

ITU-T STUDY GROUP 3

Mini-Workshop

GENEVA, 26 MAY 2014

**Towards an ITU cost model for international mobile
roaming for NRAs**

Simon Forge

Agenda

- The role of cost modeling
- Types of cost models
- Types of cost model in MNO accounting
- An example – the Roaming cost model
- Introduction – the roaming issue today and the European experience
- Development of cost model – the basis of roaming costs in the MNO
- Use cases for roaming
- Gathering the information for the cost model: Surveying MNOs with a questionnaire to gather costing information on roaming

- To understand the sources of costs and their justification
- Estimate investments needed and expected running costs to maintain and operate a business or service, for example based on mobile telecoms
- May be used in specific circumstances – for instance to understand actual costs when a monopoly operates, as against the prices charged to retail customers or to other operators for wholesale purchase of services
- Sensitivity analysis on selected parameters – eg coverage

Types of cost models: past/future

- Emphasis on expenditure and operational business costs for normal company reporting – past performance and future expectations
- Investment models – future - short term/long-term, with specific cases:-
 - Long term built-infrastructure investments (eg Smart Grids – Ofcom)
 - RDI long term programmes (eg Horizons 2020, Euro 88 Bn)
- Socio-economic cost-benefit analysis, CBA - future (eg EU KETs long term)
 - Specific types of future ventures & projects - high risk ventures, telecoms, utilities, software development, financial engineering, etc
 - Regulatory assessments – may use specific concepts – past & future
- IPR investments – specific models (eg future trading & legal assertion cost)
- Forensic accounting – investigative tracing analysis of existing and past operational costs, sometimes for legislative / legal processes, to assess if declared charges reflect the reality of the costs (eg security services, SMP enquiries, tracking criminal activity)

We use a combination of the last and the first

Types of cost models

- Generally estimate true cost for immediate investments and running costs to maintain and operate
 - **C**apital expenditure, **CAPEX** (infrastructure purchase and build, equipment procurement, cable wayleaves, site purchases/leases)
 - Running or **O**perational expenditure – **OPEX** – salaries, site rents, electricity, maintenance, back-haul leased line monthly charges, software licence renewals, back-up data storage rent, etc, etc
- Refinements
 - Constructive Cost Model (CoCoMo)** – for **software development** originally - more applicable to future networks as they will be SDNs (software defined) and NFV (virtual functions)
 - Modifications for currency movements and economic turbulence:** - eg *NPV from DCF*
Simplest : Discounted Cash Flow, DCF - Value of a network, upgrade project or venture using the time value of money spent on CAPEX and OPEX to give the net present value – NPV
All future cash flows are estimated and discounted to give their present values (PVs)

LRAIC - *Long-Run Average Incremental Cost model* – gives an overview of costs

- LRAIC - **all** elements of the costs of services provided within a cost increment.
- In mobile telecoms, LRAIC may be used to set interconnection charges
- Costs of the network providing this wider group of services are then **divided by all the traffic to produce the average incremental cost**

• **Long run** implies that all inputs are considered as variables, including capex for one service or group of services – eg for variations in equipment capex as its market price changes with volume (eg LTE eNodeB's)

• **Incremental cost** is the cost to provide an extra unit of output: eg for interconnection, local calls or premium rate calls. *Increments* are thus the whole **group of services** using the RAN and Core network, including those provided by the subject MNO and those of all interconnecting operators.

LRIC - *Long-Run Incremental Cost model* – a particular cost estimate

• LRIC - used in telecoms regulation –for cost elements of price paid by competitors for services provided by an operator, especially if significant market power (SMP) ie incumbent/ monopoly

• LRIC in contrast to LRAIC includes cost effects of adding / removing a **defined quantity of traffic**, or **addition / removal of a sub-set** of services, eg local calls, within the broader LRAIC increment

Terms of Reference: Develop cost model for IMR

- Analyse current roaming situation
- Analyse cost base in MNO, with analysis of retail and wholesale pricing
- Examine models of empirical costs for roaming
- Assess requirements for model across voice, data, SMS, for all MNO types and technologies
- Formulate the first principles of a cost model
- Develop cost model that is MNO neutral
- For data gathering by MNOs, develop method to enable the collection and analysis of the underlying operator's cost structure as well as retail and wholesale pricing data for roaming by MNOs via a questionnaire
- Offer guidelines for implementation of model for NRAs using a survey of MNOs.

Does a cross-region call
(eg in the EU) really cost
so much more than a
DOMESTIC national call
for voice or data?

Domestic Charge

- calling party pays

Roaming Charge

- Up to 4 times domestic or more
- BOTH calling and called party pay

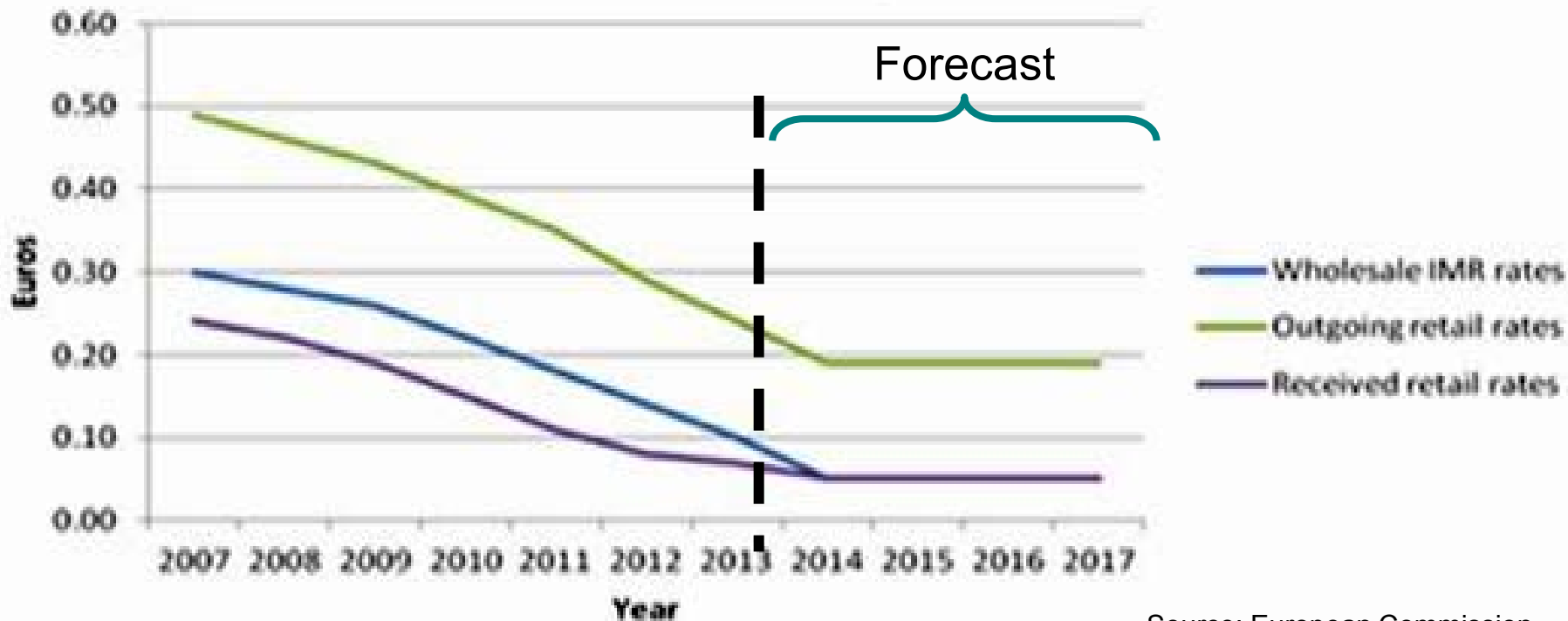
European Union roaming proposals SEPT 2013

