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Our ref: GRCR/GR 15.19
21 May 2009

Mr. David Archbold,
Managing Director,
Information and Communication Technology Authority,
3rd Floor Alissta Towers,
P.O. Box 2502GT,
Grand Cayman. KY1-1104

Dear Mr. Archbold,

Re: CD 2009-1 – FLLRIC Implementation; and ICT Decision 2008-2 – Decision for the Costing Manual Consultation

Further to section 4 of CD 2009-1, the Authority's 27 March 2009 email to interested parties, and to our email of today to interested parties, Cable and Wireless (Cayman Islands) Limited, t/a LIME ("**LIME**") is pleased to submit to the Authority the 3G mobile network module of the Forward-Looking Long-Run Incremental Cost ("**FLLRIC**") model (the "**3G Model**"), as directed by paragraph 398 of ICT Decision 2008-2. LIME is also providing a document entitled "Revision of LRIC Mobile Model from 2G to 3G" which explains the changes made to the 2G mobile network module in order to create the 3G Model.

LIME requests confidential treatment of the 3G Model, as it contains confidential information about LIME's network design, customers, costs or revenues. This information is not made available to the public, and LIME consistent treats it as confidential. It's disclosure to the public, in particular to its competitors, can reasonably be expected to cause LIME financial and competitive harm, as LIME's competitors would be able to prepare targeted and more effective competitive responses to LIME's initiatives, which would be to LIME's financial and competitive detriment. LIME has prepared a redacted version of the 3G Model, containing non-company-specific data, so that interested parties can view the workings of the 3G Model.

Please do not hesitate to contact the undersigned if you should have any questions.

Sincerely yours,
Cable and Wireless (Cayman Islands) Ltd. d.b.a LIME

'Signed'

Frans Vandendries
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c.c. Anthony Ritch, Country Manager, LIME
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Interested Parties in CD (2009-1)/(2008-2)

Encl.

LIME

Revision of FLLRIC Mobile Model from 2G to 3G

21 May 2009

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1 Introduction

After submitting the revised 2G model to the Information and Communications Technology Authority (ICTA) on April 7, 2009, the model was revised further based on 3G technology.

We note that we have achieved information for new equipment in most cases. However, where there has been a lack of available data (e.g. equipment costs, network node positioning), we have drawn upon our international benchmarks which we believe are appropriate for the purpose.

In this document, we present an overview of the changes we have made to the model. We discuss four technical sheets that are significantly rewritten:

- Technical Assumptions;
- Traffic;
- Volume Input for TD and
- Radio Calculations.

We then describe how this model comports with the principles and guidelines set out by the Authority for the FLLRIC process.

2 Overview of Changes to Model

2.1 Services

In considering what additional services to include in the 3G model, we looked at what other regulatory regimes have included when conducting similar exercises. We concluded that we should make four major changes:

1. The "Mobile data" service should be specified to incorporate a wide variety of 3G traffic types. These traffic types are explicitly listed and modelled in a new spreadsheet called Traffic.

2. As inbound roaming will now include a more significant data component, we have split the roaming service into voice and data.

3. To capture the possibility of video calls, we have added a retail video calling services as well as a video call termination service

4. We have also added the MMS service—again in both origination (retail) and termination forms.

Please not that this choice of services is consistent with the approach applied by regulators elsewhere recently, e.g., Sweden (see http://www.pts.se/upload/Ovrigt/Tele/Prisreglering/Mobil_LRIC_Conceptual_design_model_specification_Analysys_080125.pdf) and Denmark (http://en.itst.dk/interconnection-and-consumer-protection/filarkiv-lraic/lraic-pa-mobil/udsendelse-d-19-6-08/Final%20v4%20NITA%20model%20documentation_090608.pdf)

2.2 Network Elements and Cost Assumptions

The revision to a 3G network, the existing 2G network architecture as defined in the existing model needed to be changed. The diagram below illustrates the principal network elements and their positioning in the network that we have assumed in our modelling revisions. We have assumed that a 3G Release 99 network configuration is adopted, which retains separation between circuit and packet switched domains. For the access network, we have included in the model a capability for 3.5G functionality (HSPA high speed data operation), though this can be toggled off if required in the model.

