MIGRATION OF GSM NETWORKS TO EDGE

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ABSTRACT

Standardized in 3GPP as part of the GSM/WCDMA family, EDGE is a simple and cost-efficient upgrade that provides a more than threefold increase in both the capacity and performance of GSM/GPRS networks. EDGE is a digital mobile phone technology that allows improved data transmission rates as a backward-compatible extension of GSM. The structure of EDGE resembles to that of GSM network that enables it to be directly overlaid on the present structure of GSM network. Thus EDGE is also termed as backward compatible technology. EDGE combines efficient technology , a simple upgrade path and support in a large proportion of GSM and WCDMA terminals to create a compelling business case.

Keywords – Backward Compatible Technology, EDGE, GSM, Transmission Rates, WCDMA

I INTRODUCTION

Since its standardization was finalized by the 3GPP in year 2000, **EDGE – Enhanced Data rates for Global Evolution** – has achieved market maturity in terms of networks, terminals and business models. Upgrading to EDGE has become a natural step for operators who want to offer high-performance mobile data services over GSM.EDGE gives them a cost-efficient way to reach the mass market to boost the uptake of mobile data services. Market data reveals that, on average, EDGE users consume up to three times as much data as standard GPRS users. EDGE combines efficient technology, a simple upgrade path, and support in a large proportion of GSM and WCDMA terminals to create a compelling business case. Half of all mid- and high-end GSM terminals sold now support EDGE, and there is a clear trend towards EDGE being supported in low-end terminals as well. EDGE is becoming a viable alternative for providing Internet access in markets where fixed network infrastructure is yet to be established.

The performance of EDGE has improved steadily since its introduction: today it offers user bit-rates of around 250 kbit/s, with end-to-end latency of less than 150 ms. this performance is sufficient to make any data service available today attractive for users. EDGE is an important complement to mobile broadband services delivered today over WCDMA/HSPA and in the future LTE networks. EDGE provides both a fast way to achieve good indoor and outdoor coverage, and to meet increasing demand for mobile Internet services through optimal use of available radio spectrum.

II EVOLUTION OF EDGE TECHNOLOGY

EDGE is an improvement to the GPRS air interface that enables higher user bit-rates and greater system capacity by enhancing the physical layer. The higher bit-rates place extra demands on parts of the GPRS network .The core GPRS nodes, SGSN and GGSN, are more or less independent of user bit-rates and no new hardware is required. In the radio network, base station transceivers need to be EDGE-capable, and base station and BSC/PCU software needs to be updated. EDGE improves the situation by employing a new modulation method and link quality control.8 PSK(in figure 1) is a high level modulation method that carries three times more information through a extendedsignal constellation. GMSK modulation, as defined in GSM/GPRS, is also part of EDGE.

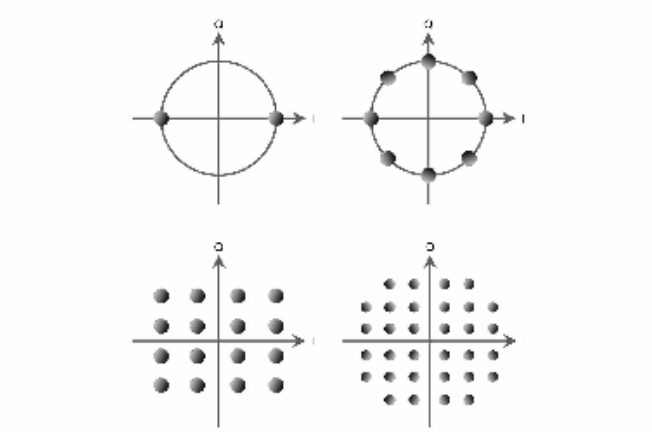

Figure 1. Top left: Gaussian minimum-shift keying (GMSK) – 1 bit per symbol. Top right: Octonary phase shift keying (8-PSK) – 3 bits/symbol. Bottom left: 16QAM: 16-level constellation – 4 bits/symbol. Bottom right: 32QAM: 32-level constellation – 5 bits/symbol

Nine modulation and coding schemes are defined in EDGE. Link quality control dynamically selects the modulation and coding scheme for transmission of data over the air interface. The protection of the data is adapted to the channel quality to obtain optimal bit-rate. Standard GPRS bit-rate saturates at relatively low channel quality, whereas EDGE user bit-rates increase with better channel quality. Link quality control in EDGE uses both link adaptation and incremental redundancy where the initial coding is selected based on measurement of radio quality and additional redundancy is sent if decoding fails.

