ISO 9001 : 2008

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NEWSLETTER

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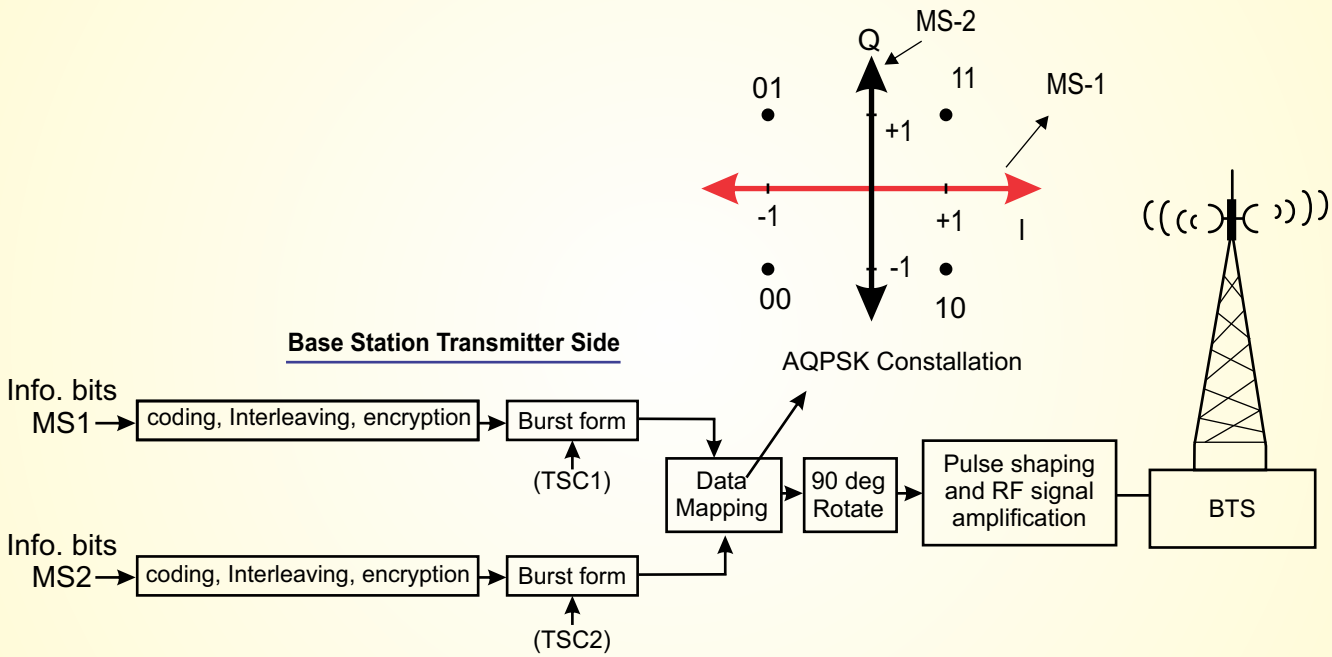
Capacity Enhancement Technique in GSM VAMOS



VAMOS Modules for transmissions to two mobile stations MS1 and MS2

ISO 9001:2008

TELECOMMUNICATION ENGINEERING CENTRE

IN THIS ISSUE

Driven by new subscriptions, extended coverage, and lower tariffs, conventional voice traffic is expected to grow nearly threefold in near future. However, revenues per user are declining, compelling mobile operators to cut costs by improving GSM networks' efficiency.

The Orthogonal Sub Channel (OSC) enables operators to double voice channel capacity in GSM radio networks by upgrading software. This upgrade is based on quaternary modulation and multi-user MIMO techniques in the downlink and uplink, respectively. To ensure immediate gains, both techniques can be applied with typical GSM handsets that support Single Antenna Interference Cancellation (SAIC). 3GPP has standardized these techniques in a work item called VAMOS, providing further gains in the near future.

It is expected OSC to reduce operator's CAPEX and OPEX for voice services by up to 50%.

