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Date: January 9, 2002

Purpose: TeleCorp PCS, Inc Quarterly TTY/TDD Report for all Lucent MSC served markets

TeleCorp PCS is fully compliant with all TTY requirements in all Lucent MSC served markets.

Date: January 9, 2002

Purpose: TeleCorp PCS, Inc Quarterly TTY/TDD Report for all Ericsson MSC served markets

Development Activities

1. network infrastructure software development;
See Attachment 1: Sony Ericsson Mobile Communications and Ericsson Inc TTY Forum #20 Report
2. handset development and testing plans;
See Attachment 1: Sony Ericsson Mobile Communications and Ericsson Inc TTY Forum #20 Report
3. beta testing and lab testing;
See Attachment 1: Sony Ericsson Mobile Communications and Ericsson Inc TTY Forum #20 Report
4. release and general availability to carriers of network infrastructure software;
Tritel Communications Inc. has purchased the necessary hardware and software and is in the process of installation and testing.
5. availability to carriers of full acceptance test units;
See Attachment 1: Sony Ericsson Mobile Communications and Ericsson Inc TTY Forum #20 Report
6. efforts toward achieving digital wireless solution compatibility with enhanced TTY devices;
See Attachment 1: Sony Ericsson Mobile Communications and Ericsson Inc TTY Forum #20 Report

Testing and Deployment Activities

7. carrier coordination of testing with PSAP;
Tritel will utilize relationships developed during Phase I E911 implementation to arrange end to end testing.
8. carrier testing activities, including field testing, consumer end-to-end testing, and other necessary tests;
See Attachment 1: Sony Ericsson Mobile Communications and Ericsson Inc TTY Forum #20 Report
9. retail availability of necessary consumer equipment;
See Attachment 1: Sony Ericsson Mobile Communications and Ericsson Inc TTY Forum #20 Report
10. geographic scope of network infrastructure deployment;
Tritel has made no deployments as of this date.

Attachment 1
Sony Ericsson Mobile Communications and Ericsson Inc.
TTY Forum #20 Report
December 10, 2001

This report details the verbal presentation provided by Sony Ericsson and Ericsson Inc. (hereafter collectively referred to as "Sony Ericsson") at the December 10th, 2001 TTY Forum 20. The attached report identifies development and testing status for network and handset products, release and general availability dates, efforts towards achieving compatibility with TTY devices, system testing, deployment activities, technical issues, and contact information.

Sony Ericsson has completed the development of TTY technology intended for integration within its products. These products are built to the approved ballot standards from the industry. The development testing has been completed for many of the products, and the products have been demonstrated to the carriers in a number of test events within the FCC required deadlines. Products that have completed the development testing, have been released to the carriers for acceptance testing. In general, the technical feasibility to transport TTY across the digital cellular systems has been proven by the product operability testing. Results have been published for TDMA base stations and TDMA handset products. GSM handset and GSM infrastructure demonstrations are nearing completion. CDMA systems are working through experienced problems related to the 13K-vocoder performance.

Isolated technical flaws and system integration issues continue to be identified in the product test and carrier test phases. Testing continues to take place in development labs, infrastructure and TTSI (ATIS sponsored) test events. Recently, interoperability incompatibilities have been identified from undocumented IS-823A vocoder functions, and between IS-840 performance standards and PSAP TTY units. Issues with CDMA test case failures, AMPS baseline error rates, and driving error rates have also been identified.

While handset to infrastructure compatibility testing has taken place between several manufactures, there is an incurred risk to interoperability testing for manufacturers that missed the initial handset testing. The next stage of testing is expected to include base station to base station interoperability, base station to landline TTY, carrier infrastructure compatibility, and PSAP operability testing. Identifying and resolving the performance objectives will require the involvement and cooperation among the manufacturers, carriers, 911 PSAP facilities, standards organizations, and governing bodies. Sony Ericsson continues to actively develop and test TTY compatible products, participate and monitor the industry standards and test events, and work closely with the regulatory bodies and the ATIS Incubator. Sony Ericsson is closely monitoring the data generated by TTSI to determine compliance to the FCC mandated <1% TTY character error rate.

