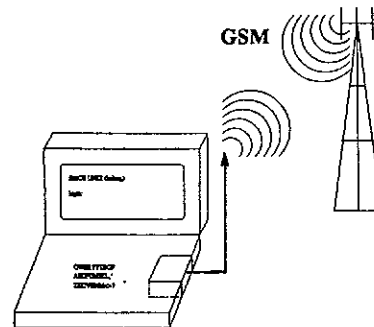# Packet Radio in GSM:

8.-12.2.93

Peter Decker / Communication Networks - Aachen University of Technology

- Features of Packet Radio

- Applications' Requirements

- Proposed Packet-Access-Protocol

- Simulation of Packet Radio in GSM

- Future Work

COM
NETS

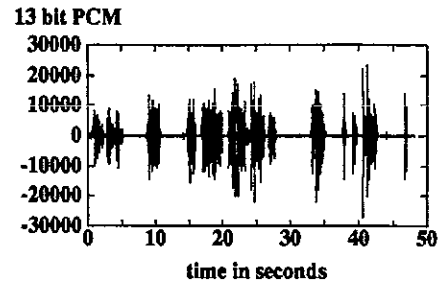## Features of Packet Radio:

- gives a better utilisation of the transmission medium (transmission only when sources are active)
  → accomodation of more users than pure TDMA.

- permits the integration of

  − different low and medium bitrate services

 − variable or bursty bitrate services

  − reliable multicast services

COM
NETS

Requirements of a Packet Voice Service in GSM:

- talkspurts:
  voice packets and SACCH
- silence periods:
  silence descriptor packets and
  SACCH

13 bit PCM

time in seconds

- voice activity: 40 .. 60% →
  channel activity: FR-TCH 47 .. 65% (HR-TCH 54 .. 70%)
- Voice Activity Detection
  - → currently used with DTX
  - → can be used for packet voice

FAX Service Requirements:

Calling FAX   **Called FAX**

T.30 Phases   9600 bps   0 bps   9600 bps

Phase B

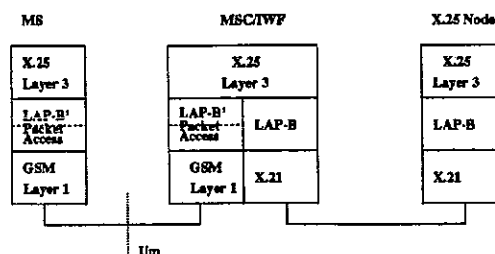Phase C   time
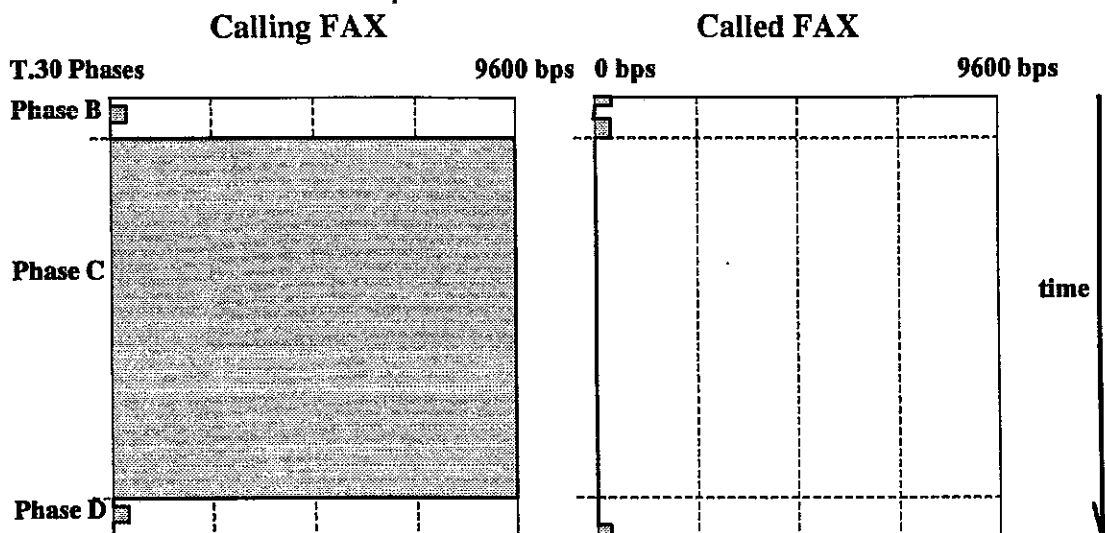
Phase D