III EDGE EVOLUTION ENHANCEMENTS

3.1 Latency reduction

EDGE Evolution makes substantial improvements in latency and perceived delay through reduced Transmission Time Interval (TTI) and additional protocol enhancements. Radio blocks are currently transmitted over four consecutive bursts on one timeslot using a TTI of 20 ms. Reducing the TTI to 10 ms

improves latency substantially, to below 100 ms. The four bursts are then transmitted on more than one timeslot (parallel timeslots on two carriers or dual timeslots on one carrier).

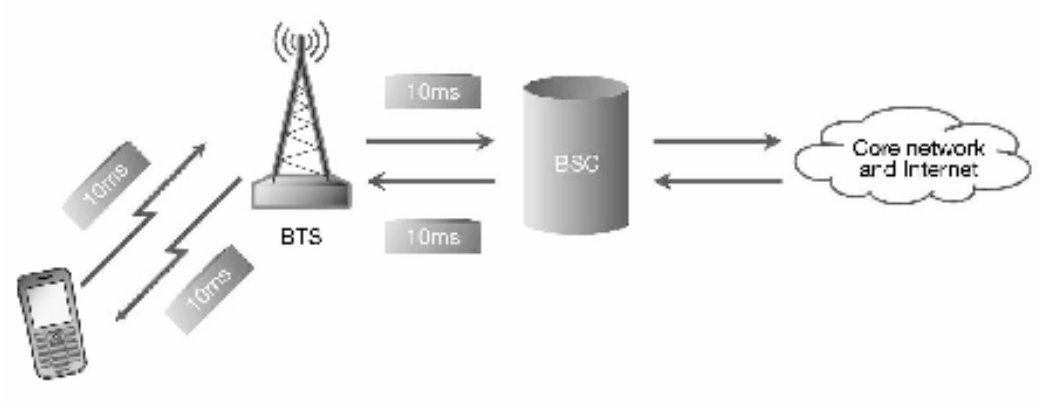

Figure 2. Lower latency with reduced TTI.

3.2 Dual Carriers

The most obvious improvement to peak bit-rates is through the introduction of dual carriers in the downlink, increasing the carrier bandwidth available above 200 kHz. EDGE terminals already use multiple timeslots for transmission and reception.

Today's terminals receive on up to five timeslots. The introduction of dual carriers doubles the available bandwidth (to 400 kHz) as well as the practical peak bit-rate. Using dual carriers and five timeslots on each carrier provides bit-rates of almost 600 kbit/s, with no other changes to EDGE.

3.3 Higher-Order Modulation, Turbo Codes And Increased Symbol Rate

Higher average and peak bit-rates and improved spectrum efficiency are achieved through more advanced modulation, more efficient channel coding and an increased symbol rate (in practice, increasing the carrier bandwidth).

Using 16QAM instead of 8-PSK modulation for some of the current Modulation and Coding Schemes (MCS) improves robustness against interference and, as a result, increases the average bit-rates. In this case, the higher number of bits per symbol (see figure 9), is used to increase the channel coding. Using so called 'turbo codes', which handle error correction more efficiently than current convolutional codes, improves average bit rates even further. With twelve MCSs – three more than with regular EDGE – enabled by higher-order modulations (16QAM and 32QAM in addition to GMSK and 8-PSK), the peak bit rate is boosted to 100 kbit/s per timeslot, equating to user bit-rates of 1 Mbit/s if dual carriers are used.

3.4 Dual-Antenna Terminals

Dual-antenna terminals enable efficient interference rejection techniques, similar to those used in base station receivers. By combining signals from the two antennas, a large proportion of the interference can be cancelled out, significantly improving average bit-rates and spectrum efficiency.

3.5 Service coverage

Dual antenna terminals can also improve service coverage. With two antennas and efficient combination methods, weaker signal transmissions can be captured. Around 3 dB less (roughly 50 per cent) signal power is needed to provide service, enabling larger cells or lower output power.

IV EDGE PERFORMANCE TODAY AND TOMORROW

Today's EDGE technology offers greatly improved performance compared with standard GPRS and the first implementations of EDGE. The increased user bit-rates and reduced latency offered byEDGE today enhance existing applications and make new services like music downloads, mobile TV and messaging services more attractive to users.

The performance of EDGE, as experienced by the end-user, is dependent on a variety of system characteristics. For example, a web download consists of multiple requests and downloads of objects and, consequently, the time it takes to download the page depends on the end-to-end round-trip time and user bit-rates in the system – which are the main performance indicators for any packet data system. Performance is normally evaluated across a common set of subscriber applications.

Today's state-of-the-art EDGE networks typically offer user speeds of 200 kbit/s, and 250 kbit/s in peak, with end-to-end round-trip time (latency) of 150 ms (as shown in Figure 3). Features like advanced link quality control and persistent scheduling have improved performance significantly over standard GPRS and the first implementations of EDGE. For example, the time it takes to download a web page is about one-quarter that taken with standard GPRS.