For intra - EU roaming, EC proposals (Sept. 2013):-

- Remove incoming call payments from 01 July 2014
- Outbound, mobile-to-mobile calls capped at €0.19/minute + VAT
- Target - phase out roaming charges altogether in 2016
- BUT MNOs largely free of European roaming regulation, if they extend their domestic bundles from 2014 so that by 2018 at latest, customers charged at domestic rates for voice and data
- MNOs have a choice, either:-
 - 1) Offer plans that apply everywhere in the European Union ("roam like at home"), with prices driven by domestic competition,
or
 - 2) Permit customers to "decouple": i.e. opt for a separate roaming provider who offers cheaper rates (without buying new SIM card).

EU Roaming – a history of moving towards cost-oriented pricing for International Mobile Roaming (IMR)

EU: Glide path, wholesale and retail roaming voice charges



Source: European Commission

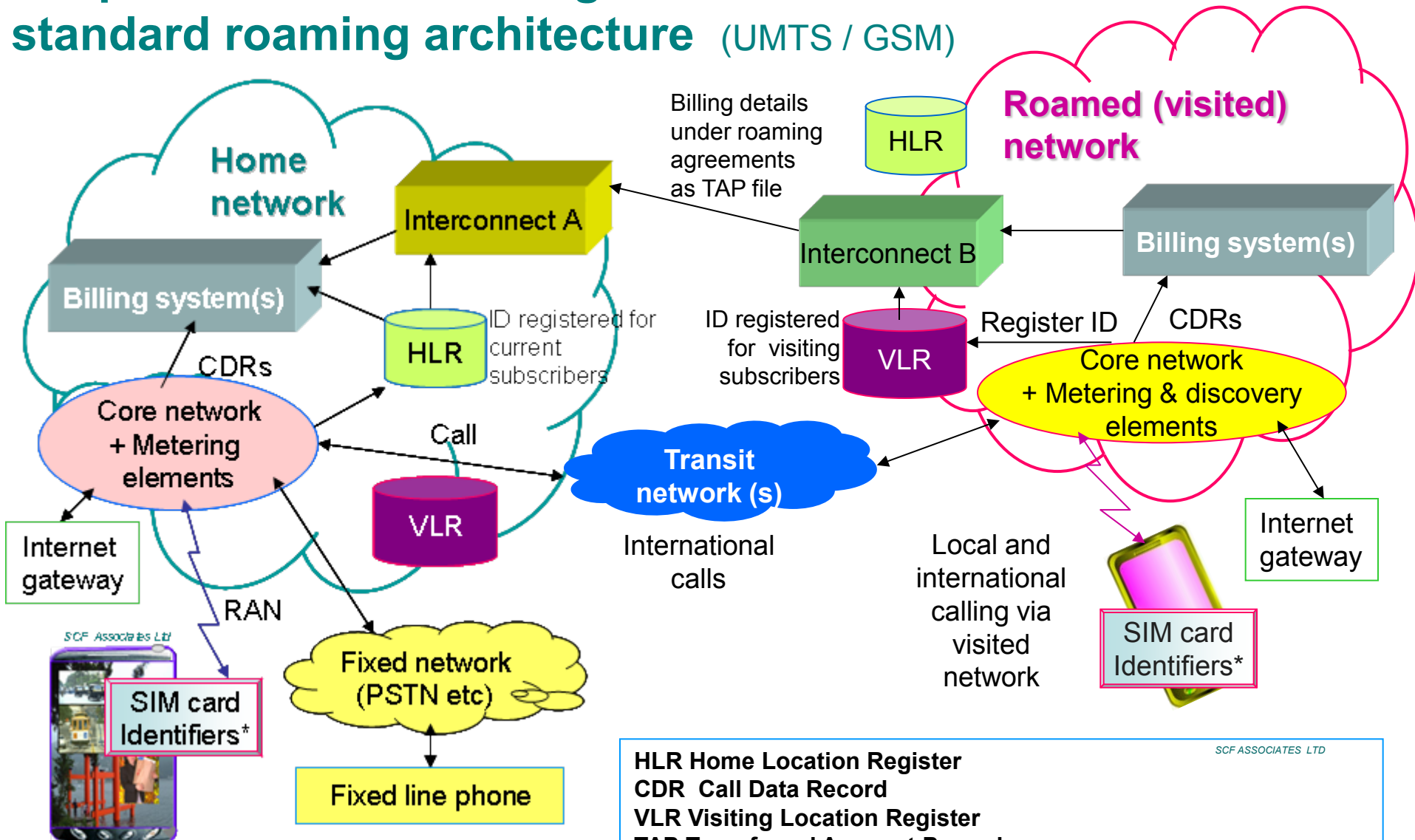
Final objectives globally: tariffs for roaming like a local

- Airtel (ex-Zain): One Network, beginning in 2006, eliminated IMR charges for its customers covering 16 African countries (customers paid domestic rates for outbound roaming calls and not charged for incoming calls; Can use visited network recharge cards)
- Conditions: Airtel – incoming calls free (up to 100 minutes) for 20 countries; outgoing calls at local rates +30% markup (exchange rates)
- MTN One World - Send/receive SMS and browse/use data at a unified call rate while visiting countries where MTN operates
- Vodacom - One Africa Family: free incoming calls in 10 African countries and default rate when roaming on Vodacom networks
- Extra roaming charges questioned when subscribers offered unlimited calls on flat subscription (eg the operator 'Free' in France offers EUR19.90 unlimited domestic calls to 100 countries)?
- In late 2013, T-Mobile USA launched flat rate international calling at 20 US cent/ minute voice for over 100 countries + flat rate SMS and data.