1.0 Introduction:

VAMOS i.e. Voice services over Adaptive Multi-user Orthogonal Sub channels uses the technique of Orthogonal Sub Channel (OSC). The OSC aims to improve cost efficiency for GSM voice services and support the vision of connecting five billion people by 2015.

The technical method of doubling voice channel capacity entails adopting the quaternary modulation scheme in the downlink and spatially orthogonal sub channels in the uplink, also called a multi-user MIMO. With these two key techniques linked to adaptive multi-rate (AMR) half-rate, four legacy SAIC handsets can be served at the same time within a radio time slot.

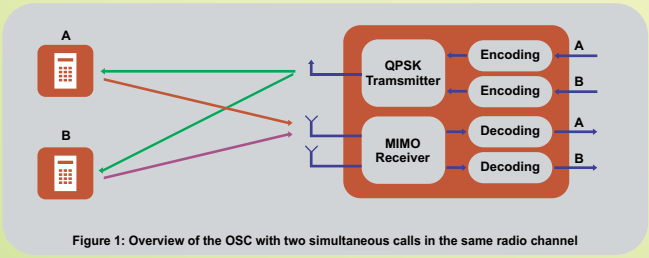


Figure 1: Overview of the OSC with two simultaneous calls in the same radio channel

In addition to new 3GPP VAMOS handsets, these radio techniques are also applicable to existing GSM SAIC handsets. Consequently, upgrading the software in GSM radio networks brings immediate benefits to network operators.

As far as radio link performance goes, receiving an orthogonal sub channel requires about the same signal energy per user as for a conventional GMSK channel. System simulations have shown significant capacity gain when the available spectrum is exploited using fewer TRXs. Each TRX's capacity increases to maintain maximum coverage and reduce per-user energy consumption. This means the OSC is able to minimize CAPEX and OPEX, paving a profitable path to growth for operators. Specifically, OSC helps operators:

- Improve BTS hardware utilization
- Exploit available spectrum efficiently
- Maintain coverage in capacity extensions
- Improve energy efficiency
- Enjoy immediate gains with existing handsets

2.0 Key cost-efficiency benefits for network operators

2.1 Improved BTS hardware utilization

The OSC feature's greatest asset is its ability to double radio capacity, enabling operators to efficiently exploit and even reduce installed hardware. For example, system simulations have shown that served traffic could exceed 20 Erlangs per carrier. And with the trunking effect, the OSC could bring even greater gains to smaller BTS configurations.

As the OSC increases voice capacity, it also frees up capacity for data traffic.

For instance, one carrier could be allocated to a downlink dual carrier without compromising voice quality or capacity in a typical four TRX per cell configuration with OSC. By introducing the OSC we may also free up antennas when another radio technology or operator needs to share the same site.

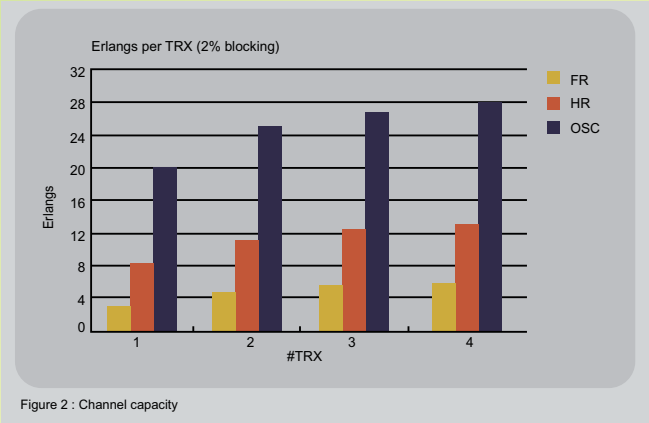


Figure 2 : Channel capacity

2.2 Efficient spectrum utilization

The OSC also increases spectral efficiency measured in Erl/MHz/cell, especially when the number of carriers is restricted in the available spectrum.

As figure 3 shows, the OSC can fully exploit available spectrum with less TRX hardware than is necessary for AMR.