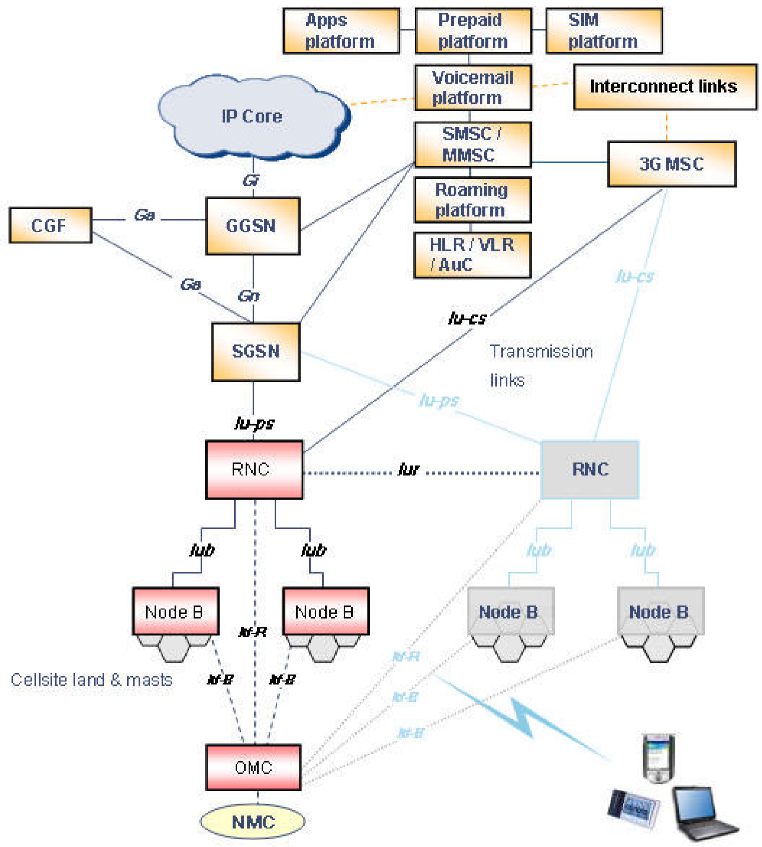

Fig 1: 3G Release 99 UMTS network architecture and network elements

The following key network elements are included in the revised model:

- Cell site land and masts – land associated with the radio base stations and towers;
- Node B – the 3G base transceiver station (BTS), inclusive of channel element cards and optional upgrades to HSPA functionality; this element effectively replaces the 2G BTSs;
- RNC – the radio node controller – a principal element in 3G access networks which effectively replaces the 2G BSC; the RNC handles radio resource processing and call (mobility) handovers for both circuit and packet switched sessions;
- IP core – revised data network definition; note that in our modelling, CGF (charging gateway function) and IP router elements are collectively defined under this item;
- 3G MSC – revised definition of the 2G MSC, which takes into account the revised architecture and cost structure typically associated with 3G MSCs which are comprised of soft switch and media gateway elements;
- Transmission links – revised definition of the transmission network, which takes into account cell site backhaul and transmission links between two RNC sites;
- Server platforms (voicemail, roaming, handset/SIM, applications, prepaid) – processing elements associated with network features which interconnect with both circuit and

packet switched sessions; these are revised to reflect the increased application functionality typically associated with a 3G Release 99 core network;

- SMSC/MMSC – revision of the 2G short message service centre 2G element to reflect the inclusion of multimedia messaging service offered with 3G networks;
- HLR/VLR/AUC – providing a similar function of the 2G HLR/VLR/AUC element;
- Interconnect links – revision of interconnect links capacity dimensioning and associated costing, reflecting higher traffic levels with 3G network;
- NMS – network management system – revised with new cost benchmark data.

The "Cost assumptions" sheet lists the required capital expenditure elements and operating costs. The capital expenditure concerns the radio elements, other network element and the spare parts. The changes that were made in this sheet for the 3G model are as follows:

1. New network components and their costs were added
   - The TRX was replaced by the CE cards (3G TRX)
   - The BTS was replaced by the Node B unit (omni and sectorised).
   - An HSDPA upgrade as well as a Carrier upgrade
   - The BSC was replaced by the Radio Network Controller (RNC)
   - Traditional GSM switching core is replaced by MSS (mobile switching server), Media gateway as well as the HLR/VLR/AuC
   - In order to meet the 3G requirements, several additional network elements were added:
     - IP Core for packet switching, which combines SGSN, GGSN and IP backbone.
     - The IMS Applications Platform
   - HSDPA and carrier upgrades are added for 3.5G capability.
   - The PCU and GPRS transmission are eliminated as no longer relevant.
2. Each allocation driver for all components is set at minutes, except for the HLR/VLR/AUC which is allocated 80% to calls and 20% to subscribers.
3. The spare parts related to the components are calculated as a fixed percentage of the capital expenditure. The assumptions used are consistent with the benchmarking from the 2G model.
4. The own-build (micro-wave option) vs. leased circuits for the backhaul transmission was moved from the "Network Cost" sheet here.