8) Network Infrastructure Development:

TDMA Status:

TDMA network infrastructure has completed product development and testing. The infrastructure software that incorporates TTY technology was released for operator/carrier field testing (First Office Application or FOA). FOA testing was conducted with AT&T Wireless Services (AWS) in Atlanta, Georgia during the week of November 12 – 16, 2001. The test involved testing with the following equipment:

- Ameritech Q90
- Ultratec Compact
- Ultratec Intellemodem 2400
- Ericsson T60d Mobile Station
- Panasonic EB-TX310 Mobile Station
- 711 TTY Relay Service
- 911 PSAP using Positron Express

Results of the testing were very positive. There were interoperability issues identified with the Positron Express PSAP equipment. Ericsson performed joint testing with Nokia mobile stations (handsets) at the Ericsson facility in Montreal from October 29-31. Several problems were identified in the use of silence frames. Technical papers to TIA 45.3 and TTSI describe the issues and resolutions addressing the silent frames and interoperability with the Positron Express PSAP.

TDMA Plans:

Sony Ericsson continues to monitor the PSAP interoperability issue. The Ericsson TDMA infrastructure was tested at the September TTSI event, and again at the FOA event in November. Test data was provided to TTSI. AWS has loaded the IS-823A infrastructure code in their lab and continues to test TTY. Cingular, which loaded and tested initial TDMA code at the first TTSI test event, has received and loaded the latest code. The Cingular FOA is anticipated to complete in December 2001.

A problem has been identified when using Nokia mobile stations with the Ericsson TDMA network software. This problem is clearly understood and is due to a difference in interpretation of TTY_SILENCE in the TIA/EIA IS-823-A standard. Since both vendors claim compliance to the applicable TIA/EIA IS-823-A and IS-840-A standards, a TR45.3.5 ad hoc meeting will be requested. A resolution plan will be developed based on the outcome.

Ericsson is working with Positron to identify the root cause of uplink errors when making a TTY call to Positron equipment. Testing was performed in the Ericsson lab facilities in Montreal during the week of December 10 to characterize the problem. Ericsson is the first vendor to have identified interoperability issues with Positron equipment, and believes this problem may affect other vendors. Sensitivity to the bit duration specified within the bit exact code of IS-823A has been demonstrated. TTSI has been notified, and confirmed the sensitivity. A resolution plan will be developed after industry consensus has been reached, as to the best course of action.

GSM Status:

The development code and products for the CTM service node are complete. System verification is complete. The GSM infrastructure solution entered FOA acceptance test on December 03, 2001.

GSM Plans:

The GSM TTY solution is undergoing acceptance test at several customer sites. AWS received the service node and system code during the first week of December. Development test cases were run in Richardson TX with approval testing completed in November. Tests were run on R300z handsets, and successfully completed. Cingular received the CTM service node and system code installed in their PBW lab in Pleasanton California. Planning to run tests December 18-20, 2001. FOA for the GSM Network is scheduled to be complete by January 28, 2002. Infrastructure rollout plans are complete, and capable of being completed prior to June 30, 2002.

C DMA Status:

The development of code for the CDMA network infrastructure TTY enhancement is nearly complete, with the completion of simulation testing and EVRC DSP code development. First simulation testing started in September followed by emulator testing and system integration testing. Operation of the development release of the enhanced vocoder has been demonstrated in lab testing. The delivery of carrier initial verification level of product was scheduled for delivery on December 31, 2001. Cricket and Qwest plan to take delivery of acceptance level code upgrades to start field-testing, in the first quarter of 2002.

CDMA Plans:

Development testing is expected to be completed by January 2002. System verification test release software is scheduled for release by the end of January 2002. System Acceptance rollout is scheduled for February 2002.

9) Handset Development and Testing Plans:

Sony Ericsson TTY terminal products have completed the development stage, and are entering the final stages of product release. The build plans and final qualification testing are in completion for all product technologies. Test data has been generated for CDMA, TDMA, and GSM products. Handsets are available for manufacturer and carrier interoperability testing, and have been used at TTSI test events.

TDMA Status

TTY development code for TDMA mobiles was released on September 21, 2001 after fixes were incorporated from the previous handset design. Final TDMA development test products were released on November 01, 2001. The handsets were used in the FOA event in Atlanta. The handset performance received an excellent response. The handsets were also used at the first and second TTSI test events, and performed well. The latest TTSI test event provided an excellent result in both data and in voice quality scoring. The final GUI interface was placed in the TDMA test handset on December 20, 2001.

