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

**Cost Modelling Purpose**

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

- **Source:** RTR

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

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

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

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Application</th>
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<tbody>
<tr>
<td>Pure LRIC</td>
<td>• Vertically integrated providers</td>
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<td></td>
<td>• Call termination services only</td>
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<tr>
<td>LRIC+/FAC</td>
<td>• Stand-alone wholesale providers</td>
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<tr>
<td></td>
<td>• Other wholesale services than termination not prospectively competitive</td>
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<td></td>
<td>– particularly passive access</td>
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<td>Other approaches</td>
<td>• Prospectively competitive services</td>
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<td>– stand-alone,</td>
<td>• Access to active infrastructure.</td>
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<td>retail minus</td>
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There are many variations on LRIC and their use will be dictated by specific circumstances.
For NGN cost models, bottom-up models are currently the preferred solution – the relative immaturity of services and technologies requires forward-looking capabilities.
The level of wholesale broadband prices can influence infrastructure investment and competitive entry.

Balancing access charges

PRICE CEILING

Encourages greater (possibly uneconomic) investment in infrastructure

Protects the incumbent versus potential competitors

PRIICE FLOOR

Encourages greater efficiency in use of existing infrastructure

May deter efficient new investment

Economic Cost
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

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

Stage 1: Capacity Planning
1. Subscriber forecasts
2. Traffic forecasts/Service

Stage 2: Network Planning
3. Driver analysis (coverage definition and capacity plan)
4. Network dimensioning rules (NGN/2G/3G)

Stage 3: Network Costing
5. Capital costs
   - ROCE (WACC)
   - Economic Depr.
6. Operational expenditures

Stage 4: LRIC estimates
7. Unit costs
   - Routing factors
   - Service usage
8. LRIC estimates (with and w/o Markups)

Outputs:
- Capacity requirements by year in agreed capacity units (mins, MB etc)
- Network design
- Network dimensioning
- Equipment planning
- Total network capital costs
- Total network OPEX
- Unit service costs
- Scenarios/sensitivities 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.
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.
**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.

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

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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>
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.
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, \[\text{until NPV of (NGN capex + its opex)} < (\text{NPV of PSTN opex}) \]. 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
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.
Key areas of discussion – Traffic volumes

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?
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.
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?
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

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<tr>
<th></th>
<th>Narrowband markets</th>
<th>Narrowband Broadband</th>
<th>NGN Broadband (&gt;25 MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand</td>
<td>Predictable and in decline</td>
<td>Predictable and growing</td>
<td>Nascent and unpredictable</td>
</tr>
<tr>
<td>Service innovation</td>
<td>Limited (Mature)</td>
<td>Medium</td>
<td>High</td>
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<tr>
<td>Diffusion</td>
<td>Mature</td>
<td>v Mature – advanced markets</td>
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<td>v Emerging – emerging markets</td>
<td>Emerging</td>
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<tr>
<td>Investment</td>
<td>Largely sunk</td>
<td>‘Sweating the assets’</td>
<td>Significant – new networks required</td>
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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?