5. Leased line tariff prices were revised. We applied the following discounts on the provided costs:

    - Volume discount: 45%

    - Wholesale discount: 20%

6. The calculation of the reduction in site leasing costs through sharing was corrected.

7. MMS platform is assumed to have been included without an increase in cost over and above what is being incurred for the SMS platform.

2.3 Demand Assumptions

The Demand Assumptions sheet summarises the demand volumes by service and provides demand parameters. The following new demand parameters were added to this sheet:

1. % of daily packet switch traffic in busy hour

2. Oversubscription ratio

3. Average MB usage of Rel99 3G service/subscriber/month

4. Average MB usage of HSDPA 3G service/subscriber/month

5. MMS kBytes per subscriber per month

6. Video call data rate

2.4 Technical Assumptions

The Technical Assumptions sheet has undergone significant change. We group these changes under the headings: radio parameters, circuit switched (CS) and packet switch (PS) bearers; and 3G cell radius assumptions.

2.4.1 Radio Parameters

Parameter	Current Value	Description
Available 3G Frequency	850 MHz	Frequency over which 3G will be deployed. For the base case, it is assumed that the same frequency would be used as per the current GSM network
Spectrum allocation	10 MHz	Have assumed here that given there is no 2G network, the operator would have the same allocation to use for 3G
Carrier bandwidth	5 MHz	Standard 3G carrier bandwidth
Max carriers per sector	2	This is derived from the above spectrum allocation assumptions and the required carrier bandwidth.
Softhandover allowance	40%	Accounts for soft handover that occurs in 3G. In hard handover (GSM) the mobile switches (and changes frequency) to the alternative cell that gives the best reception, while in soft handover (no frequency change) the mobile always makes use of the cell with the best reception. This means that the subscriber can in fact be active on more than one cell at the same time. This factor accounts for both soft handover (between cells on different NodeBs), and softer handover (adjacent cells on the same NodeB).
HSDPA enabled?	Yes	This is a selection to switch HSDPA on or off throughout the model. Turning HSDPA off will default the data traffic back on to 3G Rel99 Radio Access Bearers (RABs).
HSDPA Channel	Dedicated	Can de “Dedicated” or “Shared”. Selecting “Shared” will enable HSDPA and 3G Rel99 to share the same carrier. “Dedicated” will reserve a carrier specifically for HSDPA. If only 1 carrier is available (dependant on spectrum allocation above), then this is irrelevant, as the carrier would have to be shared with 3G Rel99 to enable voice traffic to be carried.
Radio Path GoS	2%	Standard assumption
HSDPA peak cell throughput (Dedicated Carrier)	7.2 Mbps	Peak data throughput that can be achieved on a dedicated HSDPA carrier.
HSDPA peak cell throughput (Shared Carrier)	3.6 Mbps	Peak data throughput that can be achieved on a shared 3G / HSDPA carrier.
Minimum BH throughput per customer (kbps)	40 kbps	Defines a minimum QoS level for BH customers.
Tessalation factor used for planning	20%	Standard planning assumption – allows for the imperfections of coverage planning, and adjusts the cell requirement given the maximum cell radius is specified as an input.

2.4.2 3G CS & PS Bearers

3G Rel99 uses Radio Access Bearers (RAB) to provide the user plane connection between the radio access and the Core Network. When a voice call or a data session is requested, the network will establish a RAB, and maintain it until the call or session is ended. The requested RAB bandwidth determines the amount of resource allocated to an active subscriber, and therefore has a direct impact on network resource consumption.

There are two categories of RAB, circuit switched (CS) bearers which carry traditional CS services such as voice, and packet switch (PS) bearers that carry data services.

These bearers and their corresponding bandwidths are as defined in the following input table in the model;

3GRel99 Circuit Switched RABs	Data rate	Channel Elements
Voice call (CS 12.2kbps)	12.2	1
Video call (CS 64kbps)	64	4
3GRel99 Packet Switched RABs	**Data rate**	**CEs**
Data (PS 64kbps)	64	4
Data (PS 128kbps)	128	4
Data (PS 384kbps)	384	16

Fig 2. CS & PS bearers

The bandwidths (in kbps) used and the corresponding capacity requirements in terms of channel elements, have been taken from vendor benchmarks.