Ongoing testing identified a slow typist sensitivity that resulted in a clarification to the existing IS-823A standard. TTSI has been informed of the recommended squelch level required on the TTY detector.

TDMA Plans

Carrier acceptance test units with the final user interface is expected to be available by January 15, 2001.

GSM Status

Development units were available on September 12th, 2001. Issues with error rates and TTY terminal compatibility were addressed by minor code updates. GSM development tested to performance specification 3GPP 26.231 and scored an excellent 0.5-% or less character error rate in the static state.

The R300Z has the bearer bit hard coded in the on position. The R300Z will be available from the Special Needs Center January 15th 2002. The T60G was made available to carriers/operators on December 14th for initial product testing. Future GSM mobiles have a profile setting that can be set to properly handle a TTY connection. Through such profile settings, the bearer bit is activated and deactivated.

Testing data shows an increase in the error rate when the handset is in the proximity of a certain model of TTY, and the signal at the phone was below a -105-dBm RSSI level. The TTY manufacturer was notified of this susceptibility, and requested to investigate corrective action. TTSI was notified of the issue. Tuning of the echo canceller was required for one handset model, to achieve an optimum error rate. During final development testing a TTY static error rate of less than 0.09% was demonstrated with the R300Z terminal, with a separation distance between the handset and the TTY unit. The TSB-121 interface demonstrated some electrical echo at the TTY accessory, so the load impedance has been increased to 400 ohms. TTSI was notified of the change.

GSM Plans

The first production samples of the TTY accessory were made available on December 10, 2001. Approval level terminals and accessory TTY units' (V1.19) were provided to carriers/operators on December 20, 2001. Handsets and T-Link adapters are expected to be available in the Special Needs Center by end January 15th, 2002. A second GSM handset model with an improved GUI, is anticipated to be entering approval test in January 2002.

CDMA Status

CDMA handsets encountered problems in the development test process. While the majority of development test cases have completed with success, there are test cases where the error rate can exceed 3 %. Sony Ericsson ran mobile IOT testing on October 22nd 2001, at the Lucent Whippany facility, and at the second TTSI test event during November 12 -16th 2001. The testing was intended to identify the source of the problems.

There are persistent performance issues with several test cases, including static 13K-vocoder uplink to landline, 13K vocoder connected to TSB-121 TTY impedance's, HCO/VCO

performance, and driving in the 13K vocoder mode. A test report was generated and sent to the component manufacturer for repair. The fix is expected to replace the squelch method of self-echo avoidance, with a mute method. TTSI is aware of the problem, and the problem has been identified to the TIA 45.5 standards group.

CDMA Plans

Carrier test units to a customer acceptance level have not been delivered. Current delivery plans are gated by a fix from the chipset vendor. Plans for availability are on hold.

10) Beta Testing and Lab Testing:

TDMA Infrastructure Beta Testing and Lab Testing

AWS Lab testing started October 29, 2001 and did not report any problems. FOA and Demonstration activities with AWS were completed November 17.

GSM Infrastructure Beta Testing and Lab Testing

Ericsson lab test is complete. Nearly all test cases have run to completion. Terminal and PSAP testing have completed successfully. Error rates of less than 1-% have been demonstrated.

To date, there are no outstanding technical issues.

CDMA Infrastructure Beta Testing and Lab Testing

Simulation testing is complete. CDMA integration testing is currently underway. Development testing of EVRC vocoder started December 07, 2001. Development testing is scheduled to be completed in December. CDMA Design Verification test cases have been generated, and are awaiting execution at the conclusion of development test.

11) Release and General Availability to Carriers of Network Infrastructure Software:

The TDMA network software was declared GA on December 5, 2001.

GSM System generally available (GA) with GSM R9.0 (Starting Rollout January 15 2002)

CDMA Generally Available with system Release 8.6 (Starting Rollout February 28, 2002)

12) Availability to Carriers of Full Acceptance Test Units:

TDMA Handsets December 31, 2001

GSM Handsets and T-Link Accessory December 31, 2001

CDMA Handsets on hold.

TDMA Network Infrastructure October 22, 2001

GSM Network Infrastructure November 30, 2001

CDMA Network Infrastructure dates January 31, 2002.

