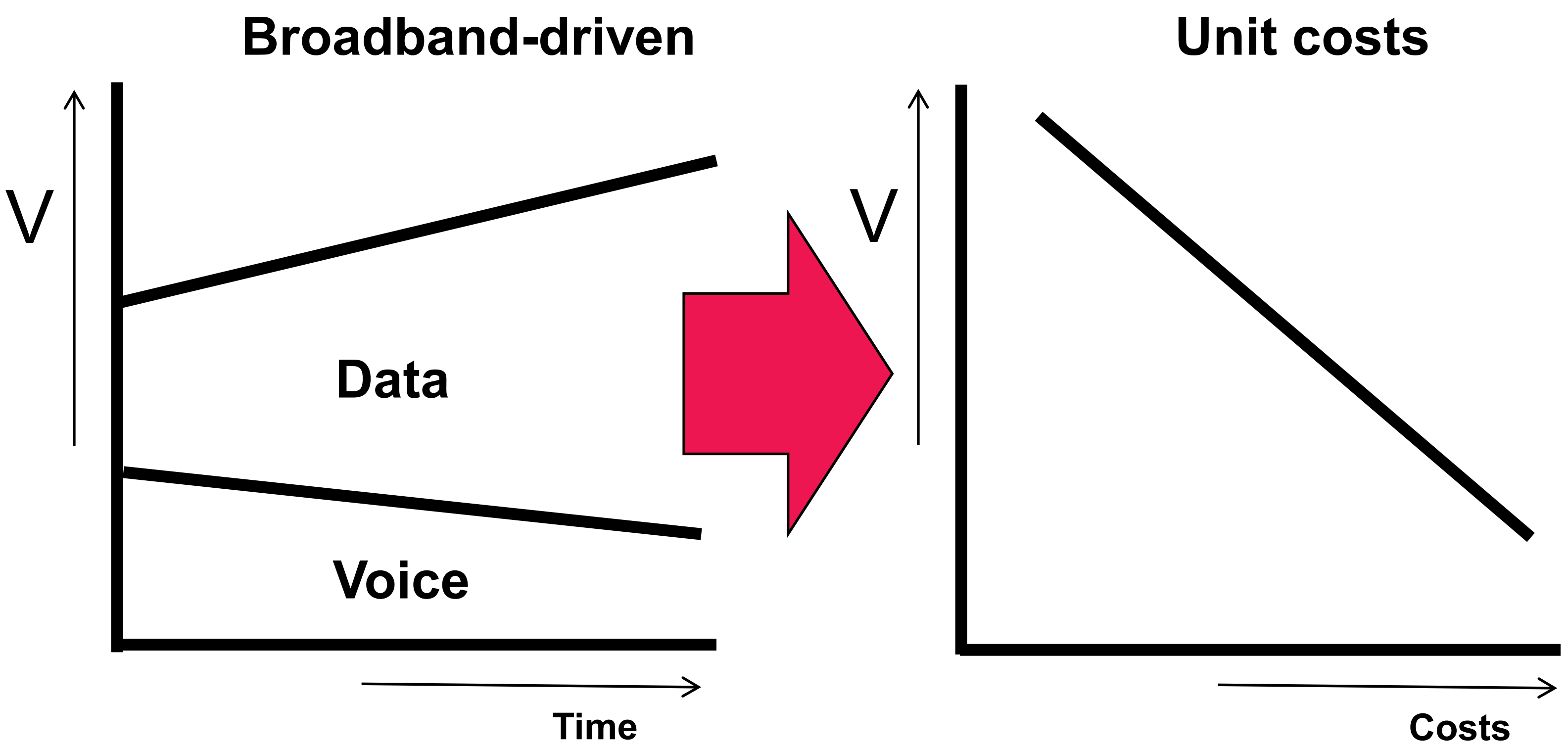
Key areas of discussion – Traffic volumes

- According to Ofcom in Q1 2010, UK subscribers made a total of 35,000 million minutes in 3 months, say 12 000 million minutes per month.
- With 10ms packets the bit rate for voice on NGN is 130kbit/s or 16 kBytes/s or 1MByte/minute.
- So total UK voice traffic is 12 000 million MB per month =12 million GB per month.
- Double the figures for both directions of the media channel assuming no voice detection = 24 million GB per month.
- There are 19 million broadband subscribers (plus business use). Average usage is at least 10 GB/month possibly much higher.
- At 10GB/month, residential broadband traffic is 10*19= 190GB/month, 8 times more than voice.