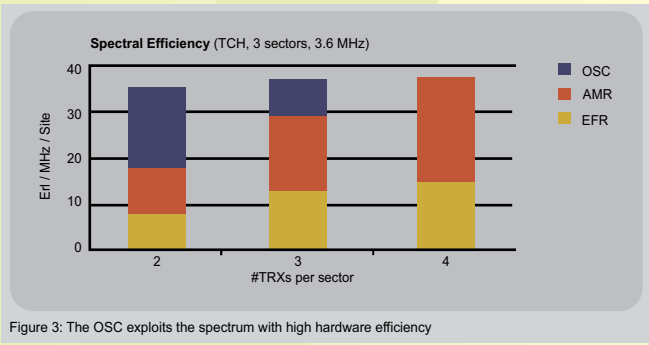


Figure 3: The OSC exploits the spectrum with high hardware efficiency

The mean C/I value is generally greater than 12 dB, so the OSC may be used typically for over 50% of calls. Dynamic Frequency and Channel Allocation (DFCA) excels at pairing and allocating two users in the optimal channel, and can further improve spectral and hardware efficiency.

2.3 Minimized site density

In the past, mobile operators seeking to extend capacity to satisfy growing traffic demand generally augmented BTS hardware at cell sites with antenna combiners to add more transceivers. Wideband transmitter combiners, for example, introduce about 3.5dB loss. Compensating for the decrease in coverage may necessitate new sites. The OSC, in turn, maintains the coverage area in capacity extensions. This can cut the site count by up to 50% and the operator's costs accordingly.

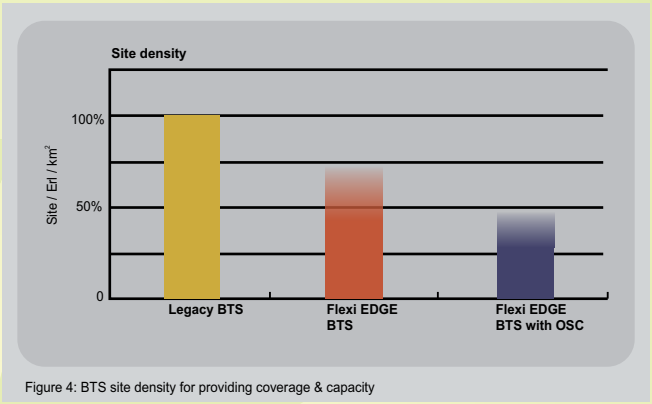


Figure 4: BTS site density for providing coverage & capacity

The OSC offers an efficient method of adding channel capacity while leaving the site hardware configuration untouched.

2.4 Improved energy efficiency

Less hardware means greater energy efficiency. Simulations with a typical traffic pattern show that the OSC reduces per-Erlang energy consumption by 20 to 50%. By extension, fewer or smaller rectifiers, cooling units, and battery backups will further reduce each site's energy consumption. Moreover a country-wide network based of fewer sites requires less power.

Conserving energy is crucial to cutting global carbon emissions. Network Operators could offer a growing range of green products designed to maximize network infrastructure's energy efficiency.

2.5 Fast deployment with existing handsets

Deploying the OSC successfully requires mobile handsets that support AMR and SAIC. Estimates put the total number of such devices on the market today at about one billion. So the operators can benefit immediately by introducing the OSC.

3.0 Technical concepts

3.1 Training sequences differentiate channels

Various training sequences used in a legacy burst structure can serve to separate two simultaneous users in the downlink and uplink. These training sequences must exhibit low cross correlation and good auto-correlation in the presence of another sub channel.

The table 1 shows training sequences that provide this combination today; enabling multiplexing of widely used SAIC handsets in both sub channels.

TRS-A/TRS-B	0	1	2	3	4	5	6	7
0	–		Yes	Yes				Yes
1		–	Yes	Yes				Yes
2	Yes	Yes	–			Yes		
3	Yes	Yes		–	Yes			
4				Yes	–		Yes	
5			Yes			–	Yes	
6					Yes	Yes	–	
7	Yes	Yes						–

Table 1: Suitable training sequence pairs for use with existing handsets

3GPP seeks to standardize an optimized set of training sequences to achieve best performance and compatibility with upcoming VAMOS handsets.