13) Efforts Toward Achieving Digital Wireless Solution Compatibility with Enhanced TTY Devices.

Sony Ericsson continues to work very closely with all manufacturers and carriers on the TTY compatibility mandate. TTY manufacturers have recently decided to change the default setting for high speed and turbo modes, to off. This ensures compatibility with digital wireless systems.

14) Testing and Deployment Activities

Sony Ericsson is working with the operators/carriers in the test and deployment of network infrastructure systems. In addition Sony Ericsson is working with the ATIS Incubator (TTSI), which is planning TTSI test event number 3 in January 28, 2002. The event will primarily test GSM infrastructure and handset compatibility.

The previous TTSI test events have produced data for more than twelve digital wireless signaling paths, including technologies of CDMA, TDMA, and AMPS to TTY' located at landline, mobile, and PSAP locations. Five of the twelve signal paths tested to date have an overall average error rate over one percent. These signaling paths include calls between technologies, and static/driving conditions. Many of the driving tests had error rates greater than one percent. The AMPS (analog) error measurement composite was nearly 2 percent. Peak measurements of 3 to 5 percent error rates were measured. Error rates of more than 1-% are currently receiving scrutiny in TTSI to identify and resolve the source of these high error rates.

- Sony Ericsson is working with Cingular to develop an automated call in test machine for PSAP testing. It is expected that the machine will be delivered to TTSI for testing of PSAP performance and tolerances when tested to a performance specification that is IS-840 compliant.
- Sony Ericsson has developed HCO/VCO testing boxes for testing the Q.90, and have worked with DSPG, HITEC, and Ameriphone to further these products
- Sony Ericsson has worked closely with Ultratec in the performance and test product software.
- Sony Ericsson appreciates all the testing efforts and help it has received to gather the significant amount of test data it has generated to date. Testing with operators, carriers, TTSI, Lucent, AWS, Cingular, DSPG, HITEC, Positron, and others contributed significantly in achieving the test progress to date.

8) Risks:

At the TTY Forum 20 several manufacturers pointed out technical risks and concerns with respect to meeting the compliance requirements by the FCC. Currently, Sony Ericsson is working several issues through the ATIS Incubator process. Several of these issues are in the resolution process.

Critical Work Status:

Sony Ericsson continues to develop product changes to resolve current issues. Sony Ericsson is concerned that current interoperability and future product developments are not assured by the defined operation within the existing TTY ballot standards. Of utmost concern is the removal of the requirement for bit exact reference code in the standards. Several passages are not

mandatory for standards implementation, which need to be mandatory to operate correctly. Sony Ericsson has generated test data on TTY performance in the presence of Echo Cancellers, and handsets with silent voice frames that require certain infrastructure configurations to achieve the mandated FCC error rates. It is currently not understood when or if the Standards Committees will address these issues. Changes need to be effected on the standards prior to the FCC mandated system availability date of June 30, 2002.

Standards Issues That Require Resolution :

- The Bit Exact Code (reference design) has been removed from the IS 823 and IS 127 Standards.
- IS-823 and IS-127 test vectors are obsolete
- IS-840 Minimum Performance Specification currently does not address normative changes in the standard.
- Several non-mandated addendum's have been made or proposed to normative text, that are required for operability and interoperability
- IS-127 changes for self echo currently do not mandate mute within the handset.
- IS-823A currently does not mandate mute to fix self echo within the handset.
- IS-823A currently does not define mute function within the network required to make echo canceller behavior transparent to TTY.
- IS-823A bit exact changes should be created for 50 baud, and include stop bit management improvements.
- IS-823A bit exact changes should be created to adjust nominal bit width if TTY signaling. The nominal TTY bit width should be changed to 22 mS with a new mechanism to be proposed to handle consecutive character strings at minimum or maximum bit width tolerance.
- IS-823A changes should be mandated for handset TTY detector squelch level
- IS-823A and IS-127 and TS 26.226 standards should adopt data levels that do not violate FCC 68.608
- TS 26.226 should require a 5-bit strength for the first bit of every call session, to be reset for each call.
- Cascaded leaky voice frame performance between GSM and CDMA/TDMA needs to be controlled.
- G.168 echo canceller Specification for TTY compatibility needs a cancellation depth specification.
- IS-825 does not specify quieting level for TTY transmitter levels, nor does it specify rise and fall times.
- IS-823A does not mandate quieting squelch level for the TTY detector in the network.
- TSB-121 load impedance needs to be increased to 400 ohms.
- TTY silence frames require mute immediately after TTY characters, within IS-823A, to prevent echoed character errors.
- CDMA 13k vocoder error rate measurements require TR45.5 to respond to performance concerns.
- PSAPS need a test minimum performance specification to achieve the FCC mandated 1-% error rate.