One of the key areas of interest is often voice call termination. However, voice is not the reason to build NGNs and voice is expected to make up only a small portion of total NGN traffic.



- Volume increases relating to data traffic drive scale effects on any network. On NGN, which is more efficient than PSTN, this effect gets even stronger.

Key question for policy makers – is it fair on regulated firms that do not use NGNs to be regulated on this basis?

Key areas of discussion

Treatment of legacy costs

- MEA costs (which might be NGN) could be used. If the new MEA costs are simply imposed, past investments would not be recovered - setting an economic precedent.
  - NRAs might then be acting ultra vires and/or it could discourage future investment as regulatory risk of repeating this would remain
- The use of MEAs and NGN costing must be used with great care. Devaluation in assets (CCA and other formulae to allow asset investment recovery) will increase calculated-costs - creating an short-term cost increase or “hump”

If operators are not allowed to recover historic investments, incentives to invest in new infrastructure get reduced.

Key areas of discussion – Rate of return

- One of the key areas of interest relates to the reasonable rate of return allowable on new investments in NGA and NGN infrastructure.
- A key difference relates to the asymmetry of risk:
  - Access providers need to make upfront investments when demand for services (and sometimes even the definition of these services) is not yet clear.
  - Access seekers can wait for demand to materialise and then decide to obtain access services from the access provider.

Key question for policy makers – how to ensure that access providers are rewarded for this risk?

Key areas of discussion – Rate of return

NRAs should estimate investment risk *inter alia* by taking into account the following factors of uncertainty:

- Uncertainty relating to retail and wholesale demand;
- Uncertainty relating to the costs of deployment, civil engineering works and managerial execution;
- Uncertainty relating to technological progress;
- Uncertainty relating to market dynamics and the evolving competitive situation, such as the degree of infrastructure-based and/or cable competition; and
- Macro-economic uncertainty.

