Update on the Evolution of the GERAN Family of Standards (GSM, GPRS, EDGE)

Andrew Howell
TSG GERAN Chairman

Contents

- Overview of TSG GERAN
- Release 7 Overview
- Release 8 Overview
- Release 9 Outline of ongoing work
- Release 10 Outline of ongoing work
- Conclusion

Overview of TSG GERAN (1/3)
Objectives and Organisation

- TSG GERAN Objectives:
  - GERAN = GSM/EDGE Radio Access Network
  - Responsible for the specification of the radio aspects of the GSM/EDGE technologies and their evolutions.
- TSG GERAN Organisation:
  - Three subgroups:
    - Working Group 1: Radio Aspects (and BTS testing);
    - Working Group 2: Protocol Aspects;
    - Working Group 3: Terminal Testing.
  - Around 120 - 130 delegates per meeting.

Overview of TSG GERAN (2/3)
Leadership of TSG GERAN

- TSG GERAN officials are:
  - Chairman:
    - Mr Andrew Howell
      - Research in Motion UK Ltd / ETSI
  - Vice chairs:
    - Dr Jongsoo Choi
      - Samsung Electronics Co Ltd / TTA
    - Mr Zhixi Wang
      - Huawei Technologies Co Ltd / ATIS
    - Mr Leo Patanapongpibul
      - Vodafone Group Plc / ETSI
- MCC support: Paolo Usai (MCC)

Overview of TSG GERAN (3/3)
Leadership of TSG GERAN WGs

- The leadership of the TSG GERAN WGs is:
  - TSG GERAN WG1:
    - Chairman: Mr Werner Kreuzer (Research in Motion UK Ltd / ETSI)
    - MCC support: Paolo Usai (MCC)
  - TSG GERAN WG2:
    - Chairman: Mr Guillaume Sébire (Nokia Corporation / ETSI)
    - MCC support: Gert Thomasen (MCC)
  - TSG GERAN WG3:
    - Chairman: Mr Stoyan Baev (Samsung Electronics Co Ltd / TTA)
    - MCC support: Ingbert Sigovich (MCC)

Release 7 Overview (1/3)

- **Inclusion of lower 700 MHz into the GERAN specifications (GSM 710)**
  - uplink: 728-746 MHz; downlink 698-716 MHz
- **Addition of new frequency band to GSM (T-GSM810):**
  - uplink 806-821 MHz; downlink: 851-866 MHz
- **Advanced Global Navigation Satellite System (A-GNSS):**
  - introduces Assisted Galileo in addition to Assisted GPS.
  - generic solution provided to allow for introduction of other satellite constellations in the future.
- **Assisted GPS (A-GPS) minimum performance:**
  - specifies a minimum performance for the GPS receiver embedded in mobile stations using A-GPS over GERAN.
- **Enhancements of Voice Group Call Service (VGCS) for public security officials (e.g., police, fire brigade, using "public" GSM networks):**
  - end-to-end ciphering;
  - SMS over VGCS;
  - emergency handling.

Release 7 Overview (2/3)

- **A interface control plane signalling over IP:**
  - A interface signalling over M3UA/SCTP/IP.
- **Dual Transfer Mode (DTM) handover:**
  - allows simultaneous handover of CS and PS resources for a given end-user.
- **PS Handover between GERAN/UTRAN mode and Generic Access Network (GAN) mode:**
  - complements the Rel-6 GAN with PS handovers between the unlicensed radio link and GSM/UMTS for improved service continuity (e.g., when leaving home).
- **MS Receive Diversity (a.k.a. DARP Phase II):**
  - improved downlink performance (quality and spectral efficiency) via use of dual antenna terminals.
- **Downlink Dual Carrier:**
  - support of simultaneous transmissions to a given user over two independent GSM carriers on the downlink, enabling to double the downlink throughput for this user.
- **Latency Reductions:**
  - reduces terminal to network round-trip time through the use of two techniques:
    - fact ack/nack reporting;
    - reduced Transmission Time Interval (RTTI = 10 ms instead of 20 ms).
  - paves the way for support of VoIP over GERAN
  - better support of delay-sensitive "conversational" type of applications
  - improves throughput of TCP-based applications due to the reduction of the round-trip time.

