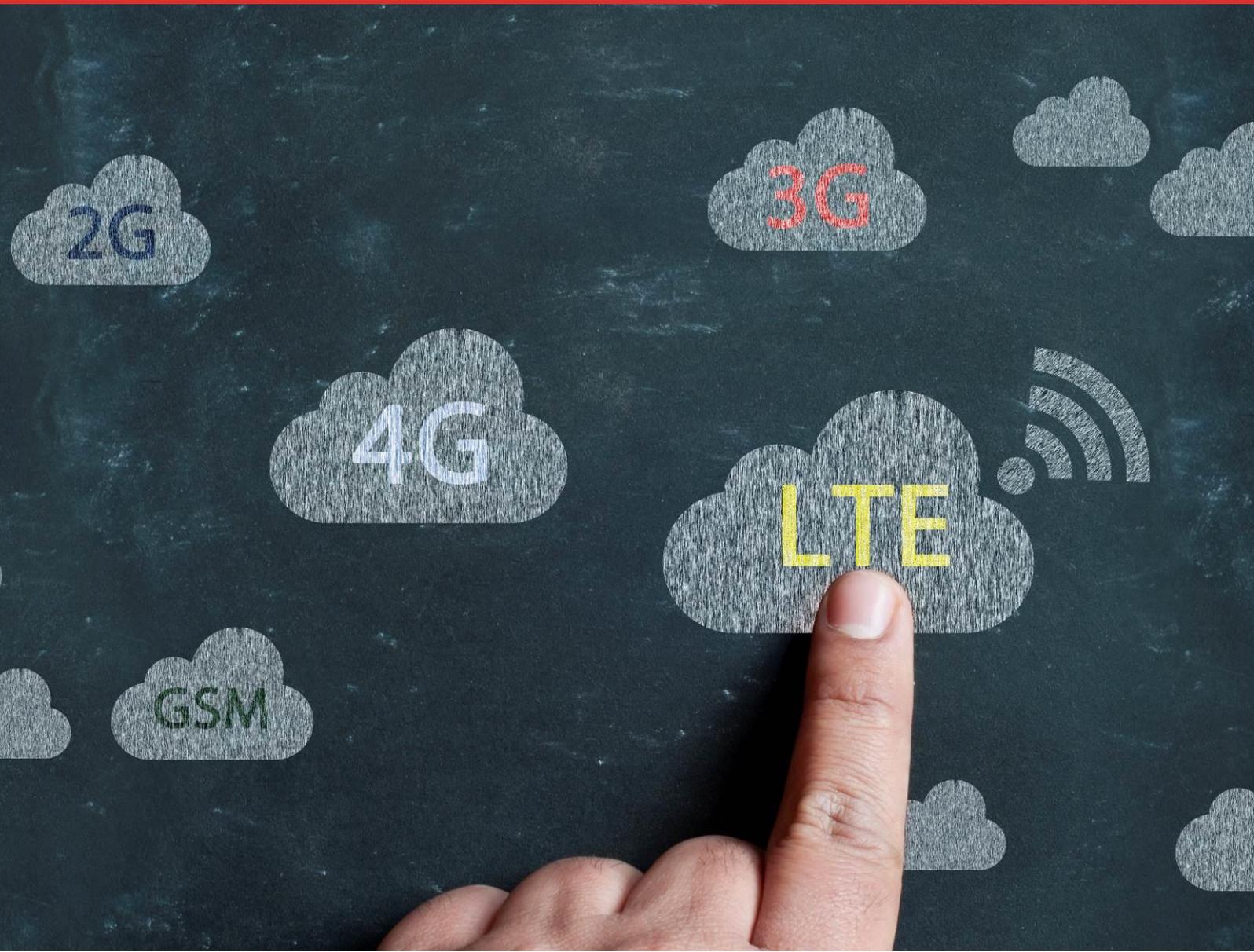WHITE PAPER

4G/LTE Networks

Introduction

There is a revolution going on to an all IP mobile environment. Much like the quiet revolution from plain old telephony services (POTS) to Voice over IP (VoIP) over DSL or cable, this 4G revolution will take place without the users realizing it.