3.2 Quaternary modulation in the downlink

The BTS multiplexes two users in the downlink, employing quaternary modulation as a combination of two orthogonal and binary sub channels with different training sequences. The sub channels are mutually orthogonal, and use $\pi/2$ symbol rotation to imitate GMSK, so legacy GMSK SAIC handsets can receive them separately.

The figure 5 shows how users A and B are mapped in a quaternary constellation known as QPSK or 4-QAM, which is also a subset of an 8-PSK constellation.

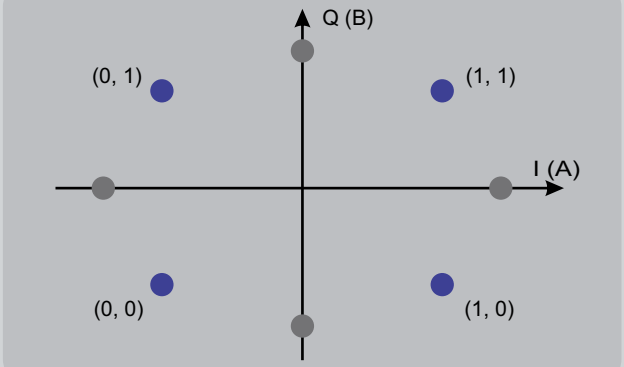


Figure 5: Bit mapping for two users (A, B) with QPSK, a subset of 8PSK

User A is mapped to the first bit and user B to the second bit, with the resulting signals appearing along the 'I' or 'Q' axis, respectively. QPSK is switched to GMSK when only one sub channel is active to also facilitate DTX gains. The transmitter switches off when both sub channels are inactive. Switching from QPSK to GMSK is possible to make signaling more robust. This switching between modulations is transparent to the legacy SAIC handset because it expects to receive GMSK all the time.

3.3 Optimized pulse shaping filter maximizes DL coverage

In the downlink, with the benefit of an added, optimized pulse shaping filter, QPSK requires about the same amount of energy per user as the related GMSK channel. As the graph in figure 6 shows, the modulation shaping filter currently used in EGPRS requires about 2dB more power.

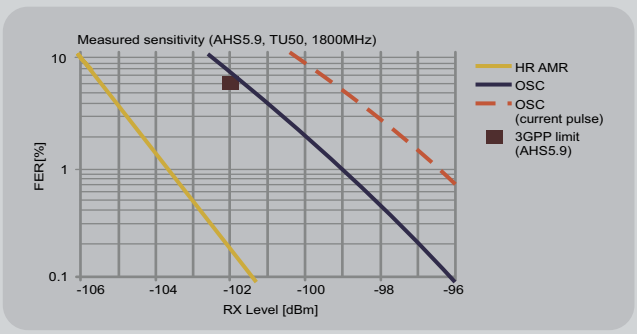


Figure 6: Optimized pulse shaping filter maximizes the OSC's coverage

This indicates the measured performance with a legacy handset for 5.9k half-rate AMR codec and the OSC with current and optimized pulse shaping filters.

3.4 Multi-user MIMO in the uplink

In the uplink, two handsets use conventional GMSK transmission differentiated by the training sequence and spatially orthogonal sub channels provided by independent multipath propagations. Base station hardware requires antenna diversity to receive two users who are transmitting at the same time. This rule of one antenna per user applies to multi-user MIMO systems in general. Indeed, the power received in the BTS should be aligned by means of power control and proper user pairing within a 15dB window.

3GPP's LTE standard has adopted similar multiple-input-multiple-output uplink technology.

3.5 Matchmaking and resource optimization by DFCA

The pairing of two users in the same radio channel is one of the most critical of all the aspects in radio resource management. The BSC can take advantage of the software-based pairing capability of DFCA (Dynamic Frequency and Channel Allocation) to search for the best pair among several candidates. Although the BSC uses part of the DFCA algorithm for pairing, it is not necessary to synchronize BSS, as is usually the case when introducing DFCA.

The great advantage of a synchronized network is that the DFCA feature can also search for the best radio resources, for example, frequency hopping parameters and training sequences. DFCA excels when there are more resources to choose from and when users have specific C/I demands.