- only 300 bit/sec during signaling phases (B and D)
- unefficient utilisation of reverse channel

OSI-Layer Model for Packet Radio in GSM:

Layer 3 virtual circuits service / connectionless datagram service

LAP-B' modified LAP-B, adapted to the applied FEC and Packet
Access (extended for reliable multicast services)
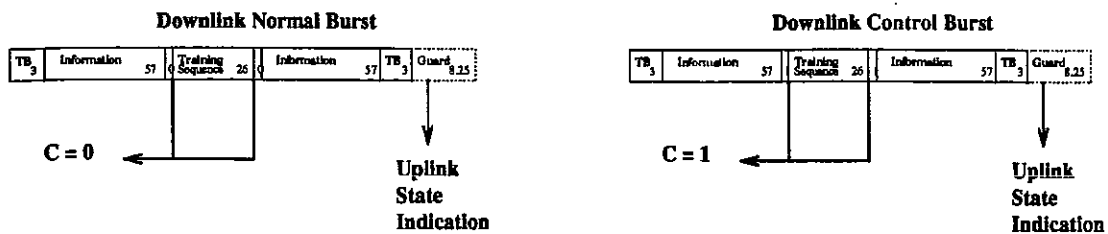
Packet Access random access,
based on reservation ALOHA (like PRMA, TM-BCMA/CD)

FEC convolutional coding (1/2) and interleaving depth 4 or 8

Packet Access in GSM:

- Packet length $\geq$ 4 (8) Bursts (minimum interleaving depth)
  Packet length $\leq$ 4 · 26 Bursts (or periodic SACCH needed)

- Reservation:

  - Reservation of a fixed number of normal bursts.

  - Reservation of a variable number of normal bursts. The
    length is either indicated by the access burst or prior to
    the end of a message

- Possible Scenarios:

  - Multiple access to one dedicated TCH
    → data only (eg. X.25 access)

  - Multiple access to a number of TCH in parallel
    → voice and data

Downlink Structure:

Downlink Normal Burst

| TB 3 | Information 57 | Training Sequence 26 | Information 57 | TB 3 | Guard 8.25 |

C = 0 ⟵

Uplink
State
Indication

Downlink Control Burst

| TB 3 | Information 57 | Training Sequence 26 | Information 57 | TB 3 | Guard 8.25 |

C = 1 ⟵
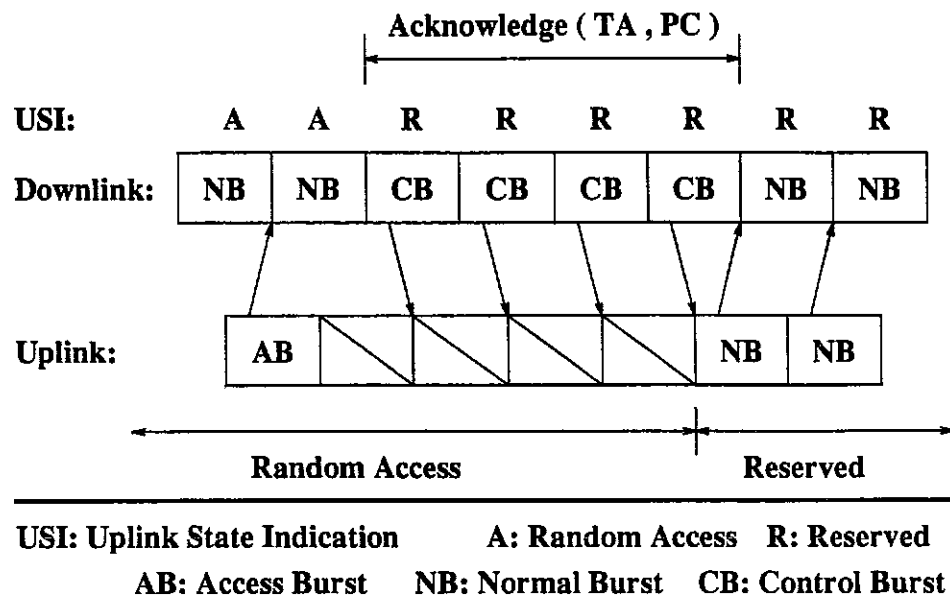
Uplink
State
Indication

- **Downlink Normal Burst:**
  Variable length packets containing data for single or multiple MSs. Special Packets for system information elements instead of SACCH.

- **Downlink Control Burst:**
  Acknowledgement for successful uplink access containing Timing Advance (TA) and Power Control (PC).

