STEM example model

Increasing market share with Voice over LTE

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What will be the impact of implementation of VoIMS for a mobile operator?

Mobile operators who have deployed *Long Term Evolution* (LTE) networks mostly resort to *Circuit-Switched Fallback* (CSFB) for handling voice calls even though this often means that data sessions are suspended for the duration of a voice call. *Voice over LTE* (VoLTE) is an emerging standard which uses IMS to carry voice as a packet-based service on the 4G data network. However, operators have been cautious to adopt this approach due to lack of consensus, and because of the cost associated with investing in the IMS sub-system.

VoLTE promises a better service experience for mobile subscribers while reducing load on an operator's legacy network. Implied Logic has developed a methodology for comparing the benefits of being the *first mover* in a market to adopt VoLTE with the disadvantages of being the *last mover*. The cut-down interface shown below demonstrates the effects as a function of market characteristics and timing.

Figure 1: Live snapshot from the model on www.impliedlogic.com

Implied Logic can work with you to customise this methodology to your individual market and current network position in order to fast track a credible financial assessment of your strategic options.

1. Overview

This model investigates the evolution to the IMS-based solution (VoIMS) for an operator with an existing legacy network, who builds or has already built an additional LTE network. It runs over a ten-year period. Both LTE rollout timing and customer migration towards LTE can be controlled. Current data from existing networks can be used.

The model contains two scenarios. The base case (*last mover*) is when an operator uses CSFB to support voice services of LTE subscribers for as long as possible. An earlier implementation of IMS is modelled as a scenario (*first mover*).

The model covers the major building blocks of an existing legacy network and a LTE network to be deployed.

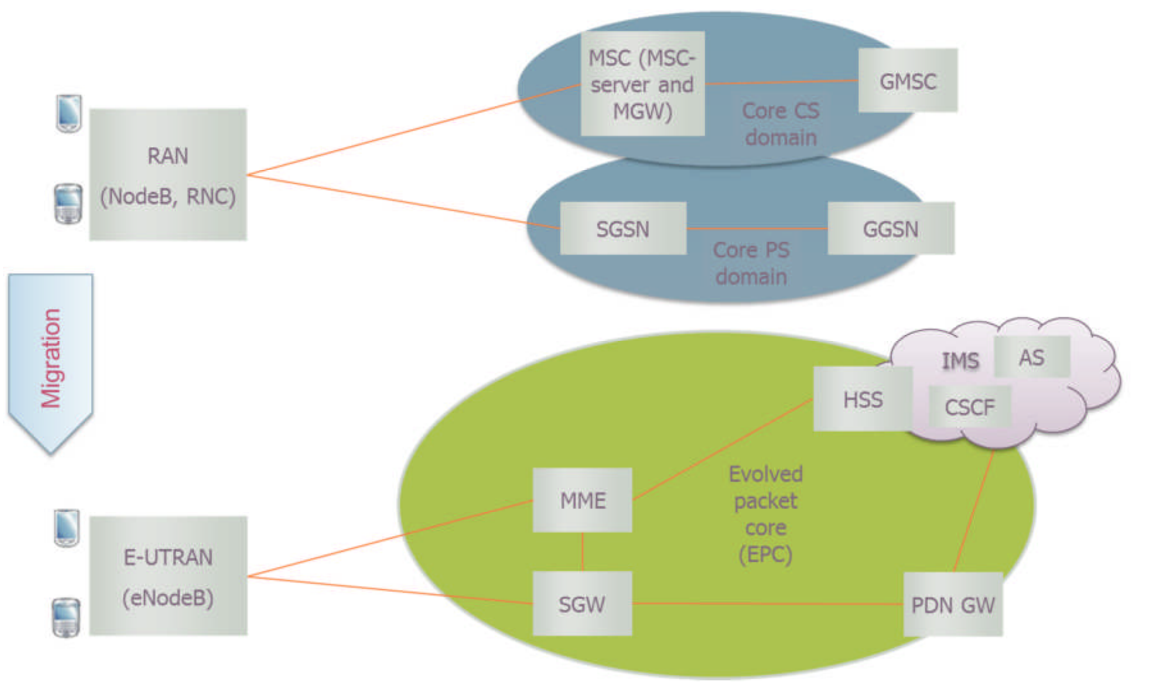

Figure 2: Structure of the modelled network

Introduction of VoIMS significantly reduces the load on legacy networks. This leads to reduction of transport capacities, switching capacities and even reduced radio network requirements. The saving effect of those measures massively depends on the current operator's environment and is therefore not monetised. Quantitative reductions are shown.

Introduction of VoIMS leads to significantly improved quality of voice services; hence an increased market share is expected for the *first mover*. Conversely, the *last mover* probably loses market share.