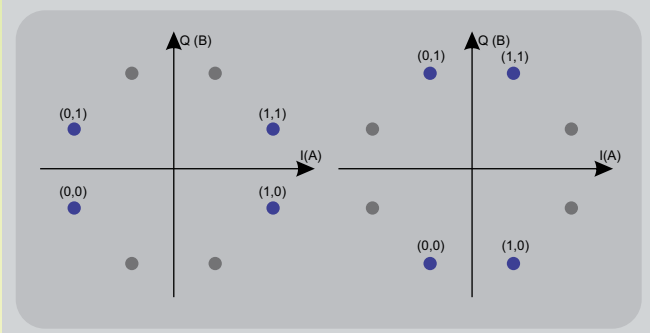


Figure 7: Quatemary constellations with unequal power,
left-hand diagram: user A has larger power than user B, right-hand diagram: vice versa

So DFCA excels at optimizing the tasks of:

- Matching pairs for the OSC
- Searching for the best training sequence for the OSC
- Searching for the best radio resources; that is, frequencies, time slot, and hopping parameters
- Optimizing system capacity for voice users with different C/I demands

3.6 Further gains with upcoming 3GPP VAMOS handsets

3GPP aims to standardize this new channel type in Release 9 as part of a work item called VAMOS, to include support for legacy and new VAMOS handsets.

New VAMOS handsets will be "aware" of quaternary modulation and training sequences in both sub channels, providing about 1dB link gain over legacy SAIC handsets.

This improved receiver performance also enables sub channel-specific power control, where the square quaternary modulation constellation in the downlink changes to a rectangular constellation, boosting power by almost 2dB for another sub channel. Constellations providing unequal power to sub channels can be derived from the existing 8PSK constellation.

This enables precise blind detection of the given modulation constellation in VAMOS handsets on a burst basis to ensure optimum performance.

Advanced receivers may also be used with the OSC in handsets, for example, receiver diversity that could double spectral efficiency.

4.0 Conclusion:

The OSC efficiently exploits radio spectrum and hardware to cope up with operators' biggest challenges – cost, capacity, and coverage. With fewer sites and more efficient hardware, the network consumes less power to deliver the same traffic, and ensures the operator leaves a much smaller environmental footprint.

The OSC factors affordability into the business equation, enabling operators to cater to new and existing subscribers with more competitive prices. Optimized pulse shaping in the BTS transmitter and matchmaking in the BSC are key capabilities for maximizing gains brought about by the OSC feature.

Doubling voice capacity and enhancing overall efficiency requires merely a software upgrade in the radio network. The technique works with existing GSM SAIC handsets, providing immediate benefits for operators who have chosen Flexi EDGE BTS.

References :

(i) http://www.ericsson.com/article/vamos_1103876834_c

(ii) http://www.telecomsemea.net/system/files/Ericsson_VAMOS_WP_0.pdf

(iii) 3GPP Specification Change Request records for: 45.004

(iv) LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (3GPP TS 36.101 ver. 10.3.0 Release-10)

(v) The LTE Opportunity Connected Devices Meet LTE by Sierra Wireless

(vi) LTE – a 4G solution, Ericsson White paper

(vii) TD-LTE and FDD-LTE a Basic Comparison: ascom

(viii) LTE-FDD and LTE-TDD for Cellular Communications A. Z. Yonis1, M. F. L. Abdullah1, and M. F. Ghanim2

Shri A.K. Mittal joins TEC

Shri Ajay Kumar Mittal took over as Sr. DDG TEC on 22.04.2013. He belongs to ITS 1977 batch. He did his Graduation in Engineering in Electronics and Communications in 1976 from IIT Roorkee. He has over 34 years of vast experience of working in telecom sector. Way back in 1981, he was instrumental in setting up of the ground segment of New Delhi Satellite Earth Station located at Sikandarabad (UP) for INSAT – 1 series of satellites. In 1991, as Director in the Headquarter of Department of Telecom, he handled licensing, regulation and tariffing of telecommunications services. He has served in BSNL in various capacities. He was responsible for setting up MLLN,SSTP and Ku band VSAT networks in BSNL. Before joining TEC, he was working as Senior Deputy Director General in DoT headquarters looking after policy on licencing of Access Services and related matters as well as implementation of telecom security related policies.