Release 7 Overview (3/3)

EGPRS2 UL:

- addition of QPSK, 16-QAM, 32-QAM and higher symbol rate in uplink
- comes in two flavours:
  - version A (**EGPRS2-A UL**): GMSK, 8-PSK, 16-QAM, legacy symbol rate 271 ksymbols/s;
  - version B (**EGPRS2-B UL**): GMSK, QPSK, 16-QAM and 32-QAM, higher symbol rate 325 ksymbols/s.

EGPRS2 DL:

- introduction of QPSK, 16-QAM, 32-QAM, higher symbol rate and turbo coding in downlink
- comes in two flavours:
  - version A (**EGPRS2-A DL**): GMSK, 8-PSK, 16-QAM, 32-QAM, turbo codes, legacy symbol rate 271 ksymbols/s;
  - version B (**EGPRS2-B DL**): GMSK, QPSK, 16-QAM, 32-QAM, turbo codes, higher symbol rate 325 ksymbols/s.

Release 8 Overview (1/3)

- **GERAN-LTE interworking:**
  - defines cell reselection and CS/PS handover between GERAN and LTE.
- **Multi-carrier BTS:**
  - through the relaxation of certain GSM BTS radio requirements, allows to convey several GSM carriers with a single wideband transceiver, in order to bring capex and opex savings to the operators.
- **Feasibility study on MUROS (Multi-User Reusing One Slot):**
  - aim is to double voice capacity of GERAN per BTS transceiver by sharing a single timeslot between up to 4 users;
- **Feasibility study on Optimized Transmit Pulse Shape for downlink EGPRS2-B:**
  - analysis of a wider BTS transmit mask to further increase throughputs of EGPRS2-B downlink whilst checking potential impact on legacy bearers using legacy terminals.

Release 8 Overview (2/3)

- **A interface over IP:**
  - support of A over IP (after support of Gb over IP in Rel-4);
  - allows to move the transcoders from the BSS to the Core Network (MGWs), allowing capex and opex savings for the operators.
- **GAN enhancements (GAN Iu mode):**
  - allows to connect the GANC to 3G Core Networks via the Iu interface.
- **Enhancements for VGCS Applications:**
  - allows to send/receive a small amount of data to/from group members;
  - allows to transfer critical data within 500 ms without impacting voice quality of the group call;
  - gathers information on the identity of current listeners in the group call.
- **U-TDOA enhancements:**
  - allows the MS to be powered at maximum power during the (brief) location procedure, in order to improve location accuracy.

Release 8 Overview (3/3)

- **A-GNSS performance and testing procedures:**
  - Specifies a minimum performance for the Galileo receiver embedded in mobile stations using A-GNSS over GERAN and defines a test framework for terminals that could be extended to the support of other constellations.
- **Additional Navigation Satellite Systems (ANSS) for LCS:**
  - Complements the GPS and Galileo constellations with other constellations such as:
    - GLONASS:
      - **ГЛОНАСС**: **ГЛО**бальная **НА**вигационная **С**путниковая **С**истема
    - Modernized GPS
    - Quasi-Zenith Satellite System (QZSS)
    - Satellite Based Augmentation Systems…

Release 9 Outline of ongoing work (1/3)