Users are addicted to their smart phones and want the newest model, replacing their smart phones on average every 2 years. At this astonishing rate everyone will be hooked on 4G networks at mobile speeds that match most fixed DSL network rivals. This paper describes what makes 4G different from the past 2G and 3G networks, and the impact it will have on the world as we know it.

4G is All IP

4G is the fourth generation mobile network in accordance with the ITU-R requirements related to the performance for IMT-Advanced (International Mobile Telecommunications) radio interface(s), also known as the Long term Evolution (LTE) standard. Other acronyms often used is LTE-Advanced or LTE+, that are used to indicate that the operator uses Advanced LTE radio features where more radio carriers are aggregated on the radio interface to achieve higher data rates.

The 4G network is a full mobile IP network. There are no dedicated voice channels for circuit switched telephony in 4G. To offer voice services and interconnection to the "old" circuit switch world, mobile operators facilitate that users "fall back" to the old 2G and 3G technology for voice services which adds additional delays on call setup. Fall back to 2G/3G is considered a temporary solution as 4G coverage may still be limited and support of voice services over 4G is lagging on both the network and terminals. 4G operators will in the near future (2015+) deploy their own Voice over IP (VoIP)

platforms (See IMS and VoLTE white paper). The services offered over these 4G operator VoIP platforms will compete head-on with the existing, more established, over the top VoIP operators like Skype and Viber.

Mobile operators however hold an important asset, the phone number, that is still valued by most users. Furthermore, the operator's voice service will be under the familiar "voice button" on the phone.

4G high speed data

Potential 4G data rates are definitely much higher than 3G data rates. 3G (HSPA+) theoretical peak data rates are 56 Mbps (down) and 22 Mbps (up), but in practice users will typically get 8 Mbps (down) and 2 Mbps (up) speeds. In 4G the discrepancy between theoretical and practical peaks data rates are no different. Our measurements in live 4G networks show that 100 Mbps down and 60 Mbps up data rates are no exception. Average 4G download speeds of 20-30 Mbps are definitely higher than 3G download speeds. These data rates will outperform any DSL offer on the market. Especially copper networks that are optimized for download speeds are no match for the 4G uplink data rate.
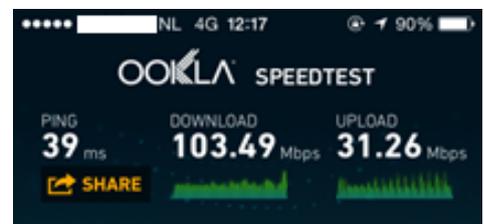

Figure 1: Speedtest measured 4G data rates in Rotterdam, the Netherland, December 2014

Achievable 4G data rates will mainly depend on, the implemented 4G radio features, the allocated radio channel bandwidth and the quality of reception. In their radio planning, operators will allocate 5MHz, 10 MHz or 20

MHz channels per cell. The larger the allocated bandwidth per cell, the larger the achievable 4G bitrate. Use of innovative antenna technology and modulation (LTE advanced) will further improve achievable 4G data rates.

4G will spell the decline for public WLAN

WLAN, also popularly referred to as Wi-Fi is used as wireless internet access at home, in the office and public places. In markets, in particular The Netherlands with four rival 4G networks, the competition is expected to drive down mobile data prices. Wide spread adoption of mobile data services with large data bundles will remove any incentive for the user to select public WLAN. While most public WLAN will get you a maximum 3 Mbps download speeds, users will discover that this performance does not match their 4G experience.

In the UK, EE the dominant mobile operator, has found that 43 per cent of its 4G subscribers are using fewer or no public Wi-Fi hotspots since adopting the high-speed 4G technology[1]. These are significant number of users saying WLAN goodbye. Some 4G mobile operators argue that congestion on 4G may be the only imaginable incentive for the 4G user to return to public WLAN. Arguably this argument only holds if the 4G operators will not be able to keep up with the demand for capacity. With more and more radio spectrum being allocated to mobile, this scenario is less likely.