Development of cost model

-the basis of roaming costs in the MNO

Simplified mobile roaming infrastructure follows standard roaming architecture (UMTS / GSM)



HLR Home Location Register
CDR Call Data Record
VLR Visiting Location Register
TAP Transferred Account Procedure
SIM Subscriber Identification Module
 * Specifically IMSI - International mobile subscriber identifier

SCF ASSOCIATES LTD

The financial structure for MNO roaming tariffs

Retail Profit Margin

Negotiated surcharges (IOTs) for wholesale termination of call between MNOs (under STIRA) and also with fixed line carriers, with its profit margin

Mark-up on costs (7BN Euro/year* for EU MNOs)

Cost base for use of the Visited country's infrastructure, mobile and/or fixed

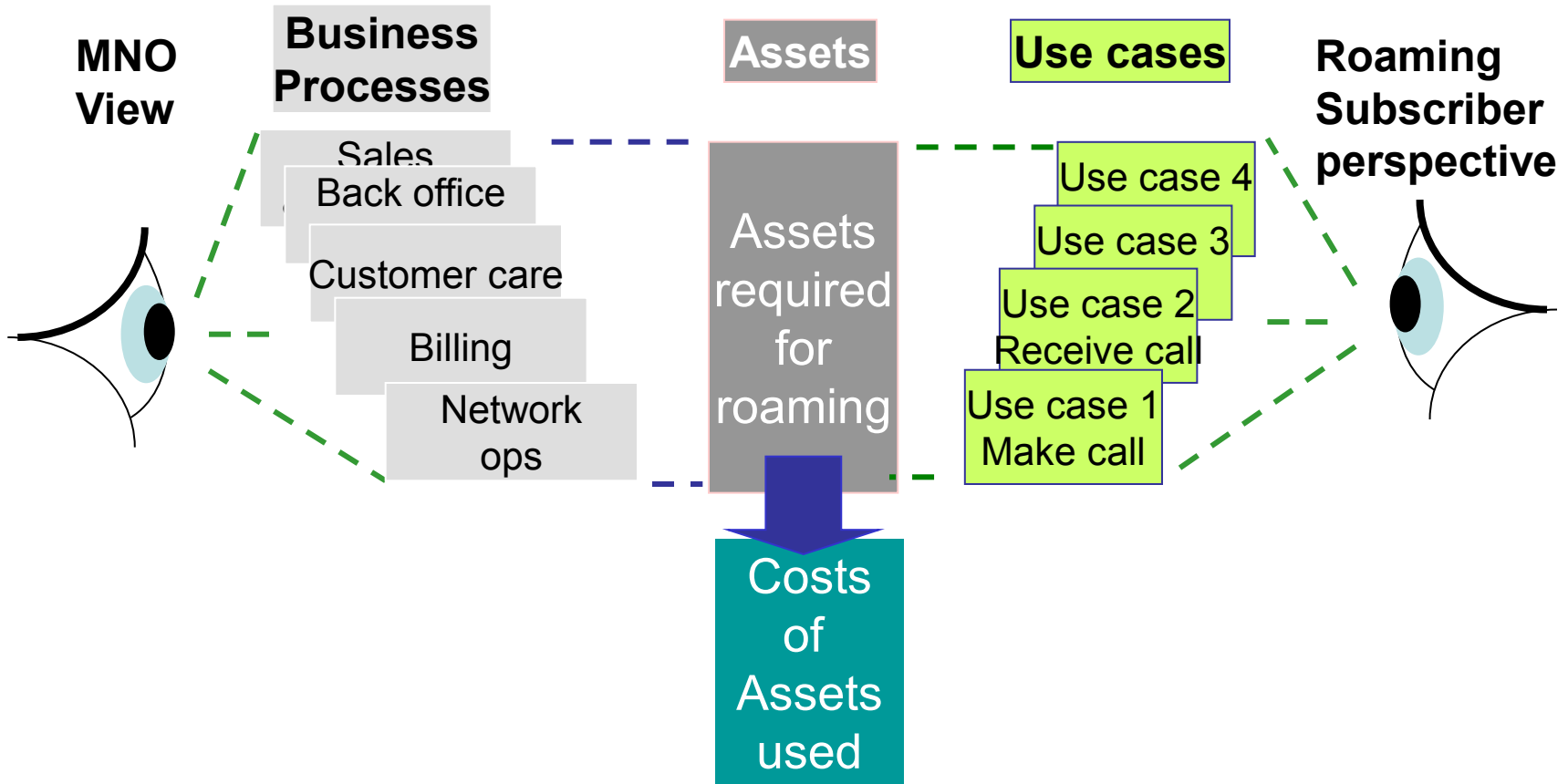
Cost- factors that may be cited as the drivers of extra marginal costs for international traffic, by volume