New Risk Factors

- TTY device requires RF susceptibility standard to operate properly.
- Wireless TTY detector can falsely start detection from TTY device noise levels.
- V.18 interoperability testing at TTSI is inconclusive, additional testing is required.
- The FCC should investigate an increased error rate benchmark for drive testing. Error rates similar to AMPS performance data collected within the TTSI database is recommended.

Please feel free to contact either Matt Kaltenbach or Steve Coston if you have any question regarding this report, or wish to contact test or product interfaces. Please contact your local customer interface for product sales and marketing information.



TTY Report for January 2002

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1. Purpose

This document outlines the progress made by VoiceStream toward the mandates required by the FCC for it to provide wireless TTY access to emergency services and full user-to-user functionality. The document is for information purposes.

2. Executive summary

Standardization work for a GSM TTY solution is continuing and VoiceStream is active in facilitating decisions that will enable 911 access as well as full user-to-user functionality. VoiceStream will deploy different solutions, depending on vendor and equipment type. VoiceStream uses network equipment from Nortel, Nokia and Ericsson in different geographical areas of the US.

VoiceStream was instrumental in working with the global GSM community to get agreement on a common signaling mechanism applicable to both the NSS and BSS solutions. Having obtained that agreement on using bearer capability signaling, VoiceStream has been working diligently with its network equipment vendors to test and verify the performance of both the NSS and BSS implementations.

During December 2001, VoiceStream loaded into its laboratories in Snoqualmie, Washington, test loads for Nortel and Ericsson TTY implementations. Test loads for Nokia were delayed due to problems with the E911 Phase 2 portion of the Base Station Controller (BSC) software. Nokia is due to release the first TTY test load on January 24, 2002.

Based on the current information from our vendors, VoiceStream expects to have solutions from all vendors for testing by the end of January 2002. Testing and verification of these pre-commercial loads will take four to six weeks. VoiceStream envisages being in the position to start deployment in initial markets some time around April 2002, with full implementation by the June 30, 2002 date

To date VoiceStream has issued Purchase Orders for \$5 Million to cover the necessary hardware and software upgrades and initial deployment costs.

3. Background

Since September 1997, the Wireless TTY Forum (TTY Forum), representing wireless carriers, wireless equipment manufacturers, manufacturers of TTY devices, public safety organizations, and consumer organizations representing individuals who are deaf or hard-of-hearing has been meeting in an effort to develop solutions that will enable TTY users to make 911 calls on digital wireless networks. Technical solutions had been proposed for all major wireless standards and these solutions have been undergoing study in the relevant technical bodies, TR45.5 (CDMA), TR45.3 (TDMA) and T1P1/3GPP (GSM).

The GSM solution uses CTM (Cellular Text Telephony Modem) as a method of transmitting Baudot over the GSM network. It is difficult to transmit Baudot code over the digital channel of

VoiceStream Wireless

GSM to the FCC-mandated 1 percent Total Character Error Rate (TCER), as the digital codecs have been optimized for speech. Baudot uses frequency components at 1.4 and 1.8 KHz, which would be attenuated by the low pass filtering in the codecs. In addition, the error correcting protocols of GSM result in the character error rate for a Baudot Code transmission increasing dramatically in case of a decreasing channel quality.

For this reason, CTM had been designed to work with all speech coding strategies and it has been successfully tested with the relevant codecs for the US, which are the GSM FR, EFR and all modes of the AMR codec. CTM signals have components only between 400 Hz and 1000 Hz, which corresponds to the nature of human speech. A converter would handle the CTM functionality at the mobile, which would be either incorporated into the mobile or available as a clip-on/add-on unit. The three documents specifying CTM have now been approved in the U.S. as American National Standards. These documents have also been submitted to 3GPP and have become the basis for the specifications developed by that group for all GSM systems worldwide.