In an 4G network, a data session is established by default. Unlike 2G and 3G, where one can turn off the data and still be connected for circuit switch (voice) services, in 4G no service will be available if you turn off your data. To allow users to manage their

4G data connection, the 3GPP standards body developed the ANDSF standard[2].

The ANDSF (Access Network Discovery and Selection Function) function provides information to the terminal about the available access networks (such as, 4G and WLAN) and policies to select the available networks. The purpose of the ANDSF is to help the terminal discover the access networks and to provide rules (policies) to prioritize and manage connections to these networks. These rules may for example specify that the terminal will only use WLAN for internet browsing while 4G is used for streaming and VoIP services. The rules can be set by the operator or user and can be very detailed if desired. The rules can be set per location and/or time of day, and will allow you to still use your WLAN at home for Internet browsing while reachable for voice calls via 4G (VoLTE).

4G when roaming

Users have become addicted to having the news, social networks, internet at their fingertips. Especially when vacationing, sharing those special moments with others is a must. Customers expect the same service when roaming, including the 4G data speeds that they will be accustomed to.

To enable 4G roaming, operators need to upgrade their roaming agreements both technically and commercially. For the technical part, the IPX (IP eXchange) operators play a vital role. The IPX operators, provide both the infrastructure for the Diameter and SIP signalling between roaming operators and the Gigabit backhaul to transport the data payload (media/Internet) traffic to the home operator.

[1]   http://www.mobileworldlive.com/ee-says-lte-is-knocking-public-wi-fi-usage

[2] 3GPP TS 24.312, "Access Network Discovery and Selection Function (ANDSF) Management Object (MO)".
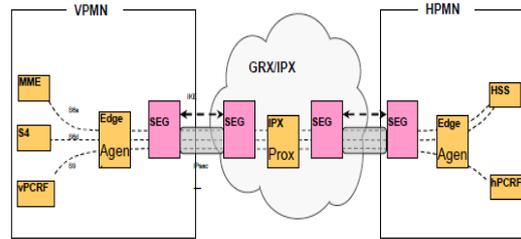
Figure 2 : IPX operator providing connectivity between visited network (VPLMN) and home network (HPLMN) - Source: GSMA ir.88 v-10.0

We are well aware that we are at a transition phase to a full 4G always connected network environment, where 2G and 3G support will only be there for legacy devices. With our experience with both the new (4G) and legacy systems, we can help to make this a successful transition.

MVNO and ESP

Mobile Virtual Network Operators (MVNOs) and Enhanced Service Providers (ESPs), do not have their own radio network but make use of the mobile network of a MNO (Mobile Network Operator). All MNO in the Netherlands have upgraded their network with 4G. This however does not imply that the MVNOs or ESPs on these networks have access to the 4G service.

Altough MNO's have 4G in their network, MVNOs and EPSs still need to think about 4G service offerings

Aside updating the commercial agreement with the MNO to include 4G, technical arrangement need to be in place to support 4G for MVNOs/ESPs. For example, an MVNO with its own HLR will need to deploy a Home Subscriber Server (HSS) and the Diameter signalling infrastructure in order to connect to the MNO.

An ESP with an own prepaid platform may need to fine tune real time rating parameters to cope with 4G data rates. Impact on billing platforms also need to be reviewed as some formats (e.g. cell IDs) may not be compatible with 2G and 3G formats.

Prodapt Consulting

Our seasoned consultants are experienced with LTE implementations at various operators. Network implications as well as the impact on IT systems are well understood.

Contact Details

Europe

Prodapt Consulting B.V.
De Bruyn Kopsstraat 14
2288 ED Rijswijk Z-H
The Netherlands

Phone   :   +31 70 414 0722

Adriaan van Donk
Phone   :   +31 6 5335 4335
E-mail   :   adriaan.van.donk@prodaptconsulting.com

Ben van Leliveld
Phone   :   +31 6 5335 4337
E-mail   :   ben.van.leliveld@prodaptconsulting.com

Paul Termijn
Phone   :   +31 6 3010 9117
E-mail   :   paul.termijn@prodaptconsulting.com