Parameter	Current Value	Description
Capacity per 3GRel99 carrier (Mbps)	0.73 Mbps	Industry benchmark – defines the carrier capacity of 3GRel99
Baseband capacity – Channel elements per baseband card	64	Baseband cards are used in 3G similar to TRXs in GSM – to provide baseband capacity at the BTS/NodeB. Where GSM TRXs have TS, each capable of carrying 1 voice call, 3G has channel elements (CEs) that can also carry 1 voice call. However the capacity of one CE card is much higher than a single 2G TRX (64 per 3G CE card vs 8 GSM per TRX).
CE blocks per HSDPA carrier	4	Defines the number of CE cards required to support a HSDPA carrier (7.2Mbps)

2.4.3 Traffic split across Rel99 RABs

The following table is derived as an output from the "Traffic" worksheet, and is specific to the PS bearers for 3GRel99.

3GRel99 Packet Switched RABs	Distribution	Utilisation
Data (PS 64kbps)	31%	3%
Data (PS 128kbps)	29%	32%
Data (PS 384kbps)	39%	22%

Fig 3. Traffic characteristics for 3GRel99 PS bearers

In order to dimension the capacity requirements for 3GRel99 traffic we need to understand the relative usage of the different bearer types. If HSDPA is enabled, then we only need consider the CS bearers, and hence the above table will not be used.

2.4.3.1 Dimensioning CS 3GRel99 traffic only;

Using the table in Fig 2. above, we can convert any video traffic into the equivalent voice requirement. So for the air interface, the data throughput for a video call is 64/12.2 = 5.25 times the size of a voice call. And for the baseband capacity, a video call is 4/1 = 4 times the size of a voice call. This then enables us to use traditional Erlang theory in order to estimate the required capacity.

2.4.3.2 Dimensioning CS & PS 3GRel99 traffic;

If HSDPA is enabled, we also need to be able to convert the data traffic into equivalent voice traffic (or Erlangs).

This is done in 2 stages;

i) Firstly we need to understand the data usage per PS RAB (using the Distribution parameters in Fig 3),

ii) Once we have the user data throughput per PS RAB, we can then determine the bearer throughput. This means that we factor the user data throughput up using the utilisation % in Fig 3, to give us the throughput in terms of the actual RAB size (this also gives us an indication of how active the RAB is in the BH). For example if the PS128kbps bearer is carrying 10 kbps traffic in the BH, and we know that it is 32% utilised, the bearer throughput is 10 kbps / 32% = 31.25 kbps. This also tells us that bearer was only active 31.25 / 128 = 24% of the time.

iii) Finally we need to convert the usage per RAB by the appropriate factor from Fig 2 to convert the PS RABs in to equivalent voice Erlangs. We do this the same way that we would for the CS Video bearer above. For example, for PS128kbps bearer traffic, we multiply by 4/1 = 4 to get the equivalent voice requirement for CEs.

2.4.4 3G cell radius per frequency

Parameter	Current Value	Description
850MHz 3G data cell radius factor	25%	If the operator were to dimension their 3G network for voice only, they could deliver an equal, if not better, QoS using the footprint of the existing 850MHz GSM network. However, to deliver high speed data services, they may need to deploy additional infill due to the impact of cell breathing. Benchmarks from analysis undertaken by the UK regulator (Ofcom) have been used here to estimate this uplift in the cell site requirement.

Using this uplift we have estimated the impact on the 850MHz cell radius. Using additional information from industry benchmarks, it is also possible to estimate the impact of using alternative frequencies to deploy 3G.

	Frequency		
3G cell radius	**850**	**1900**	**2100**
Dense	0.72	0.57	0.54
Medium	1.16	0.92	0.87
Rural	2.41	1.91	1.81

Fig 4. Maximum cell radius estimations for 3G at different frequencies

2.5 FAC Input

The FAC Input sheet summarises the network and overhead expenses used in the model. An addition column has been added to allow the user to make adjustments to the expenses to reflect the new technology. We suggest but have not implemented (this in accordance with ICT Decision 2008-2 para. 237 to maintain the same expense factors for 2G and 3G) two adjustments:

1. Any cell site related expense is adjusted on the basis of the increase (decrease) in the number of cell sites relative to that observed in the 2G model; and

2. Product development and management has been increased on the basis of the increase number of services in the model

2.6 Reval Assets

The "Revaluated Assets" is an input sheet providing the net book value of various 2G network assets. The Reval Assets sheets brings together the asset valuations on the basis of which expense factors and overhead will be allocated to network elements. The reval assets values in the model are a paste-value of the GRC that appears in the Scenario Output sheet. This function has not been automated.