Cost base for use of the Home country's infrastructure, mobile and/or fixed

*MNO estimates from Orange, Vodafone, O2, 12 Sep 2013

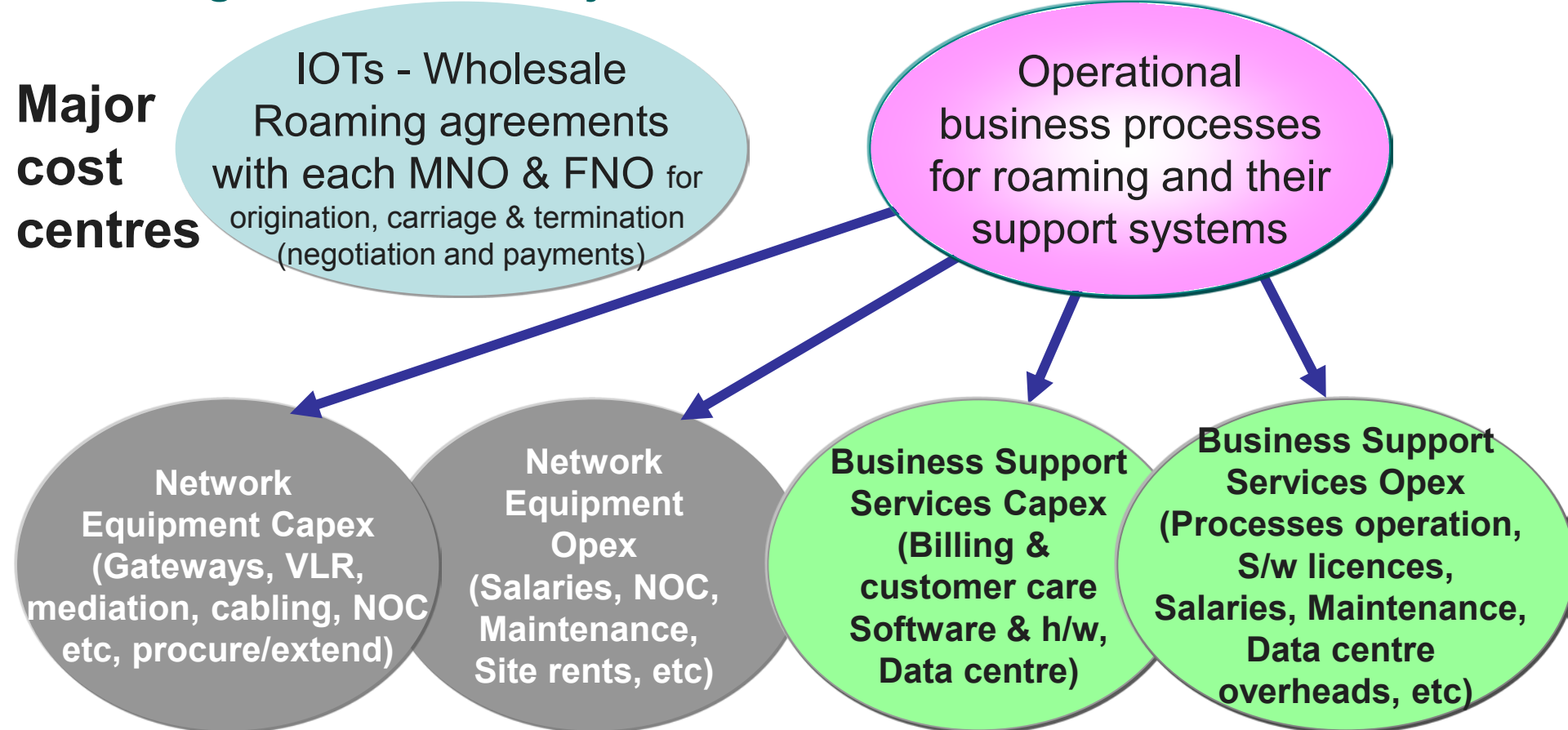
The basis of the cost model : defining what roaming demands via USE CASES drawn from actual behaviour:-

- To define the business processes, with staff and support infrastructure with its software / hardware
- And therefore to identify the cost structures of IMR services with the elements,



International roaming involves the following cost centres which are extensions of the existing domestic network operational systems

Roaming costs should be just an additional *fraction* of domestic costs



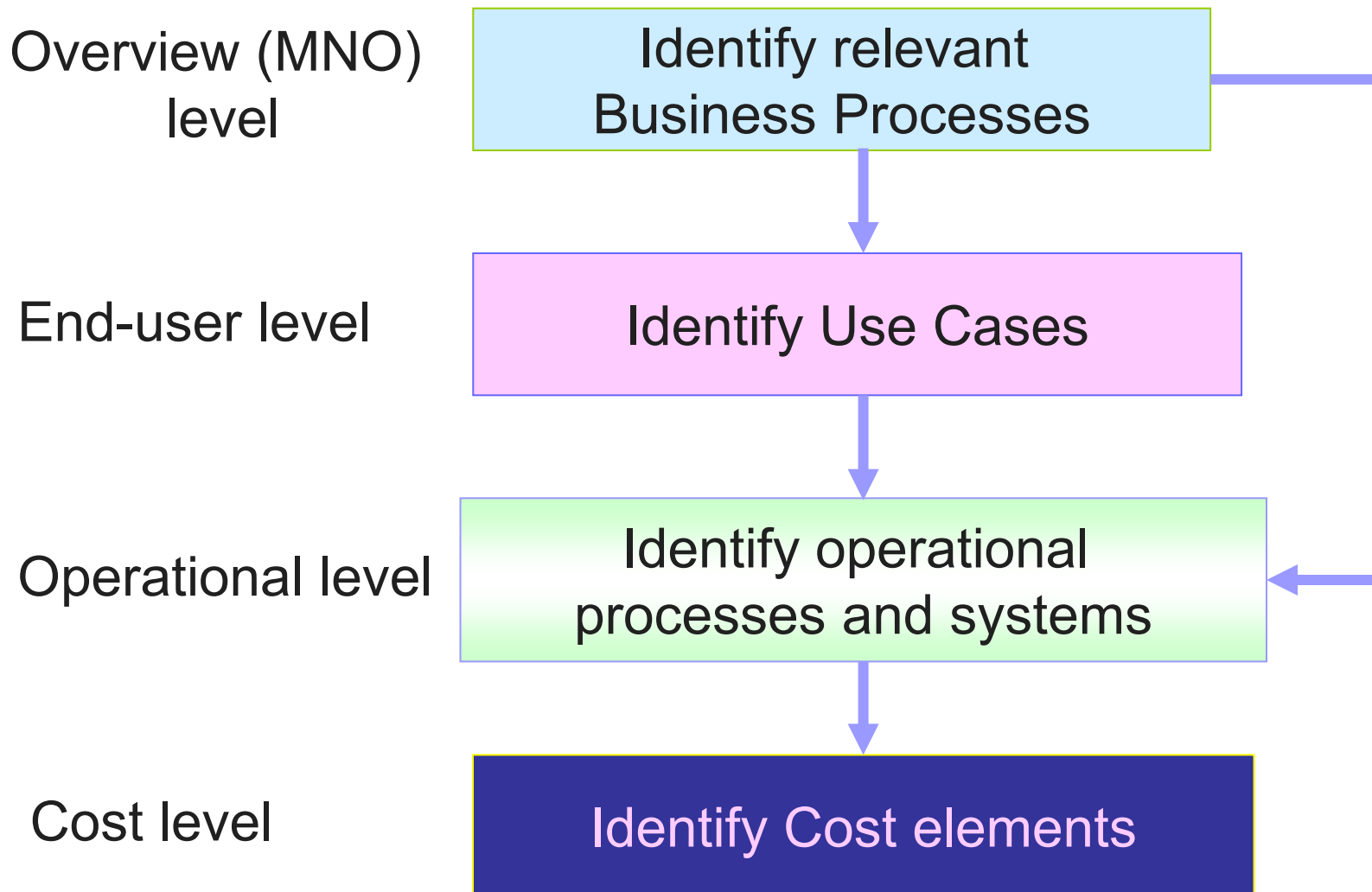
MNO= Mobile Network Operator, FNO= Fixed Network Operator
 VLR= Visiting Location Register, NOC =Network Operating Centre, & systems