- **USI** Uplink State Indication (**R**eserved / Random **A**ccess)

Uplink Structure:

Uplink Normal Burst

| TB 3 | Information 57 | Training Sequence 26 | Information 57 | TB 3 | Guard 8.25 |

F (Final) ⟵

Uplink Access Burst

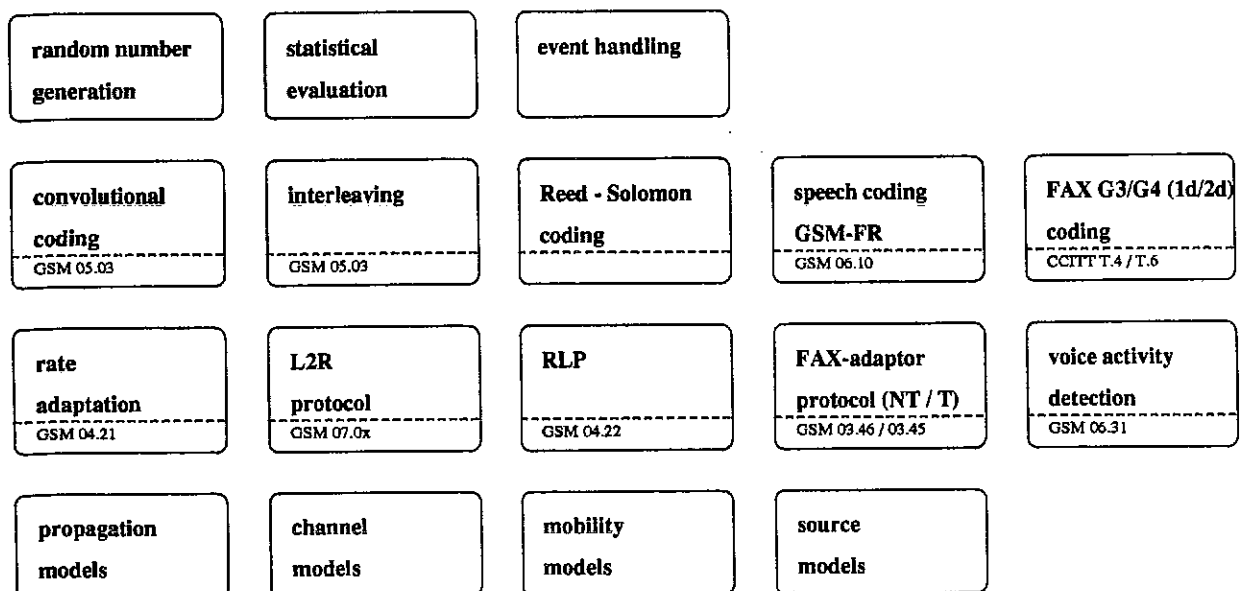| Ext. TB 8 | Sync. Seq. Bits 41 | Encr. Bits 36 | TB 3 | Guard Period 68.25 |

1/2 FEC

| Data 11 | CRC 6 |
| | BSIC 6 |
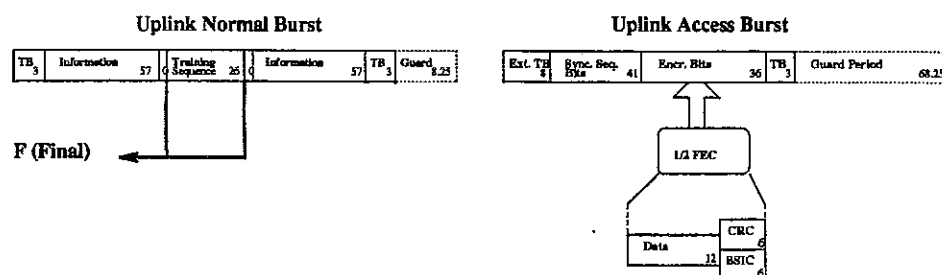
- Uplink Normal Burst: (in reserved state)
  Packets containing data from a single MS. Length indicator or final bit is needed.

- Uplink Access Burst: (in random access state)
  Access bursts containing virtual circuit identifier or random number (like in RACH). Not acknowledged successfully received access bursts will be queued.