2.7 Expense Factors and Overhead Expenses

The expense factors and overhead expenses sheets assign network and overhead expenses to the network elements. The network elements have been updated in these sheets.

2.8 Routing Factor Input

New routing factors were added for video calling, video call termination, MMS and MMS termination and inbound data roaming. The derivation of the routing factors for video calling is shown explicitly in the sheet, and is derived as the weighted average of domestic originated video calls as well as international inbound calls. The routing for Video termination (domestic) is analogous to domestic voice termination. The routing for MMS and MMS termination is analogous for that of SMS and SMS termination, respectively.

The routing factors for inbound data roaming are analogous for inbound voice roaming except that the data does not use the switch but rather the IP Core and Applications platform.

The routing factors for Mobile Data were also changed to reflect that data is taken off the switch and routed through the IP Core and Applications platform.

The routing factors for On-net calling were changed to reflect the fact that not all calls will "touch" two RNCs. We have assumed that the traffic has equal probability of using two RNCs as just one, resulting in a routing factor of 1.5. With respect to the MSC, we have assume there is one touch per call.

With respect to voicemail, routing was added for cellsites and masts. The value is equivalent to that used for the Node B element.

The routing for the SMS was changed so the use of cell sites and HLR was taken into consideration. The use of cell sites should logically match the use of the Node B and HLR with the switching platform.

The routing for inbound voice roaming was changed so that the use of the interconnection link was used for off-net traffic.

2.9 Erlang B

The Erlang B is an input sheet providing all options on assumptions for probability of call loss on circuits. The sheet is used as input to the Radio Calculations. This sheet remains unchanged from the 2G model.

2.10 Demand Calculations

The Demand Calculations sheet was modified to incorporate the volumes for the new services and ensure flow through to the rest of the model. Account is taken for data traffic flowing inbound as well as outbound over the interconnect link.

2.11 Radio Calculations

2.11.1 Overview

The structure of the Radio Calculations sheet has been kept similar to that in the original GSM model. The main differences are in how the 3G NodeBs are dimensioned in comparison to the GSM BTSs. We will consider the 3G dimensioning in the rest of this section.

2.11.2 3GRel99 Dimensioning

As mentioned previously, if HSDPA is not enabled in the Technical Assumptions sheet, then all of the data traffic will need to be carrier on 3GRel99. The model does this in 2 stages. Firstly it determines whether the traffic demand exceeds the 3GRel99 spectral (over the air) capacity, and increases the cell volumes if it does. If not, the model will then consider the CE requirement for the NodeB to support the capacity requirement at a baseband level.

2.11.2.1 3GRel99 spectral capacity

To determine whether additional sites are needed, the model considers whether the cell traffic demand exceeds the spectral capacity. First it converts the video and data traffic into equivalent Erlangs by dividing the demand in kbps by the data rate for voice (12.2kbps). Once this is done it applies Erlang theory to the voice equivalent Erlang demand to determine the required Erlang capacity per cell. If this is less than the spectral capacity of 3GRel99, then it proceeds to the base band dimensioning (CEs). If the spectral capacity is exceeded the model will check to see if there are any additional carriers that can be deployed on site, and if not more cell sites will be deployed to soak up the additional demand.

2.11.2.2 3GRel99 base band capacity

To determine the CEs required for capacity at the nodeB, user demand is converted into the required channel elements. For voice this is simple as there is a 1 to 1 mapping of a voice call to a single CE. For video and PS data services there are more CEs required. The actual number required per service (or RAB used) is as defined in the Technical Assumptions sheet (please refer to section above and Fig 2). So, the model determines the CE requirement for each service based on the RAB throughput requirement (this is calculated as described in the Technical Assumptions discussion above), and the CEs needed to support that RAB (Fig 2). Once all service types are converted to CE demand, the model can then once again use Erlang theory to calculate the required CE capacity.

2.11.3 HSDPA Dimensioning

If HSDPA is enabled, then all data traffic will be carried over HSDPA, and voice traffic will remain on 3GRel99 and will continue to be dimensioned as above. The data traffic throughput demand is then compared against the minimum throughput QoS requirement as specified in the Technical assumptions sheet (40 kbps). If the QoS requirement represents a great BH throughput on the cell compared to the actual traffic, then we take this value as the throughput demand to be satisfied.

