Scanning with Sony Ericsson TEMS Phones

Technical Paper

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Contents

1. Introduction

This document details the WCDMA and GSM scanning capabilities and performance of Sony Ericsson phones equipped with TEMS software.

The document covers all scanning functions available among all Sony Ericsson phone models currently offered with TEMS products. Scanning capabilities of specific phones are detailed in chapter 5. Please note that the range of scanning functions supported in the various TEMS products is not necessarily identical with the capabilities of the phones; again, see chapter 5 for details.

2. Scanning with Sony Ericsson Phones

There are tangible benefits to implementing scanning functionality in a commercial phone. To convey an understanding of these benefits, it is instructive to contrast the scanning done by commercial Sony Ericsson phones with that conducted by a TEMS phone.

Commercial phones continuously engage in scanning in order to monitor the radio environment. However, they do not scan more than is required to maintain good radio performance; nor do they have very much time to spend on scanning while busy delivering a service. Compared to the operation of a dedicated scanning device, the scanning performed by a commercial phone is slow and patchy (yet wholly adequate to allow the phone to interact successfully with the network).

For the purpose of dedicated scanning, Sony Ericsson TEMS phones go into a special scan mode which is not available in commercial phones and has vastly superior performance. In scan mode, the channel selection is furthermore completely controlled by the user, unlike the situation in regular phone mode where the phone is told by the network where to scan.

While differing radically in the above respects, the two forms of scanning also have a great deal in common, particularly since both execute on the same hardware. To give an example from WCDMA, the TEMS phone in scan mode delivers CPICH signal strength readings identical with those of a commercial Sony Ericsson phone, using exactly the same path searcher circuitry. More generally, being equipped with identical hardware, the TEMS phone has no need to simulate any part of the commercial phone’s scanning procedure in software.

Scanning with Sony Ericsson TEMS phones therefore brings the best of both worlds: their output precisely matches that of commercial phones, while performance-wise they are (in TEMS scan mode) fully on a par with scanners built on dedicated hardware.

Another advantage inherent in a scanner built on commercial phone hardware is the overall robustness of the device (resistance to shock, moisture, temperature variations, etc.). Full details in this regard are available in Sony Ericsson technical specifications. Selected data of this nature is presented in chapter 6.

3. WCDMA Scanning

Sony Ericsson phones are capable of the following forms of WCDMA scanning:

- CPICH scanning: See section 3.2
- BCH scanning: See section 3.3
- Network search: See section 3.4.

3.1. Supported WCDMA Bands

WCDMA scanning can be performed on all WCDMA frequency bands supported by the handset. For details regarding specific phones, please turn to sections 5.1–5.2.

Transitions from one WCDMA band to another during scanning with Sony Ericsson phones are very smooth, with virtually no measurement time being lost. This applies equally to all WCDMA scan modes covered below.

3.2. CPICH Scanning

Sony Ericsson phones can do CPICH scanning on up to 12 UARFCNs at a time. This is equivalent to the full number of carriers that can be accommodated on the WCDMA 2100 MHz band (each carrier requiring 5 MHz of bandwidth). Note, however, that the scanned UARFCNs may perfectly well be located on different WCDMA bands.

RSCP, Ec/No, and timing are all obtained separately for each Rake finger.

System Information Message decoding can be performed as an option in this scan mode. A snapshot of the System Information Messages is then taken once for each cell camped on. Specifically, System Information is captured every time a new cell has become the strongest, unless that cell has previously appeared as the strongest during the last two minutes. On completing the System Information decoding, the phone reverts to regular CPICH scanning. See also section 3.2.2.

Note that a different scan mode (“BCH scanning”) is also available which focuses on *continuous* monitoring of System Information messages, while reducing the CPICH scan update rate. See section 3.3 on BCH scanning below.

3.2.1. Typical Applications of CPICH Scanning

- Measuring the coverage area – obtaining input for coverage optimization with respect to RBS placement at rollout time.
- Assessing the pilot pollution situation – collecting input for neighbor list optimization.

- Troubleshooting quality problems caused by poor RF environment (RSSI, RSCP, and Ec/No).
- Checking synchronization between cells to find out whether they are on the same site.
- Checking timing drift between cells and sites in order to troubleshoot performance issues in connection with radio link set modification (cells added/removed in soft handover) as well as hard handover performance.
- Comparing chip offsets between sectors on the same site (they are normally offset by 256 chips).
- Measuring delay spread and checking for reflexes (multipaths) from distant objects.

3.2.2. Typical Applications of System Information Decoding

The “one-shot” decoding of System Information performed in this mode provides the same data as the continuous BCH scan described in section 3.3, though not as frequently. This mode is the ideal choice for a user whose primary aim is to scan the CPICH but who is also interested in System Information data, yet does not require constant and immediate access to this data. If the latter is a requirement, the BCH scanning mode should be used instead.