2. Services

Services are derived from an overall stable mobile market segment. First introduction of VoIMS is considered to give an advantage compared to other operators, thereby leading to a slightly higher market share, especially in the first few years until all operators have introduced VoIMS.

Subscribers are migrating from a legacy network to LTE network of the same operator.

The traffic volume of voice subscribers stays stable. VoIMS could lead to a higher voice traffic volume, which could be driven by the introduction of a special flat-rate tariff.

Data traffic volume grows in both networks, but on LTE it grows faster. Data services on the legacy network are assumed to be completely supported by the packet domain. Data services have only a tiny impact on the comparison of different scenarios regarding the VoLTE implementation and so they are not modelled in high detail. Additional services are beyond the scope of this model (e.g. video, M2M communication).

Market segment	*Derived services*	*Description*
Low usage voice	Legacy voice	Subscriber on legacy network with low usage of voice services
	LTE voice	Subscriber on LTE network with low usage of voice services
High usage voice	Legacy voice	Subscriber on legacy network with high usage of voice services
	LTE voice	Subscriber on LTE network with high usage of voice services
	LTE voice flat	Subscriber on LTE network with increased usage of voice services driven by a special tariff
Corresponds to supporting network	Legacy data	Data services used by legacy subscribers
	LTE data	Data services used by LTE subscribers

Figure 3: Summary of market segments and services

3. Network traffic

Number of subscribers, traffic volume and busy hour estimations are used to calculate the busy hour traffic for voice subscribers. In the CSFB scenario the traffic generated by legacy and LTE subscribers needs to be supported by the legacy network. In the VoIMS scenario, traffic generated by LTE voice subscribers stays in the LTE network.

Data traffic assumptions lead equally to an expected busy hour load. Data traffic is mainly supported by the corresponding network. A special case is the handling of data sessions during voice calls for CSFB. The model is built on the assumption that data traffic of LTE subscribers is supported by the legacy network during the duration of the voice call.

Voice services generate a symmetrical traffic load, whereas data services are asymmetrical. Considering the scope of this model the following simplifications are made:

- voice and data busy hours are identical
- data traffic is only considered in the downstream direction
- no roaming for LTE subscribers due to lack of coverage required.

4. Radio network

Mobile radio networks are driven by two requirements: coverage and capacity.

Coverage driven dimensioning

Operators already running a mobile network would always try to reuse as much of the existing network as possible. There is a wide range of possibilities to operate both networks in parallel and gain the maximal synergy effects. Re-usage of network elements is not related to the type of VoLTE support; therefore, the radio networks are modelled without complex calculations as a reflection of the current situation in terms of Base station sites.

For a closer relationship to standard planning rules the radio network is divided into different density classes. The model uses the replication feature of STEM to reflect these density classes (*Dense; Urban; Suburban; Rural).*

The number of *NodeB* (sites) per density class and a rough estimation about the subscriber split into these density classes are expected as inputs. As we assume a re-usage strategy, these inputs can also be used as targets for the LTE rollout.

Traffic driven dimensioning

Cell capacities and dimensioning rules depend of course on the type of network; the model uses a simple bandwidth-driven approach, converting voice and data traffic into bandwidth requirements in the busy hour.

The capacity per carrier is dependent on many factors (traffic/service mix, number of users, distance and speed of users …). Without detailed knowledge of all these factors a simplified approach is to assume an average mean capacity and apply the busy hour traffic to this mean capacity.

Main elements

- *NodeB* and *eNodeB* sites are driven by geography and traffic load (maximum carriers and sectors per *NodeB*).
- *NodeB* and *eNodeB* carriers are driven by geography and traffic load (mean capacity).
- Transport requirements from *NodeB* and *eNodeB* are driven either by peak capacity of one cell or the sum of the mean capacities of all cells; at least one link per *NodeB* is required.

- RNC are driven by geography (deployment input for number of sites) and capacity limitations in terms of maximum number of *NodeB* sites served or maximum throughput on the *NodeB*-facing interfaces (Iub).

5. Core network

The legacy core network design and dimensioning is influenced by a huge number of factors from load and processing requirements, redundancy concepts, optimised transport networks and load balancing, up to optimised interconnection points. Detailed modelling is not required as the legacy network is already in place, and so the model concentrates on the major building blocks *MSC*, *GMSC*, *SGSN* and *GGSN*, which are connected to the radio network and between each other by standard SDH-type links.

The legacy core network consists of a circuit switched and a packet switched part. The circuit switched part shows significant traffic reduction if voice services are completely supported by LTE (VoIMS). This mainly affects the capacity of the MSC and transport requirements. The model can predict only the reduced capacity requirements for these elements; possible closures and savings are too complex to reflect in a generic model.

The LTE core network is called evolved packet core (EPC). It is a flat, all IP network and contains the main elements *MME*, *SGW*, *PGW* and *HSS*. As for the legacy network, the number of network elements is calculated based on simple assumptions and dimensioning rules.