TTY support in GSM networks has been formalized and is outlined in Technical Specifications- TS 23.002, TS 23.226. TTY support is enabled using one of three solutions:

- The "All transcoder solution (All-TRAU)" with CTM on every circuit leading out to the terminals.
- The "CTM Circuit pool solution" with a mechanism for selecting a circuit leading to the terminal that has the proper CTM detection/conversion capabilities, based on the terminal indicating CTM capabilities.
- The "CTM-SRF service node solution" with a service node in the core network and a mechanism to route through it for CTM detection/conversion.

The GSM technical specifications require the support of Bearer Capability Signaling from the handset to the network for both the circuit pooling as well as service node solutions. This solution for a common signaling mechanism allows a handset to signal the network at call setup that it is sending a CTM call and thus the network can direct that call to a network path that can convert the CTM signal into Baudot.

Because the signaling mechanism is common to both the server as well as the circuit pooling solutions and is transparent to the All-TRAU solution, the operator can choose the equipment option that best fits its equipment implementation and still maintain interoperability across platforms. The signaling mechanism is totally transparent to the user – that is, a TTY call can be made by any CTM-capable handset regardless of the network implementation utilized by the operator.

4. VoiceStream's Network Progress

VoiceStream has issued Purchase Orders of about \$5 Million to cover the initial deployment of TTY. Additional funds have been set aside to cover any additional costs associated with the testing and deployment phases. VoiceStream has firm technical proposals from all three network equipment vendors and has commercial agreements in place with two of the vendors; the commercial terms with the third vendor will be concluded in the next two weeks.

VoiceStream Wireless

Each vendor has chosen a slightly different implementation option based on the ease and speed of deployment.

Nokia - Is implementing the All-TRAU solution and requires a software upgrade to all transcoder units. The software to support CTM/TTY is part of the S.10 release.

Nortel – Nortel is supporting the All-TRAU solution on the BSC E3 platform using the TCU E3 transcoder. CTM/TTY is supported in release 13.2. For the BSC 2G Nortel is supporting the CTM circuit pooled solution requiring release 12.4D+.

Ericsson – Is implementing the Service-Node solution, using Telegent (Sweden) servers. The new servers are supported by R9 BSC and MSC software releases.

Irrespective of the implementation option chosen by the vendor, the process for testing the CTM/TTY functionality will proceed as outlined below.

Laboratory Functional Testing (LFT) - Testing of the CTM functionality as a stand-alone function will be performed in a controlled environment. Software may be pre-release. The aim of this testing is to confirm that the CTM translation is correct and that the CTM/TTY functionality is able to meet the defined GSM and FCC requirements. Testing of early release code may not involve full call control functionality but may only test the CTM/TTY translation performance.

Laboratory Acceptance Tests (LAP) - Testing of the full end-to-end functionality of the new software and hardware needed to support TTY, including regression tests of basic GSM features such as voice call completion, GPRS call completion etc, to ensure that software changes have not introduced unforeseen errors in other blocks of code.

Soak Test (ST) - A stability period to ensure that software and hardware is stable and is able to operate in a normal loaded condition.

First Office Application (FOA) - Limited deployment in the live network, to ensure that no unforeseen problems occur that could not be observed in the laboratory.

General Acceptance (GA) - Full deployment to all relevant network nodes.

Table 1 shows the current progress and latest estimated start dates for each of the phases of the test and verification program. The program shows the testing dates and the expected start of national deployment (GA).

	LFT	LAT	ST	FOA	GA
Nokia	01/24/02	02/18/02	04/22/02	04/22/02	06/18/02
Nortel E3 BSC	12/11/01	03/04/02	04/01/02	04/15/02	04/29/02
Nortel 2G BSC	N/A	04/11/02	04/18/02	05/01/02	05/15/02
Ericsson	12/14/01	01/21/02	02/14/02	02/28/02	03/18/02

Table 1: Estimated Test and Verification Dates

VoiceStream Wireless

As is the case when introducing new functions and features into the network, there is some element of risk in the program being delayed due to unforeseen technical difficulties. For vendors such as Nokia, that have implemented the TTY feature as part of a series of new features and functionalities, there is a risk that the program may be delayed due to problems with the performance or operation of another feature. The S.10 release from Nokia contains significant functionality changes related to the introduction of E911 Phase 2.