Use cases define the MNO actions necessary to support the subscriber

Use cases are employed as they provide a realistic assessment of cost elements involved which is also:-

- Technology Neutral
- MNO size neutral
- MNO/FNO neutral
- End to end across networks, BSS, both operators and any additional systems or processes

Costing mechanism used in the roaming cost model



The MNO runs on business processes that are defined by the subscriber needs for using the mobile communications network, with its business support services, and all the business operations

The major business processes for the MNO:-

- Acquire assets including real estate for BSTs, network equipment, IT systems, data centres, etc
- Build network
- Rollout network services and value added services – eg mapping, Apps Store, etc
- Operate networks and services
- Acquire subscribers
- Register subscribers
- Activate subscribers
- Provision subscribers
- Retain subscribers
- Billing for domestic and roaming services - plan, build, train, operate, maintain
- Customer care – services and infrastructure – plan, build, train, operate, maintain
- Handle network management, including repair teams - plan, build, train, operate, maintain
- Manage logistics for network elements
- Manage logistics for retail sales channels, especially handset inventory and supplier contracts
- Acquire, equip and manage tied or owned retail outlets
- Marketing, with promotions, handset subsidies, etc
- Sales, with contracts and/or prepaid
- Accounts, with accounts payable and payroll
- International negotiations for roaming agreements
- Regulatory negotiations and policy with spectrum acquisition

Each business process will breakdown into subsidiary or component business processes, defined in aggregated mode through the user experience, often via ‘use-cases’

Roaming costs

International roaming involves the following activities for equipment, systems and operations:-

- **Collection/ transport of call data records (CDRs) with costs of retail billing for roaming subscribers; may include specific real-time systems (e.g. for pre-paid customers) such as CAMEL; (NOTE for prepaid - need for a local recharge hub, or some agreement to use local recharge cards)**
- **Interconnection & transit infrastructure costs for international calls & payments to transit carriers;**
- **Payments for call termination for visited MNO, at wholesale prices, with discrepancy resolution;**
- **Associated additional home network and business systems costs;**
- **Costs of negotiation/upkeep of roaming agreements**

Should this technical infrastructure cause higher roaming costs?

- The core issue is whether IMR calls have a different & higher cost structure than national “offnet” calls i.e. calls terminated on another network nationally
- Reasonable to expect increased network & support systems for IMR capacity
- The nature of these extra costs is for network and billing systems to cover international call transport, with wholesale invoicing and retail billing
- Questionable whether cost differences are large for this type of expansion over that required for a *national increase in traffic minutes. Likely that any increase is a fraction not a multiple of current national real costs*
- Further investigation requires empirical cost accounting analysis with a cost model that is MNO and technology neutral.

Cost accounting analysis requirements

- **Total roaming revenues (for each service - voice, SMS data)?**
- **Total costs of roaming (for each service - voice, SMS data)?**
- **Roaming costs breakdown i.e. costs allocation of items included under capex and opex for roaming?**
- **Cost items included in the accounts, for domestic services, for both capex and opex?**
- **Roaming traffic volumes ingoing and outgoing totals for voice, data and SMS?**

Examples of MNO cost centres for roaming

COST ITEMS – note that roaming costs be either for dedicated items or they may form *a proportion* of the total cost of the item, possibly less than 10%

- Network elements costs
- Network management and its operational costs (OSS, NOCs, etc)
- Network attachments for roaming costs (eg CDR capture and storage with mediation)
- Network roll-out , support and maintenance operational costs
- IT elements costs in total
- Software - eg billing and customer care
- IT Hardware
- IT Operations including data centres, their support services (eg power) and set up
- Other costs – eg special customer service
- Roaming Business process – total cost of operations
- Cost of accounting for roaming

Example of overall costs analysis

ITEM - for elements dedicated to roaming, which may be a portion of the total costs	Domestic	Roaming
a) Network elements costs?		
Capex		
Opex		
b) Network management and its operational costs (OSS, NOCs, etc)		
Capex		
Opex		
c) Network attachments for roaming costs (eg CDR capture and storage with mediation)		
Capex		
Opex		
d) Network roll-out , support and maintenance operational costs		
Capex		
Opex		
e) IT elements total		
Total Capex		
Total Opex		
f) Software eg billing and customer care		
Capex		
Opex		
g) IT Hardware		
Capex		
Opex		

Use Cases for roaming

Key business processes for the roaming phases

Handle sign-up when arrive in visited country



Common USE-CASES that define the roaming business processes

1 Place call inside visited country a) to another mobile, offnet or on-net or b) to a fixed line subscriber

2 Place call to home – a) to a mobile or b) fixed termination

3 Receive call from home, a) from a mobile, or b) fixed source

4 Place call while in visited country to a 3rd country a) to a mobile or b) to a fixed termination

For voice, data and SMS



Return to home network and sign -up

Business process for sign – up : Visitor enters foreign country and is registered with local visited MNO (GSM/UMTS procedure)