Transport network dimensioning should be much easier than for legacy networks thanks to the flat all-IP structure. The connection from *eNodeB* to the first concentration/aggregation point would have to consider the maximum and the mean throughputs of the connected *eNodeB*, whereas the following network would be based on mean throughputs. There are several possibilities to build all-IP networks. Finally, the effect of voice traffic being transported (IMS) or not (CSFB) is tiny. Thus, a model having just one artificial ‘transport cloud’ in capacity steps or ‘slices’ (each slice could be a 10G ring) has been chosen.

6. Interconnection

Interconnections with PSTN and OLO are modelled so far based on minute-based rules. Significant changes are expected with the introduction of IP-based interconnections; this will be added later.

7. Scenarios

Two scenarios are modelled: both start with the current solution of circuit switched fallback to the legacy network; the timing of the implementation of voice over IMS is modelled as a scenario (*first mover / last mover*).

8. Cross section of results

The model investigates different possibilities of VoLTE support. Subscribers are migrating from the legacy network to LTE. The support of voice services by LTE leads to increasing customer satisfaction and could lead to an increasing market share for the first operator that introduces it (*first mover*).

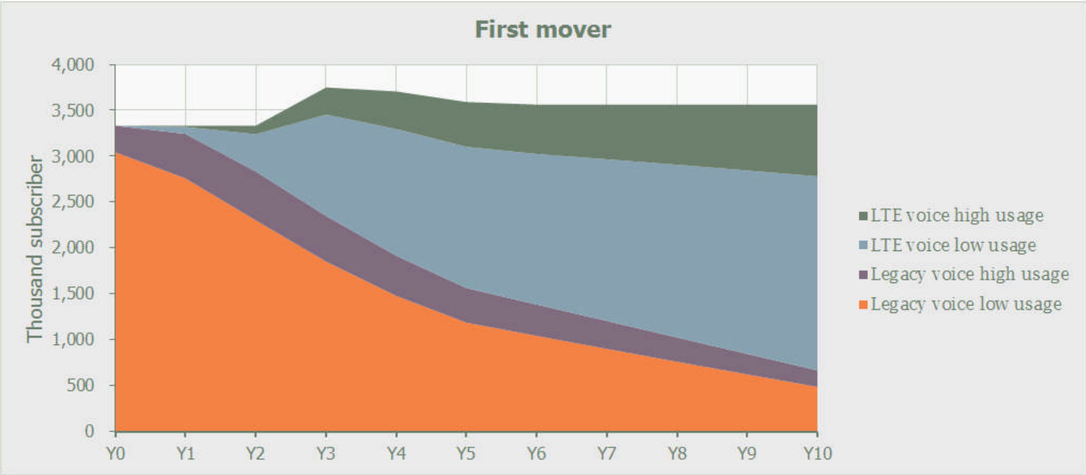

Figure 4: Increasing subscriber numbers driven by IMS implementation as first operator

Conversely, the operator introducing VoIMS later (*last mover*) loses LTE customers.

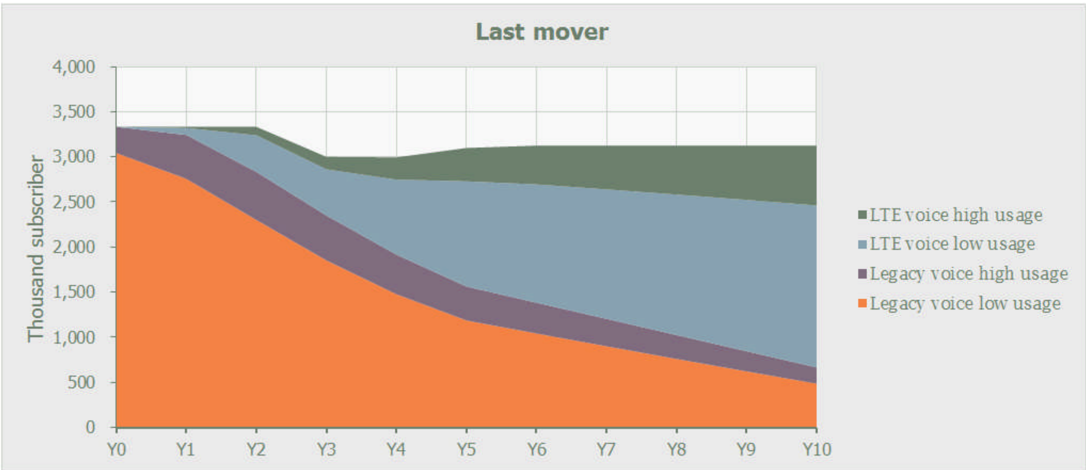

Figure 5: Decreasing subscriber numbers driven by late IMS implementation

The increase in number of subscribers creates additional revenue.