3.2.3. Technical Data and Performance

For the Sony Ericsson phones listed in chapters 5–6 of this document, the following holds:

- Two scan modes: Top-N or List mode. Scanning of up to 40 cells (scrambling codes) per UARFCN in either case. In List mode, up to 40 × 12 = 480 cells can be measured simultaneously.
- Measurements taken: RSCP (total and per path), Ec/No, RSSI
- Acquisition time: 20 ms (typical; i.e. about 50 cells are measured each second)
- Measurement resolution: 0.01 dB
- Measurement accuracy: ±1.0 dB (typical)
- Measurement range: –116 ... –15 dBm
- Ec/No cell limit configurable within range –30 ... 0 dB. The rate of false cell detection depends on the Ec/No cell limit setting as shown in this table:

Ec/No Cell Limit (dB)	False Detection Rate (%)
< –28	> 17

Ec/No Cell Limit (dB)	False Detection Rate (%)
–27	2.5
–26	0.026
–25	0.011
> –24	< 0.0065

- CPICH detection thresholds:
  - Relative: Ec/No = –30 dB
  - Absolute: Ec = –116 dBm
- Maximum number of Rake fingers: 12
- System Information Messages decoded (if that option has been selected):
  - MIB
  - SIB1 … SIB7, SIB11, SIB12, SIB16
  - SB1

3.3. BCH Scanning

This scanning mode is centered on System Information Message decoding.

In this mode, UARFCNs and scrambling codes are selected for scanning in the same way as in CPICH scanning mode. The same CPICH scan data will be collected in BCH mode also; however, the update rate will be considerably lower, and the sensitivity of the scrambling code detection may be lower as well (the Ec/No cell limit is not configurable but fixed at –20 dB, just as in regular phone mode).

The processing time freed up in this way is instead used to decode System Information Messages. This decoding is furthermore *continuous*, unlike that available in regular CPICH scanning mode (see section 3.2).

3.3.1. Typical Applications of BCH Scanning

The BCH scan mode is intended for users who want to be able to capture System Information Messages at any time, without waiting for a snapshot to be taken (compare section 3.2). This may be desirable for example when conducting a close-up investigation of parameter settings.

One good reason to keep constant watch on System Information Messages is to become thoroughly informed of cell configurations, not least neighbor relations. An example of refined output in TEMS Investigation that can be based on System Information is the Missing Neighbor Detection event which warns about missing neighbors in WCDMA.

One piece of data found in System Information Message is an uplink interference measurement. This is particularly interesting for HSUPA, where the guiding principle of scheduling is to provide (as far as possible) all UEs with all the resources they need while also making sure that the total uplink interference does not exceed the acceptable maximum in each situation. The uplink interference measurements are extracted as information elements in TEMS Investigation.

3.3.2. Technical Data and Performance

For the Sony Ericsson phones listed in chapters 5–6 of this document, the following holds:

- Scanning of up to 12 UARFCNs and up to 40 cells per UARFCN
- Additional measurements (compared to CPICH scanning with no System Information decoding): Uplink Interference, Intra-frequency Cells (i.e. neighbor list of scanned cell)
- System Information Messages decoded (default SIB mask settings):
  - MIB
  - SIB1 … SIB7, SIB11, SIB12, SIB16
  - SB1
- Additional channels (on 850 MHz and 1900 MHz bands[1]) supported
- Acquisition times (typical):
  - Single System Information Message: 50–200 ms (random wait until a message arrives)
  - One cell with 6 System Information Messages being broadcast: Approx. 300 ms
- Ec/No cell limit: –20 dB (fixed)

[1] Additional channels are spaced 100 kHz apart rather than 200 kHz as is the case with the general channels. Additional channels have UARFCNs that are completely different from the general channels on the same frequency band. (See 3GPP TS 25.101 section 5.4.3–5.4.4 for details on the two kinds of channel.)

3.4. Network Search

This scanning mode searches all supported WCDMA bands for WCDMA carriers (UARFCNs). For each WCDMA carrier found, the carrier center frequency is identified, and one cell (scrambling code) is detected if possible.

If a GSM or other non-WCDMA network is encountered, no output is produced. See also section 4.3.

3.4.1. Typical Applications of Network Search

This scanning mode is useful for obtaining a quick bird's-eye view of an unfamiliar WCDMA environment.

A network search can also detect inappropriate allocation of UARFCNs, resulting in carrier overlap. A mobile phone in regular phone mode, once it has found a WCDMA carrier, will automatically assume that there are no further UARFCNs within ±3 MHz of the detected carrier, and it is therefore unable to spot overlapping carriers. In contrast, a Sony Ericsson TEMS phone performing a network search scan as described here is usually able to identify all carriers, overlapping or not, thus allowing faulty frequency allocations to be easily found and rectified.