1. Visited MNO responds to request from handset for assignment to network – either through direct sign-up as preferred carrier or by manual selection of MNO
2. Informs the home network MNO of the subscriber presence in the foreign country by TAP file (Transferred Account Procedure). Requests service information (eg whether or not the mobile is allowed to roam) about the roaming device using the IMSI number. If there is no roaming agreement between the two MNOs, service is denied by the visited MNO.
3. If verified by the home network, enters dialogue with home MNO- A) For Pre-paid - check credit available and the appropriate accounting process at roaming rate on visited MNO. Home network has CAMEL module to monitor and control calls made by its roaming subscribers
OR B) For Post-paid – check valid contract details for roaming and roaming allowed.
4. Visited MNO makes entry in customer database to set up new visiting subscriber on visited network following handset request *. At same time, the home network updates subscriber file to indicate now on the visited network so that any information sent to that device rerouted.
5. OTA activation of new visiting subscriber
6. Send SMS message to subscriber as welcome, showing roaming charge information for voice, data & SMS or confirming all is same as at home (option)

* In some mobile networks, anti-fraud measures are also taken, to transfer unrated CDRs back to the home network much faster than normal, using a hub between MNOs to exchange CDRs and so detect fraud patterns. The hub is termed a “Near Real-time Roaming data exchange” (NRTRDE) following GSMA guidelines, and is supported via shared costs.

For analysis of the International Mobile Roaming service cost structures – Use Case 1: Roaming mobile call made within visited country

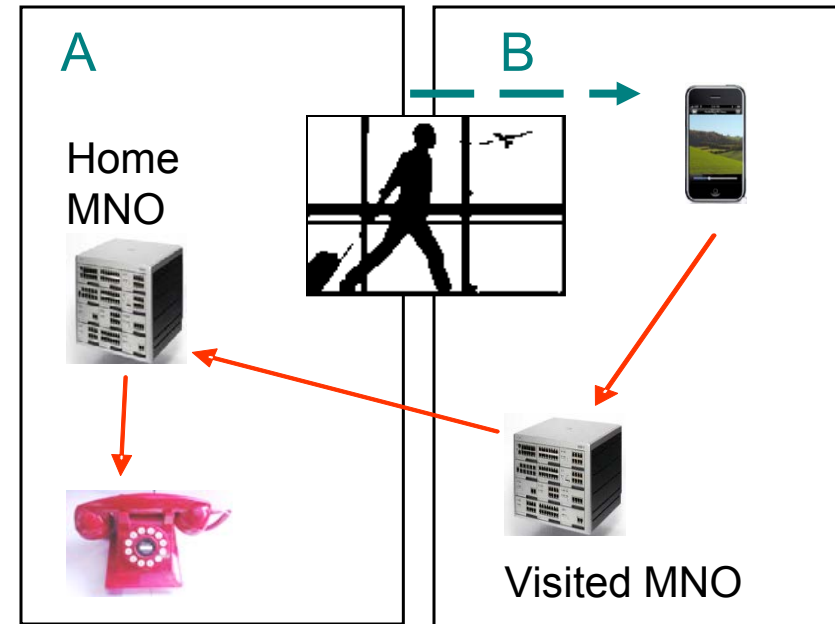
Call type	Cost elements	Use Case Illustration
<p>A traveller from Country A goes to Country B and makes a call to a subscriber in country B</p> <p>Roaming mobile call made within visited country to local subscriber</p>	<ul style="list-style-type: none"> • Mobile origination in country B • [National transit in country B] • Mobile termination in country B • Roaming specific costs – (technical & operational) eg authentication and authorisation with home MNO • Retail specific costs (technical & operational) 	<p>Country A Subscriber in home country A</p> <p>Country B Visits (roams) in country B</p> <p>Home MNO Network Infrastructure</p> <p>Visited MNO Network Infrastructure</p> <p>Local Subscriber</p> <p>Verification signalling</p>

Use Case 2: Call from visited country back to home country

A traveller from country A goes to country B and makes a call back home to a subscriber in country B.

Call type

International call back to home country from visited country



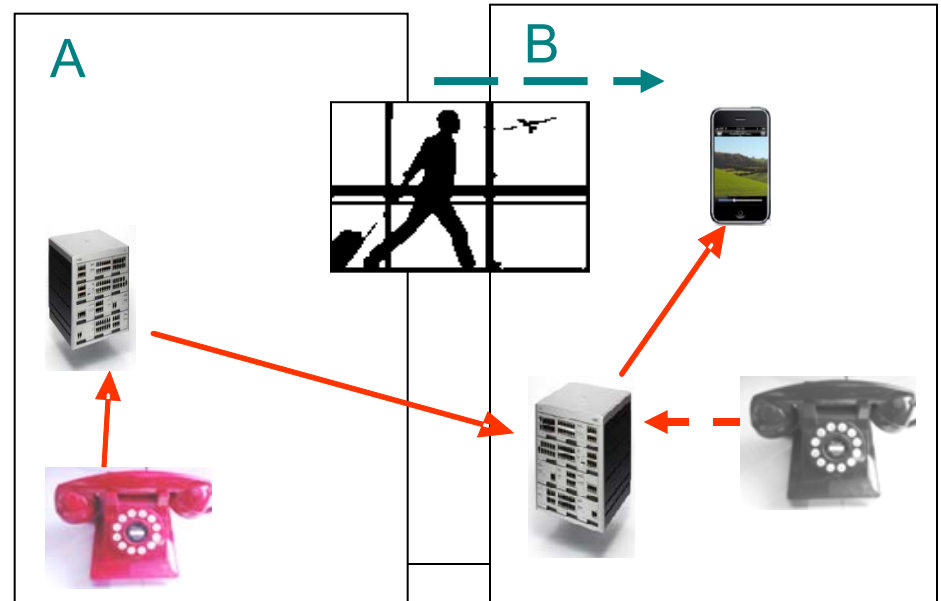
Cost elements

- Mobile origination in country B
- International transit
- Mobile or fixed termination in country A
- Roaming specific costs (technical & operational)
- Retail specific costs (technical & operational)

Use Case 3: Receiving a call in a visited country

(from home or visited country)

A traveller from country A goes to country B and receives a call - from *either* of the countries A or B – so may be a local or international call



Call type

Incoming call while roaming that originates from home country, or, from inside the visited country, and may come from a mobile or a fixed line phone