Proposed Packet-Access-Protocol:

Acknowledge (TA , PC)

USI:	A	A	R	R	R	R	R	R
Downlink:	NB	NB	CB	CB	CB	CB	NB	NB

Uplink: | AB | | | | | NB | NB |

Random Access   **Reserved**

USI: Uplink State Indication   **A: Random Access**   **R: Reserved**

AB: Access Burst   **NB: Normal Burst**   **CB: Control Burst**

Simulator Structure (Modules)

| random number generation	statistical evaluation	event handling		
convolutional coding GSM 05.03	**interleaving** GSM 05.03	**Reed - Solomon coding**	**speech coding GSM-FR** GSM 06.10	**FAX G3/G4 (1d/2d) coding** CCITT T.4 / T.6
rate adaptation GSM 04.21	**L2R protocol** GSM 07.0x	**RLP** GSM 04.22	**FAX-adaptor protocol (NT / T)** GSM 03.46 / 03.45	**voice activity detection** GSM 06.31
propagation models	**channel models**	**mobility models**	**source models**	

Overview of implemented protocols

- Radio Link Protocol

- FAX Adaptor non-transparent (transparent)

- Voice DTX

Packet Radio Service:

- CELLPAC

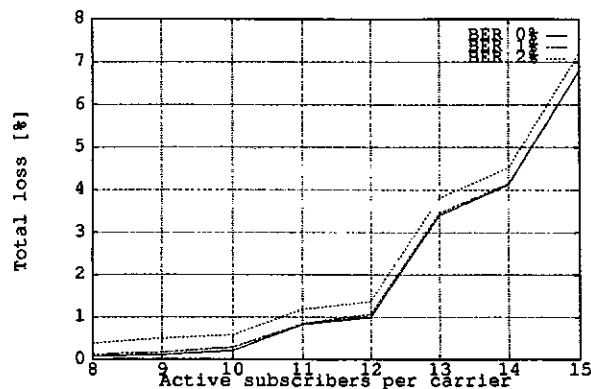- basic packet access mechanisms for GSM (like PRMA)

Packet Voice GSM (Simulation Assumptions)

- voice activity: 40%
- silence descriptors
  (transmitted relative to
  the end of talkspurt)
- SACCH
  on separate channel
- Rayleigh Fading Channel
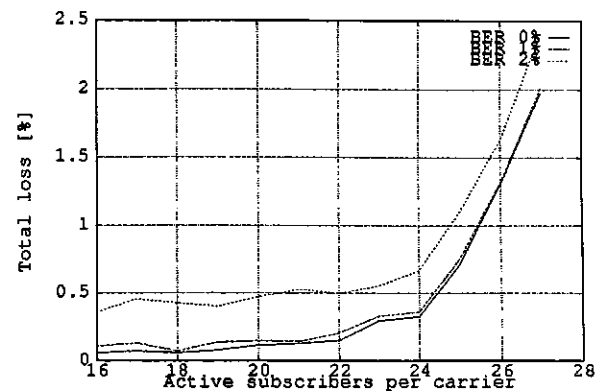 with BER = [0..2%]
- 8 Full Rate TCHs
  (16 Half Rate TCH)
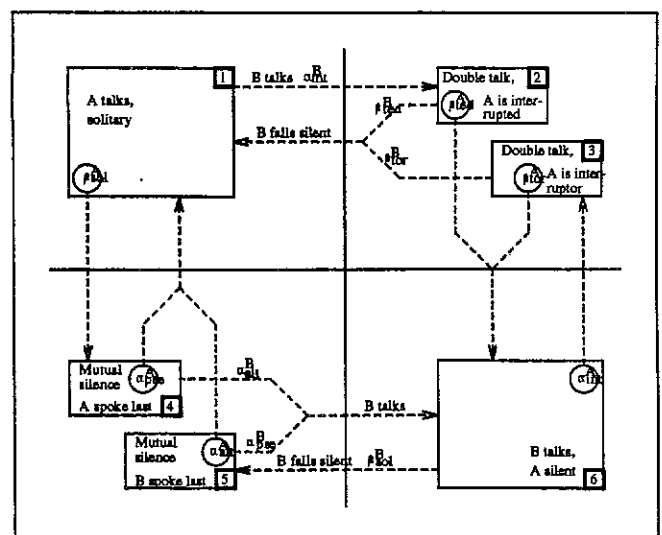
The Brady Modell

Packet Voice in GSM: Packet Loss
(Collisions and Interference)

Packet Voice on 8 FR-TCH **Packet Voice on 16 HR-TCH**

Future Work

- Development of suitable logical link control protocol

- Integration of a load dependant contention control mechanism

- Optimization of access control and logical link control protocol under mixed traffic scenarios

- Integration of new channel models

- Consideration of security aspects