3.4.2. Technical Data and Performance

For the Sony Ericsson phones listed in chapters 5–6 of this document, the following holds:

- Scanning of up to three UARFCN intervals in parallel
- Ec/No cell limit configurable in range –30 ... 0 dB
- RSSI limit configurable in range –101 ... –40 dBm
- Additional channels supported (selectable)
- Search time, example: Approx. 30 s with the following scan setup and radio environment:
  - Search all of WCDMA Band I (277 UARFCNs), RSSI limit = –90 dBm
  - Three WCDMA networks present

4. GSM Scanning

Sony Ericsson phones are capable of scanning GSM carriers including decoding of BSIC.

4.1. Supported GSM Bands

GSM scanning can be performed on all GSM frequency bands supported by the handset. For details regarding specific phones, please turn to sections 5.3–5.4.

4.2. Scanning of GSM Carriers: Technical Data and Performance

For the Sony Ericsson phones listed in chapters 5–6 of this document, the following holds:

- Scanning capacity: Either individual carriers or carrier ranges can be selected.
  - Individual carriers: Up to 200.
  - Carrier ranges: Up to 4, each of which may extend to an entire GSM band. It is thus possible to scan all carriers on four GSM bands simultaneously.
- Measurement range: –117 ... –38 dBm
- Measurement resolution: 1.0 dB
- Measurement accuracy: ±2 dB (typical)
- Resolution bandwidth: 200 kHz
- Scanning speeds: See section 5.4.2 (in part phone-dependent).

4.3. Using GSM Scanning Mode to Scan WCDMA Carriers

The GSM scanning mode can alternatively be used as a spectrum analyzer for the purpose of detecting WCDMA carriers. This is possible for all WCDMA bands that coincide with GSM bands, for example:

- GSM 850 overlaps WCDMA Band V (869–894 MHz)
- GSM 900 overlaps WCDMA Band VIII (925–960 MHz)
- GSM 1800 overlaps WCDMA Band III (1805–1880 MHz)
- GSM 1900 overlaps WCDMA Band II (1930–1990 MHz).

Please refer to 3GPP TS 25.101 and 45.005 for precise and exhaustive data on frequency ranges.

5. Scanning Support by Sony Ericsson Phone Model and TEMS Product

5.1. WCDMA Frequency Band Support

WCDMA Band	DL Frequencies (MHz)	Z750i	W760	C702
I	2110–2170	✓	✓	✓
II	1930–1990	✓	✓	
III	1805–1880			
IV	2110–2155			
V	869–894	✓	✓	
VI	875–885			
VII	2620–2690			
VIII	925–960			
IX	1844.9–1879.9			

5.2. WCDMA Scanning

Scanning Method/Feature	TI		TA		Phones		
	9.0	9.1	7.0	7.1	Z750i	W760	C702
CPICH, static SC set	✓	✓			✓	✓	✓
CPICH, Top N	✓	✓	✓	✓	✓	✓	✓
CPICH, one-shot SIB decoding	✓	✓		✓	✓	✓	✓
CPICH, SIB mask config.				✓	✓	✓	✓
(CPICH +) continuous BCH scanning	✓	✓			✓	✓	✓
CPICH: No. of UARFCNs					12	12	12
Network search	✓	✓			✓	✓	✓

5.3. GSM Frequency Band Support

GSM Band (MHz)	DL Frequencies (MHz)	Z750i	W760	C702
850	869–894	✓	✓	✓
900	925–960	✓	✓	✓
1800	1805–1880	✓	✓	✓
1900	1930–1990	✓	✓	✓

5.4. GSM Scanning

5.4.1. Capabilities

Scanning Method/Feature	TI		TA		Phones		
	9.0	9.1	7.0	7.1	Z750i	W760	C702
GSM carrier scan	✓	✓	✓	✓	✓	✓	✓
BSIC decoding	✓	✓	✓	✓	✓	✓	✓

5.4.2. Speeds

Scanning Setup	Z750i	W760	C702
GSM carrier scan	Max. ARFCNs/sec		
• Whole bands, no BSIC decoding	1400	1600	1600
• Individually selected carriers, no BSIC decoding	min. 50, max. 300		
• With BSIC decoding	21	40	40

Minimum frequency of SCH attempts (when FCH has been found but SCH detection fails): 16 attempts per second

6. Selected Physical Phone Specifications

6.1. Dimensions and Weight

Feature	Z750i	W760	C702
Size (length × width × thickness)	97.0 × 49.0 × 20.0 mm/ 3.8 × 1.9 × 0.8 inches	103.0 × 48.0 × 15.0 mm/ 4.1 × 1.9 × 0.6 inches	106.0 × 48.0 × 16.0 mm/ 4.2 × 1.9 × 0.6 inches
Weight	110.0 gr/3.9 oz	103.0 gr/3.6 oz	105.0 gr/3.7 oz

6.2. Scanning Sensitivity to Speed

The scanning performance of the Sony Ericsson phones mentioned in this document is maintained without degradation at speeds up to at least 250 km/h.

7. MTU Operating Constraints

If the Sony Ericsson phone is mounted in an MTU, the operation of the phone is constrained by the MTU's operating temperature range, which is –20 … 55°C. If the temperature goes outside this range, the MTU halts its measurements.