2.11.3.1 HSDPA spectral capacity

Similarly to the 3GRel99 example above, the model first considers whether the throughput demand on HSDPA exceeds the HSDPA spectral capacity as defined in the Technical Assumptions sheet (7.2Mbps on a dedicated carrier, or 3.6Mbps on a shared carrier). Again, if the spectral capacity is exceeded, additional sites will be deployed.

2.11.3.2 HSDPA base band capacity

The CE requirement for HSDPA has been defined in terms of the number of CE cards required to support 7.2Mbps throughput (4 CE cards). The model therefore assesses how much of this Peak data throughput is utilised per cell, and deploys the corresponding required CE cards.

2.12 Transmission Links

In the transmission links sheet, an initial statement is made as to whether the model is assuming that backhaul (NodeB to RNC) is own-build, i.e., using a wireless system, or leased. There then follows a table that calculates the leased cost were the latter scenario in force. The table is structured analogous to the one in the 2G model.

There then follows a calculation of the leased line transmission costs for the two RNC-MSC links.

The remainder of the sheet has the same structure as in the 2G model and calculates the cost of:

- the own-build microwave system for NodeB to RNC links;
- the national submarine transmission; and
- the interconnection links.

2.13 Traffic

2.13.1 Purpose of the Traffic worksheet

The Traffic sheet has been included in order to translate a high-level monthly per subscriber data demand, into a BH throughput requirement for the Radio Calculations sheet. The main outputs are;

- BH data throughput / data user (kbps)
- Distribution of RAB usage %
- Average RAB utilisation %

The first output above is used for both 3GRel99 and HSDPA dimensioning; however the second and third outputs are specific to 3GRel99 and feed in to the Technical Assumptions sheet as describer in the previous section. The following section looks at the derivation of these 3GRel99 parameters.

2.13.2 Service characteristics (3GRel99)

The 3GRel99 traffic model considers the service mix for an average data user.

Service characteristics				
Service type	**Mix of subscriber data usage (%)**	**Monthly usage per data active sub (MB / month)**	**Selected bearer used to deliver service on 3GRel99**	**Av. user throughput requirement per session (kbps)**
HTTP PDA web browsing	27.16%	6.79	Data (PS 128kbps)	41.60
FTP PDA file sharing	27.16%	6.79	Data (PS 384kbps)	93.81
VoIP	2.04%	0.51	Data (PS 64kbps)	4.80
IM	0.00%	0.00	Data (PS 64kbps)	0.00
LBS	0.20%	0.05	Data (PS 128kbps)	26.67
Gaming	2.04%	0.51	Data (PS 128kbps)	24.80
Video / media streaming	12.22%	3.05	Data (PS 384kbps)	66.00
PTT voice	2.04%	0.51	Data (PS 64kbps)	4.80
Email	27.16%	6.79	Data (PS 64kbps)	1.41

Fig 5. Service characteristics for 3GRel99 Traffic Model

Parameter	Description
Mix of subscriber data usage (%)	Defines what proportion of the total monthly traffic per subscriber is attributable to each service defined.
Selected bearer used to deliver service on 3GRel99	For each service we define on average which bearer would be used to deliver the service on the network.
Av. user throughput requirement per session (kbps)	Considering the behaviour of each of the services (i.e. payload, peak bandwidth requirement, read time …etc) this defines the average throughput per session for each service defined.

The above parameters are then used to derive the usage per bearer, and the utilisation of each of those bearers (as per the table in Fig 3 above).

2.14 Switching Calculations

The Switching Calculations sheet is structured in the same way as the 2G model. The changes reflect the incorporation of the new network components.

2.15 Network Costs

The Network Costs sheet is structured in the same way as the 2G model. The changes reflect the incorporation of the new network components.

2.16 Scenario Volumes and Volume Inputs for TD

The Network Costs sheet is structured in the same way as the 2G model. The changes reflect the incorporation of the new services. There are additional specific changes to the Volume Inputs for TD sheet which we discuss in detail here.