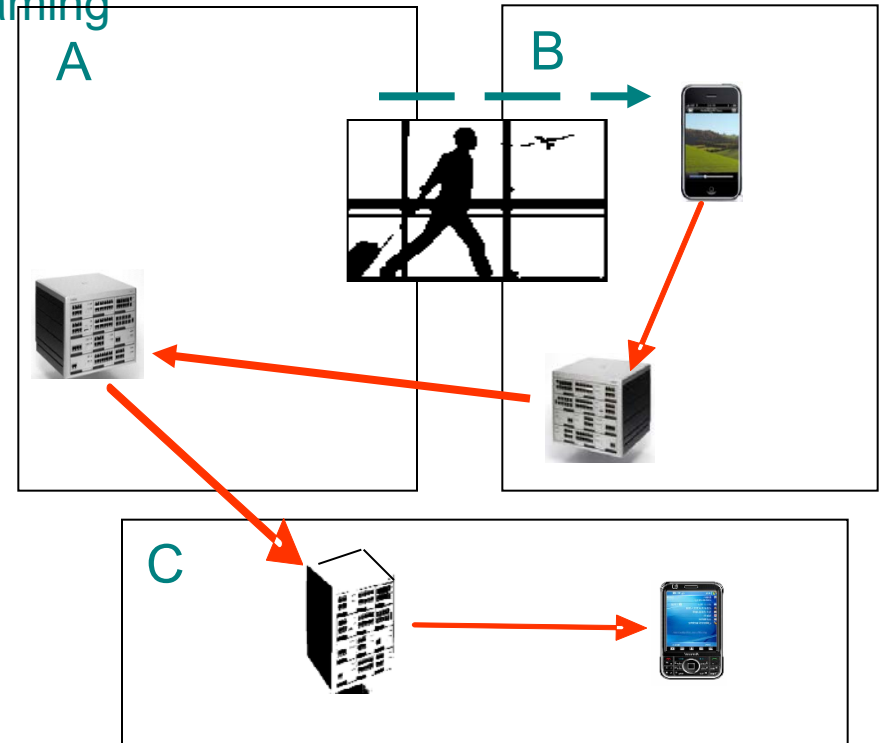
Cost elements

- Mobile termination in country B
- Possible International transit
- Roaming specific costs (technical & operational)
- Retail specific costs (technical & operational)

Use Case 4: Call to a third country while roaming

A Traveller from country A goes to country B and makes a call to a subscriber in country C.

Note that country C may or may not be in a region where international roaming prices are regulated.



Call type

Call from inside a visited country to a third country

Cost elements

- Mobile origination in country B
- International transit
- Mobile origination in country A
- International transit
- Mobile or fixed termination in country C
- Roaming specific costs (technical & operational)
- Retail specific costs (technical & operational)

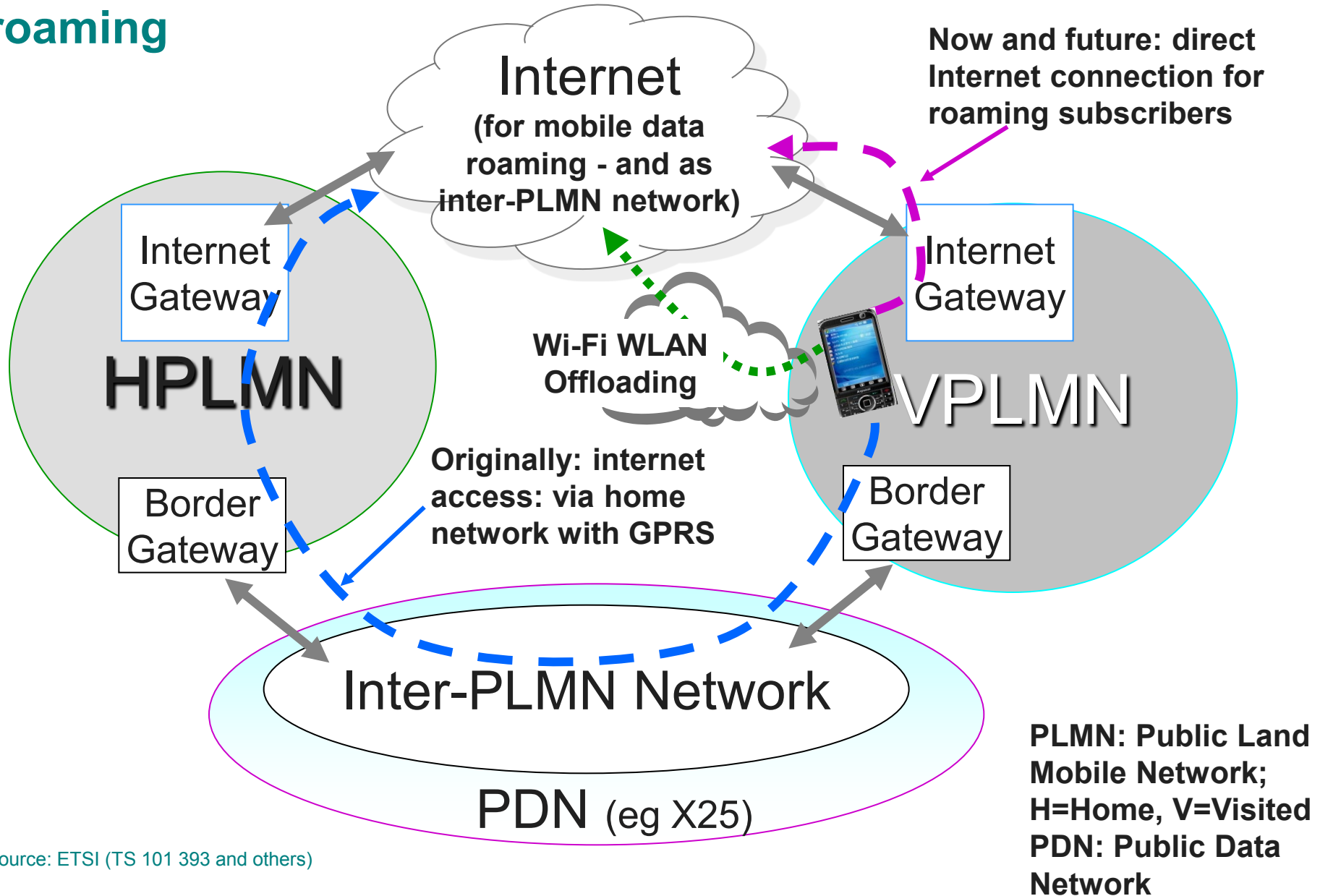
Information Requirements for the Cost model: obtain the underlying costs of roaming

- To make comparisons- gather BOTH **domestic retail** rates and **roaming retail** rates for visited countries - for voice, SMS & mobile data services
- Gather data for both **prepaid** and **postpaid**
- Requires both **domestic wholesale** rates and **roaming wholesale** rates for voice, SMS and mobile data services
- To see how roaming traffic levels are changing - traffic volumes, for domestic and roaming, for voice, SMS and mobile data services with history (eg over 2 years by quarter) so can compare.