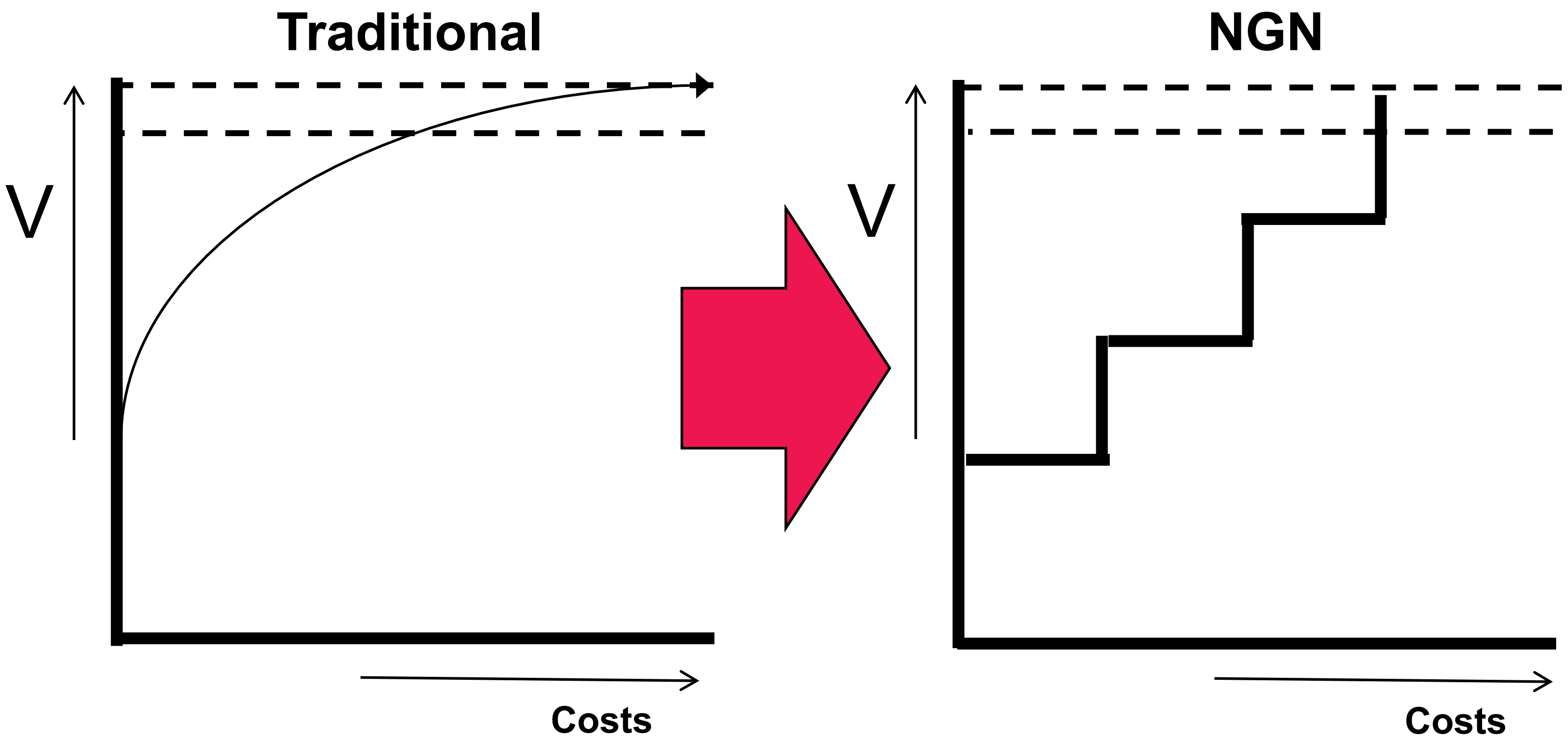
These factors may change over time, in particular due to the progressive increase of retail and wholesale demand met. NRAs should therefore review the situation at regular intervals and adjust the risk premium over time.

Different risk profiles require different returns

	Narrowband markets	Narrowband Broadband	NGN Broadband (>25 MB)
Demand	Predictable and in decline	Predictable and growing	Nascent and un-predictable
Service innovation	Limited (Mature)	Medium	High
Diffusion	Mature	❖ Mature – advanced markets ❖ Emerging – emerging markets	Emerging
Investment	Largely sunk	'Sweating the assets'	Significant – new networks required

Services over traditional PSTN services are less risky than VDSL services which are in turn less risky than FTTH services.

Key areas of discussion – impact of small increments



- One of the effects of falling voice volumes as a percentage of the total is that if small voice related increments are used to set interconnection rates, LRICs can be close to 0 due to the large capacities of network elements in relation to the increments.

The use of, for example, Pure LRIC can have the above effect. Question – if you were running a commercial business, would you set tariffs in this way?

Recommendations

Recommendations for regulators

- The traditional economic approaches to costing still apply.
- However, NGN networks have much higher fixed common costs than traditional PSTN networks.
- As a consequence allocation of fixed common costs to individual services becomes more contentious and likely results in regulatory error.
- Regulators can address this by:
    - Moving away from service specific regulation
    - Developing forward-looking bottom-up LRIC cost models based on best-practice principles
    - Ensuring rate of returns are based on appropriate risk profiles.
    - Frequently review the market and adapt remedies where needed.

The process of economic analysis becomes more frequent as a consequence of rapid market change.

Any questions?