2.16.1 Additional inputs to quantify service demand for 3G/HSDPA services

As indicated above, the following are additional services that have been added to the model to address any potential services that could be launched with 3G;

- 900-MMS
- 900-VIDEO CALLING
- 900-MMS TERMINATION
- 900-VIDEO CALL TERMINATION
- 900-INBOUND DATA ROAMING

2.16.2 Revised input service volumes

Parameter	Current Value	Description
900-MOBILE DATA Volume – 2M	17,298,800	The total annual data volumes have been derived from the MB/data sub/month assumption that is inputed in the Demand Assumptions sheet. This is then scaled up by the number of data active subscribers
900-MOBILE DATA Volume – Lines	14,762	The number of data active subscribers has been revised to reflect an uplift that you would expect to see when launching a 3G/HSDPA service (additional assumptions used to derive this are discussed in the following section).
900-MOBILE DATA Volume – Minutes	23,632,241	This is a conversion from data volumes into equivalent voice minutes in order to allocate costs later in the model (parameters to derive this are discussed in the following section)
900-SMS Volume – Minutes	171,234	This is a conversion from SMS volumes into equivalent voice minutes in order to allocate costs later in the model (parameters to derive this are discussed in the following section)
900-SMS TERMINATION Volume – Minutes	79,424	As above
900-MMS Volume - Calls	788,019	Benchmarks have been used to estimate the MMS volumes based on a proportion of SMS volumes on the network.
900-MMS Volume - Minutes	788,019	This is a conversion from MMS volumes into equivalent voice minutes in order to allocate costs later in the model (parameters to derive this are discussed in the following section)
900-VIDEO CALLING Volume – Calls	530,854	Benchmarks have been used to estimate the Video call volumes based on a proportion of voice calls on the network.
900-VIDEO CALLING Volume – Minutes	780,489	As above
900-MMS TERMINATION Volume – Calls	365,511	As per MMS
900-MMS TERMINATION Volume - Minutes	88,977	As per MMS
900-VIDEO CALL TERMINATION Volume - Calls	90,863	As per Video Call
900-VIDEO CALL TERMINATION Volume – Minutes	143,369	As per Video Call
900-INBOUND DATA ROAMING Volume - 2M	1,729,880	Calculated as a % of subscriber driven data traffic (discussed in next section)
900-INBOUND DATA ROAMING Volume – Minutes	2,363,224	Conversion as for Mobile Data

2.16.3 Additional service assumptions

Parameter	Current Value	Description
% MMS of SMS	5%	Taken from industry benchmarks from other operators to estimate MMS volumes likely to be seen on the network.
% Video calls of Voice	0.50%	Taken from industry benchmarks from other operators to estimate Video calls likely to be seen on the network.
% data inbound roaming traffic vs sub orig	10%	Used to estimate the volume of traffic for inbound roaming. Stated as a % of subscriber originating data traffic. No firm data to benchmark, checked against europe data at c. 25% 2009. Europe is deemed a leader in cross border travel - inflated from 5% to 10%, estimated only.
2G Data active subscribers	6,610	Taken from the 2G model
% 2G Data active subscribers	7.7%	This is a derived value from the above data active subscribers on 2G. Used as a benchmark to understand the 3G assumption (as shown below)
% 3G Data active subs	17%	3G has been seen to stimulate a greater take up of data services in other regions where it has been deployed. This percentage is based on the view of LIME commercial staff. Benchmarks against other operators show this is a reasonable assumption in this time frame.

2.16.4 Service conversion factors

Parameter	Current Value	Description
MB per voice minute conversion factor	5.46	Used to convert data traffic into equivalent voice minutes (as described in 3.2). Calculation is as follows: =[8 (bits in a byte) x 50% (allowance for packetisation)] / [12.2 (data rate for voice) / 1000 (kbits in a Mbit) x 60 (seconds in a minute)]
SMS per voice minute conversion factor	0.011	Conversion factor from SMS volumes in to voice equivalent minutes. Calculation as follows: =[0.5 (kbits per SMS msg) x 1000 (bits in a kbit)] / [767 (voice channel rate for SMS in bits/s) x 60 (seconds in a minute)]
MMS per voice minute conversion factor	0.24	Conversion factor from MMS volumes in to voice equivalent minutes. Calculation as follows: = [44.548 (Kbytes per MMS msg) x 5.46 (MB per voice minute conversion factor – as above)] / 1000 (Kbytes in a Mbyte)

2.17 Output Sheets

The model has three key outputs sheets:

- Scenario Output
- Mobile Network Costs
- Mobile Service Costs

The function of these sheets remains the same as in the 2G model, namely:

- the Scenario Output sheet uses the capex and opex outputs from the Network Costs and Expense Factors sheets and presents them in the *scen_out* table, which in turn is used to generate the network component costs in the Mobile Network Costs and Mobile Service Costs sheets;
- the "Mobile network Costs" sheet consists of a table calculating the average unit network cost of each network component, categorized into duration sensitive, call sensitive, subscriber sensitive and bandwidth sensitive segments; and
- the "Mobile Service Costs" sheet calculates the average unit cost of each service.