हिंदी कार्यशाला

दूरसंचार इंजीनियरी केंद्र द्वारा दिनांक 20 जून 2013 को ''हिंदी अनुवादन'' विषय पर कार्यशाला का आयोजन किया गया। श्री केवल कृष्ण, वरिष्ठ तकनीकी निदेशक, राजभाषा विभाग द्वारा इस कार्यशाला में व्याख्यान दिया गया तथा शब्द कोष, यूनिकोड और हिन्दी अनुवाद के मूल सिधांतों एवं दैनिक व्यवहार में किस तरह हिन्दी को त्रुटि रहित लिखा एवं बोला जाए इस पर प्रकाश डाला गया।

कार्यशाला में भाग लेते हुये अधिकारी एवं कर्मचारीगण

Activities at NTIPRIT

ADEsT probationers of 2010 batch were taken on a trekking tour to Manali from 4th May to 13th May. The purpose of this tour was to inculcate team spirit among the young officers. The tour proved to be very encouraging and successful. Here are some glimpse of the tour. The details of various courses conducted at the institute are given on the last page.

Approvals from Apr'13 to Jun '13

S.No	Company/Product
1	M/s Nokia India Private Limited
1.1	Bluetooth,MD51W
1.2	Bluetooth,MD100W
1.3	Switching Node with Network-Network Interface at 2048 Kbits,IPA 2800
2	M/s Cygnus Microsystems (P)
2.1	High Speed Line Driver,CYGNUS 850 (64K COD) (G.SHDSL Stand –Alone Type)
3	M/s Signal Networks Pvt. Ltd
3.1	ISDN PABX,SGN ICM 30
4	M/s Sony Mobile Communications
4.1	Bluetooth,SBH-20
5	M/s Tata Power Company Limited,
5.1	IP PABX FOR PRIVATE USE,NG 2121
6	M/s Sunren Technical Solutions Pvt. Ltd
6.1	G - 3 FAX Machine, PROXPRESS M3370FD
6.2	G - 3 FAX CARD, BOISB-0903-00
7	M/s MRO TEK Limited,
7.1	High Speed Line Driver,WL /B / FE/ 2W/AC/DC
8	M/s Huawei Telecommunications India Co. Pvt. Ltd.,
8.1	Switching Node with Network-Network Interface at 2048 Kbits,UGC 3200 with UMG 8900

Important Activities of TEC during Apr13 to June13

GR/IR Amended
- Microduct for FTTH Applications
- Amendment to GR for SMPS Based Power Plant

Technical White Papers/Study paper
- VAMOS and LTE devices
- Higher Capacity PON

Other activity
- Coordination with IPv6 ready logo Committee, Japan
- Testing of MSC server (Huawei) at Gurgaon
- Training on "NGN transport lab test Bed"
- Sub DCC on Thermoshrink sleeve, clousure channel and branch – off clip
- Sub DCC on SMPS based Power Plant

Presentation on
- IPv6 by DDG (NGN) in FICCI
- MPLS-TP technology in TEC

Activities at NTIPRIT

a) Courses For ADEsT 2010 batch
- Course on Cyber Security
- Course on Lawful Interception & Monitoring Sys.
- Course on NGN and LTE/ WiMAX/3G
- Course on Licensing and USOF

b) Courses For ADEsT 2011 batch
- Course on Radio Communication
- Course on Satellite Communication
- Course on Optical Communication
- Course on Data Communication

c) In-service Course on IPV6

d) Training for 34 probationers of JTO Batch, 2011 to commence from 29th July

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Approvals issued by TEC during the period from April 2013to June 2013

Interface Approvals..... 08
Type Approvals 0
Certificate of Approvals.....03

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Editor : Sunil Purohit, DDG (S) Phone : 23329354 Fax : 23318724 E-mail : ddgs.tec@gov.in

Sai Art Graphics : Mob. 9899027477