Examples of cost elements involved in the Use Cases for mobile Internet - dependent on the technology

USE CASE	2G GPRS/EDGE Example	3G UMTS Example	2G GPRS example of interconnect with 3G IP streaming
<p>1B : Send while roaming: log on to Internet, access email server and send email or data to local subscriber in visited country or elsewhere, or browse web (GSM procedure) or if 3G+, download video or audio or stream video</p>	<p>VLR check: Home network advised, authenticates and authorises; Send data to home MNO for Internet access. 2G RAN and GGSN/ SGSN network interconnect. CAMEL for pre-paid data over GPRS networks and for connecting to visited Internet gateway</p>	<p>Data transfer either with or without Internet gateway. VLR check; Home MNO advised, authenticates and authorises. For connection to 2G network: RAN and GGSN/ SGSN (& CAMEL signalling for prepaid) for network interconnect. Send data to home MNO for Internet access (or 3G + perhaps data transfer via visited MNO Internet gateway)</p>	<p>GPRS tunnelling protocol between MNOs with CAMEL system for 2G pre-paid checking. Possible direct connection to visited MNO's Internet gateway</p>
<p>2B: Receive email and data from home, a) from a mobile or b) any internet connected source: log on to Internet and connect to mail server or other dat sources</p>	<p>VLR check Home network advised, authenticates and authorises 2G RAN and GGSN/ SGSN network interconnect: CAMEL for pre-paid for browsing for GPRS data networks</p>	<p>Data transfer either with or without Internet gateway, with VLR check; Home network advised, authenticates and authorises. For 2G, RAN and GGSN/ SGSN network interconnect, CAMEL for pre-paid for browsing for GPRS data</p>	<p>GPRS tunnelling protocol between MNOs with CAMEL system for 2G pre-paid checking. Possible direct connection to visited MNO's Internet gateway</p>

Alternative routes for mobile Internet access while roaming



Gathering the information for the cost model:

Surveying MNOs with a questionnaire to gather the costing information on roaming

The Questionnaire's principles

Analyse the cost basis for IMR charges using the MNO business model:

- **Examine using a bottom-up view of assets employed compared to domestic operations:-**
 - **Network assets**
 - **CDR management**
 - **Business support systems (billing and customer care assets)**
 - **Any other relevant costs**

Analyse whether latter may show that the cost of IMR is:-

- **Inflated**
- **May not justify a wide variance in surcharges by operator and by country**

Building the MNO Cost base: Capex & Opex

- Objective of questions is to obtain a clear idea of cost allocation across network elements and other cost items across domestic and roaming services
- Have to differentiate between:-
 - Postpaid and prepaid
 - Voice, SMS and data
 - Networking, BSS and other cost centres

For understanding roaming wholesale prices (voice, data, SMS) key cost parameters are required:-

- Inter-operator tariffs (IOTs) charged by each MNO to foreign correspondent MNOs for terminating roaming calls
- IOTs paid out to correspondent MNOs for domestic subscribers when roaming
- Conditions which may result in differentials (volume discounts, time of day, etc.)
- Domestic call termination rates, with other domestic MNOs and with fixed line operators, in order to compare tariffs with roaming
- Roaming specific costs (billing, signalling, customer care)
- Transit costs
- Cost difference between prepaid and postpaid, domestic and roaming.

Questions for pricing of roaming retail services

- **Prepaid and postpaid roaming rates for all countries retail and wholesale, voice, data, SMS? - Use spreadsheets for called and calling country**
- **Factors used in setting retail prices?**
- **Time series for prepaid and postpaid retail prices?**

The Questionnaire survey process

- Select most suitable 4 or 5 MNOs for first piloting the data gathering exercise – ie, the most likely to respond, where feedback will be rapid and complete (ie good relationship with NRA and well organised internally, with comprehensive accounting)
- Pilot test the questionnaire and spreadsheets with the selected MNOs
- Analyse pilot survey returns
- Use lessons learnt from feedback to improve the questionnaire before proceeding to information gathering from all relevant MNOs across the visited MNOs
- Proceed to full survey of all relevant MNOs

Pilot Questionnaire: Issue for Comments

- PART 1A Pricing of Wholesale services - for voice, data and SMS
- PART 1B Pricing of Retail services – for voice, data and SMS
- PART 1C Accounting analysis
- PART 1D MNO Costs base – Elements of Capex and Opex
- PART 2: Questions for regulatory bodies to consider and review powers and jurisdiction before questionnaire survey

In conclusion for the MNO roaming survey

Important to get good responses to questionnaire:

“ the response rate to the questionnaire (on roaming) was fairly low (41%) and much of the information provided by the operators was incomplete or insufficient.” CRASA Roaming project information analysis and research report, 2012

➤ What other key issues or points do YOU see being raised by the questionnaire process and the study overall?

There are also questions for the NRA to consider

Objective of questions is to judge to what extent NRAs are in a position to gather the relevant costing information and so implement a suitable roaming framework:-

- **For wholesale roaming prices that domestic MNOs *are charged by* visited MNOs - can the NRA obtain the wholesale pricing information?**
- **For the wholesale roaming prices that domestic MNOs *can charge out to* visited MNOs – can the NRA obtain the pricing information?**
- **Has NRA authority to share information with NRAs from other countries?**
- **Has NRA authority to regulate retail roaming prices charged by domestic MNOs to their roaming subscribers?**
- **Has NRA authority to regulate wholesale roaming prices charged by domestic MNOs to visited MNOs?**

International Telecommunication Union

Committed to connecting the world