- A-GNSS minimum performances
  - Clarifications relating to satellite constellation and assistance data.
- RF Requirements for Multicarrier and Multi-RAT BS, GERAN part
  - Looking at alignment of blocking requirements in multi-RAT operation and in GSM single-RAT operation for MSR equipment.
  - Review of GERAN related changes to TS 37.104, TS 37.113, TS 37.141, and TR 37.900.
- Voice services over Adaptive Multi-user channels on One Slot (VAMOS)
  - Shifted SACCH agreed for VAMOS-II mobile stations.
  - First set of performance requirements for VAMOS-I MS presented
  - Open issues
    - Decision on signalling of VAMOS capability in uplink and VAMOS mode in downlink
    - Specification of maximum subchannel power imbalance ratio (SCPIR) value for downlink
    - Decision on optimised pulse shape in downlink.
    - Specification of TX and RX performance requirements in downlink for VAMOS-I and VAMOS-II mobiles and for BSS in uplink.

Release 9 Outline of ongoing work (2/3)

- Home NB and Home eNB enhancements
  - CSG reporting: Agreed working assumptions
    - The reported CSG cell is the strongest cell on a frequency.
    - The thresholds for CSG reporting are different from the ones for macro cell.
    - Ec/N0 plus RSCP, RSCP, RSRQ plus RSRP, and RSRQ plus RSRP are used to set thresholds for CSG reporting for UTRAN FDD, UTRAN TDD, E-UTRAN FDD, and E-UTRAN TDD respectively.
  - Handover to CSG cells
    - Changes have been identified and technically endorsed but will be resubmitted for approval once a full set of changes is available for H(e)NB Enhancements

Release 9 Outline of ongoing work (3/3)

- BSC-CBC Interface
  - Supervision of the BSC/CBC interface is now complete with the definition of a Keep Alive procedure in 3GPP TS 48.049
  - Ongoing improvements also being looked at
- General Technical Enhancements and Improvements
  - Power level for RACH
  - Clarification of DTM support for EFTA and interpretation of multislot class parameters for EFTA
  - Review on cell reselection enhancements.
  - Self Optimising Networks (SON)
  - Mix of RTTI+BTTI for a given TBF (MTTI)
  - Enhanced Flexible Timeslot Allocation (EFTA)

Release 10 outline of ongoing work (1/2)

- Some general observations:
  - A significant part of the work of TSG GERAN is to maintain compatibility of the GSM based systems with the other systems being evolved by 3GPP and this work continues within the Release 10 set of specifications.
  - For the foreseeable future, especially given the widespread deployment of GSM based systems, it is expected that GERAN will need to continue to adapt to ensure compatibility of existing equipment with the evolving networks
  - GSM based systems continue to provide an excellent low cost platform for many developing services

Release 10 outline of ongoing work (2/2)

- In addition to the ongoing work of keeping GERAN based systems compatible with other systems (i.e. UMTS, LTE) other areas of work within Release 10 include:
  - Local Call Local Switch
  - GERAN Improvements for Machine-type Communications
  - Technical Enhancements and Improvements, such as:
    - Dynamic Timeslot Reduction a.k.a. DTR
    - Optimized DRX mode
    - Enhanced Multiplexing for single RLC entity a.k.a. EMSR
    - Precoded EGPRS

Conclusions

- The GSM radio interface has evolved over the past few years and will continue to evolve in the future to bring additional features and improvements attractive to both operators and subscribers.
- Evolution is primarily focused around the following areas:
  - Inter-working with other access technologies (e.g. LTE);
  - Increasing throughputs;
  - Increasing capacities (improved spectral efficiency and hardware efficiency);
  - Support for additional frequency bands;
  - Support of (additional) location techniques;
  - Support of IP-based interfaces.

Conclusions (cont)

- The ongoing work within TSG GERAN continues to increase the suitability of GSM/GERAN:
  - for standalone networks;
  - for networks used in conjunction with other radio access technologies (UMTS, LTE...) to provide global coverage whilst allowing excellent service continuity;
  - as a future proof platform providing a smooth migration path towards other 3GPP based systems (UMTS, LTE).
- <u>GSM is an alive and evolving technology which will continue to provide for the needs of operators for many years to come</u>