Figure 6: Potential revenue increase driven by increasing subscriber numbers compared to base case

The model contains the main building blocks of the legacy and LTE networks. The radio network is dimensioned in density classes. Results are available per density class.

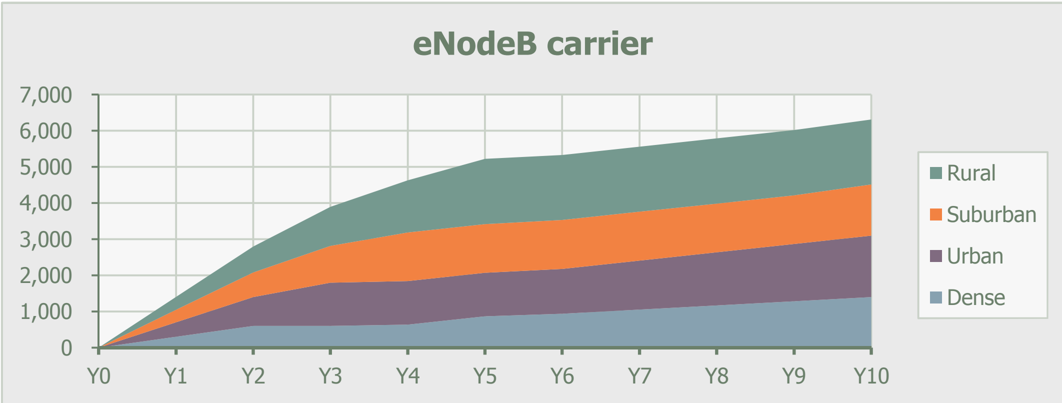

Figure 7: eNodeB carrier per density class

Voice traffic is minor in comparison to data traffic and so the effects on the dimensioning of LTE components (base stations, transport network) are minor.

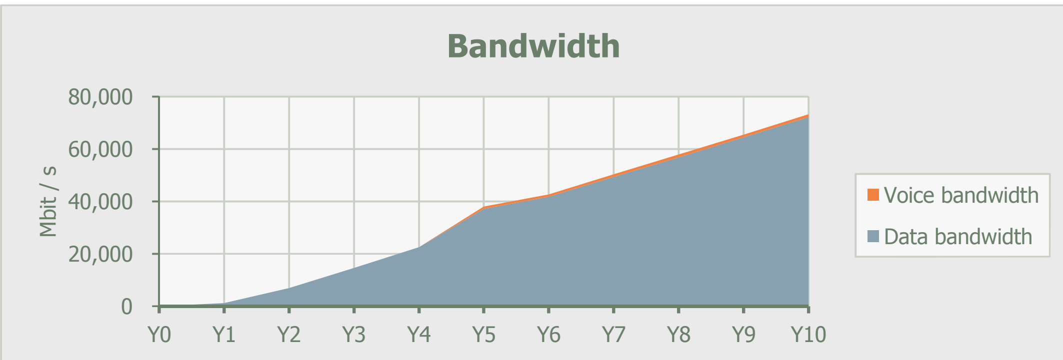

Figure 8: Data and voice bandwidth on LTE in case of IMS

The current model shows increasing termination revenue based on increased customer numbers, assuming a traditional minute-based charging contradicted by increasing interconnection fees. As the termination revenue per minute is higher than the interconnection fee, a positive net result is derived from increasing traffic.

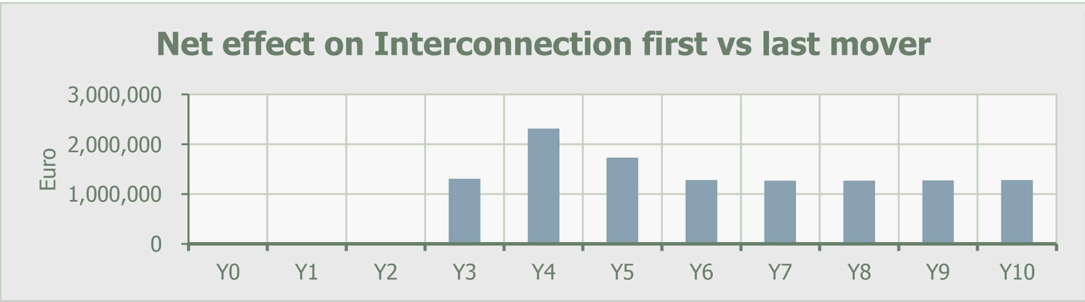

Figure 9: Comparison of interconnection charges and revenues

A major effect could arise from the possibility of IP-based voice interconnection.

9. External interfaces

The main inputs and results of the model are available to the user in Microsoft Excel workbooks. Model results can also be presented directly with the STEM results program. A web-enabled version can be accessed live at www.impliedlogic.com.

For more information please contact:

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