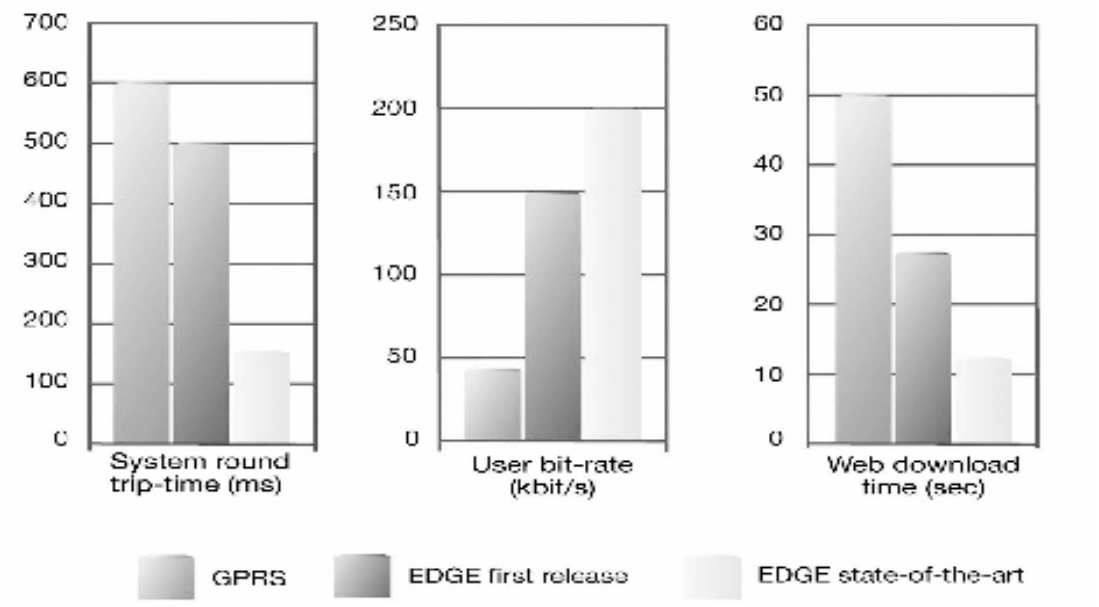

Figure 3. Typical Live Network Performance Indicators And Application Performance.

V EDGE ADVANTAGES

In the mid-1990s GSM deployment gathered pace around the world, and this growth continues today. More than 80 per cent of all mobile users in the world are served by GSM, and every month another 30–40 million new users join the GSM community.

As a mobile technology, the coverage, economies of scale, simplicity and maturity of GSM are unmatched, and these are all benefits that EDGE shares too. *Introducing EDGE normally only requires a software upgrade of the existing GSM/GPRS network: it does not require any new sites or new spectrum, and has no impact on existing cell or frequency plans.* With EDGE, GSM operators are able to extend their service offering to include high-performance mobile data. They can rapidly target all potential data users thanks to EDGE's ability to achieve high geographic and population coverage in a short period of time. This is one of the main reasons that several hundred GSM networks have already upgraded to EDGE, or are in the deployment phase. EDGE is not launched as a service: it is an enabler of new services and faster Internet access – a virtually mandatory upgrade, with a clear and compelling business case.

Mobile phones and the Internet are an increasingly important part of people's day-to-day lives. Now, thanks to the advances being made in mobile networks and terminals, these two invaluable technologies are coming together. Mobile data rates are getting higher, prices are coming down, and services are becoming more user-friendly.

VI CONCLUSION

EDGE is delivering high bit-rates and spectrum efficiency for GSM operators around the world, and is becoming a standard capability of GSM and WCDMA phones. In effect, EDGE enables 3G applications over current GSM networks, and provides seamless services with 3G.Today, EDGE enables user bit-rates of 250 kbit/s and a latency of 150 ms. This means it can handle four times as much traffic as standard GPRS, increasing the usability of mobile data services, enhancing customer satisfaction and boosting data revenues.EDGE Evolution, currently being standardized in 3GPP, will improve performance and coverage even further, with bit-rates of up to 1 Mbit/s and latency below 100 ms. For GSM operators around the world, this makes the business case for EDGE even stronger than it is today – whether or not they have access to 3G spectrum

REFERNCES

[1]. *"The Evolution Of Edge"*, White Paper By ERICSSON in February 2007.

[2]. *"Enhanced Data Rates for GSM Evolution(EDGE)"*, White Paper On Nokia's vision for a service platform supporting high-speed data applications By NOKIA in 1999.

[3]. *"GSM/EDGE Continued Evolution"* White Paper By ERICSSON prepared by Håkan Axelsson, Peter Björkén, Peter de Bruin, Stefan Eriksson and Håkan Persson.