The changes in these sheets are the incorporation of the new sets of services and network elements.

Also, with respect to the retail costs, in the Mobile Service Costs sheet, certain retail costs were reallocated in order to accommodate the new retail services. The previous level of SMS retail cost is split on the basis of relative traffic volumes between SMS and MMS. Similarly, a portion of the previous levels of retail cost for On-net mobile, Mobile-to-Other and International Outgoing are reallocated to video calling. This is done on the basis of the relative level of traffic volume.

3 ICTA Principles and Guidelines

The principles and guidelines the Authority established for the FLLRIC methodology in ICT Decision 2005-4 were observed in the construction of this 3G model.

Principle 1 states that the methodology must follow a forward-looking long-run incremental cost approach. Further statements of what the Authority expects to see for compliance in respect to this approach were set out in ICT Decision 2008-2. We believe that this model is compliant with this principle and the clarifying statements.

Principle 2 states that the costs modelled shall be "calculated as if the service was being provided for the first time by a new carrier… shall ignore embedded and historical costs… and reflect technologies that are currently operational used and available in the marketplace." The model's bottom-up approach using latest available technology valued at current market prices meets this requirement. As the Authority is aware, certain operating expenditure from LIME's financial accounts were used in this model, but that expenditure was recent and so its use should still be compliant with this principle.

Principle 3 states that the costs modelled should be those assumed to be incurred by a efficient operator meeting required demand at a particular grade of service. This model incorporates the changes made in the 2G model designed to meet the Authority requirements to ensure that the costs are efficient.

Principle 4 states that FLLRIC should only include "causal" costs. We believe the bottom-up approach taken in the model necessarily captures this principle. We also have retained the "large increment approach" required by the Authority.

Principle 5 states that incremental costs do not include components prior to a course of action. We have used current costs and a network driven from underlying demand. We therefore believe that the principle has been observed.

Principle 6 states that all relevant start-up costs should be included. Both capital and operational expense costs in start-up have been included in this model.

Principle 7 states that the FLLRIC of a service or network element should include both volume sensitive and non-volume sensitive costs. We have done so and explicitly shown the relevant drivers and allocators of costs in the model.

Principle 8 states that FLLRIC includes direct increment costs of providing a service and no common costs that would be incurred if the service is not produced. The Authority had determined that C&W's methodology employed in previous models fulfils the requirements of Principle 8. We have preserved that same treatment of such costs in this model.

Principle 9 states that the long-run is a horizon long enough so that there are no sunk inputs or costs. The Authority had determined that C&W's methodology employed in previous models fulfils the requirements of Principle 9. We have preserved that same approach to long-run costs in this model.

Principle 10 states that common costs must be justified and reasonably assigned. The Authority had specific requirements about how common costs should be allocated in the 2G model. These have been respected these requirements in the 3G modelling approach.

Principle 11 states that the model should be transparent. LIME has simplified the revised models it has submitted. It has also increased the transparency of the calculations in this model and documented the changes made to assist the user.

Principle 12 states that C&W has the onus of demonstrating that it costing methodology complies with approved FLLRIC principles and guidelines. We hope that the revisions to the 2G model that were designed to make its costing methodology compliant have done so. We have preserved those revisions where relevant here and attempted to ensured that new elements to the methodology employed in this model are compliant with the principles and guidelines.

The Authority states that C&W's methodology employed in previous models fulfils Guideline 1 (bottom-up approach), Guideline 3 (scorched node) and Guideline 4 (current generation technology, without interworking with previous generations). We have preserved that same approach to these issues in this model.

With respect to Guideline 2 (grade of service), we believe the 3G model is more specific about the service standards used to provide 3G service.

With respect to Guideline 5 (total service increment), the model incorporates the Authority's "large increment" requirement.

With respect to Guideline 6 (expense factors), the model preserves the specific reductions called for and the capability—introduced in the revised fixed and 2G mobile model—for the user to introduce further efficiency reductions.

With respect to Guideline 7 (asset lives), we have used the asset lives determined by the Authority where relevant and adopted the same asset lives for new network component analogues.

With respect to Guideline 8 (WACC), we have used the same WACC as determined for the 2G model.