

1 **Title**

2 GERAN Design

3 **Source**

4 Lucent Technologies

5 **Abstract**

6 This contribution proposes a layered design for GERAN. The proposal
7 derives from the existing stage-2 description and from 3G TS 25.301
8 (*Radio Interface Protocol Architecture*).

9 We believe the proposed design minimizes changes to existing
10 standards while meeting the requirements of the stage-2 description.

11 **Recommendation**

12 Adopt the proposed design as a basis for further development. Include
13 Figure 1 in the stage-2 description.

14 Adopt names for the channels exposed at the top of each layer.

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GERAN-003	MS Physical Layer.....	Enclosure (1)

Revision History

Date	Description
07 Aug 00	First release.
28 Aug 00	Second release.

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1. Overview

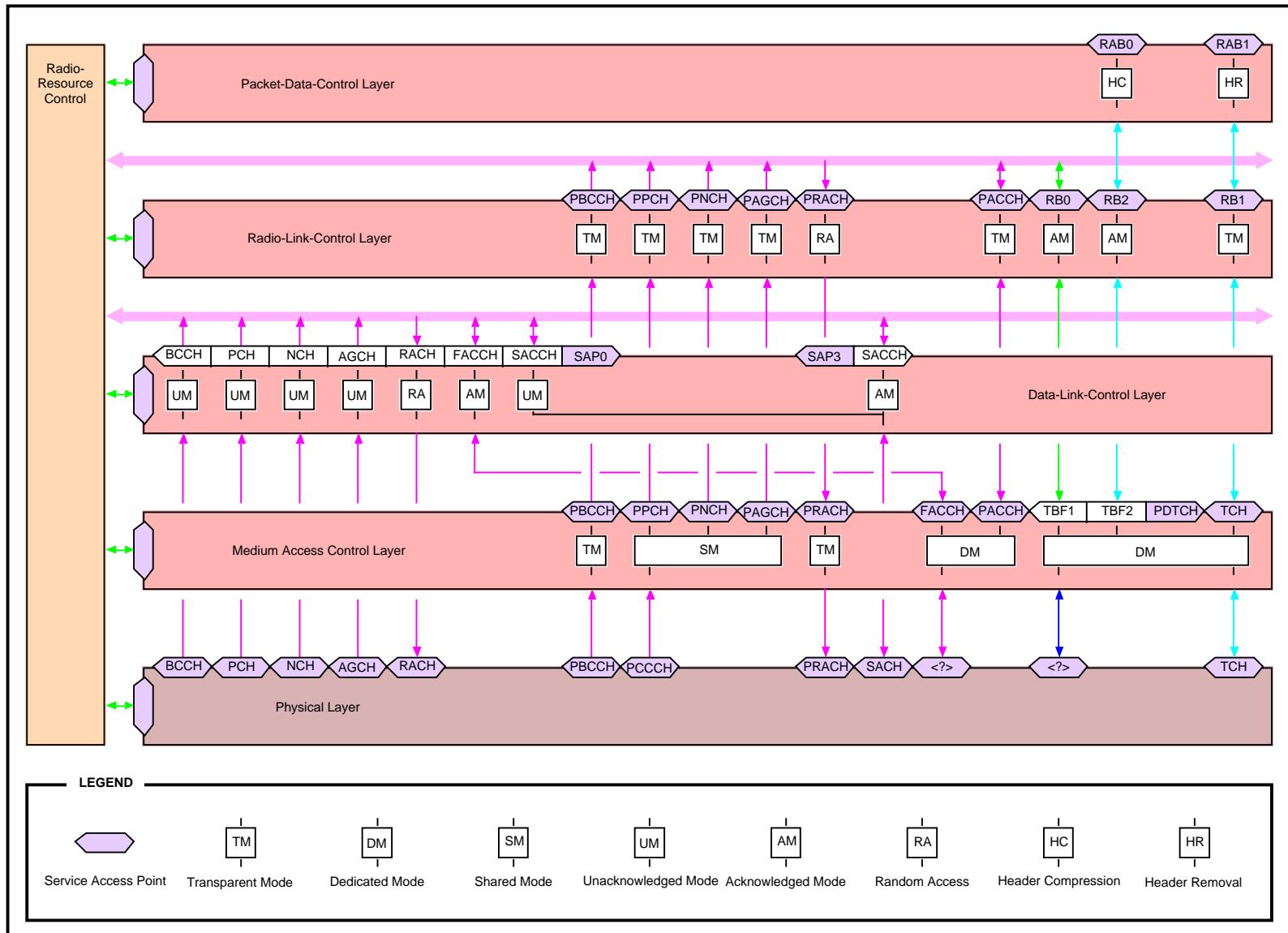
Figure 1 proposes a GERAN protocol architecture for the mobile station. It is based on Figure 2 from 3G TS 25.301 [1] and the GERAN stage-2 description [9]. The figure shows the following layers:

- Layer 1 comprises the physical layer.
- Layer 2 comprises the medium-access-control layer (MAC), the data-link-control layer (DLC), the radio-link-control layer (RLC), and the packet-data-control layer (PDCP).
- RRC manages and controls the other layers.

Subsequent sections describe each of these layers.

We believe the architecture proposed in Figure 1 minimizes changes to existing standards while meeting the requirements of the stage-2 description.

Figure 1 GERAN Protocol Architecture for Mobile Station



1 2. Physical Layer

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The physical layer exposes various channels to the upper layers. The
GSM physical layer exposes *logical* channels most of the time; the
UTRAN physical layer exposes *transport* channels. Why the *physical*
layer doesn't expose *physical* channels is a question best left for
another time. At some point, however, we need to choose a name:
perhaps *logical channel* to maintain consistency with GSM.

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As specified in GSM 05.01 [5], 05.02 [6], and 05.03 [7], channels
exposed by the physical layer are characterized by physical attributes,
not content; however for some content, such as optimized speech, the
resulting physical attributes preclude the channel's use for anything
else.

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Physical-layer attributes are as follows:

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 - Direction of transmission.
 - Carrier frequency.
 - Modulation.
 - Burst type within a timeslot.
 - Timeslot within a frame.
 - Frames within a multiframe.
 - Physical-layer header (stealing bits).
 - Encryption.
 - Interleaving.
 - Channel coding.

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These various attributes can be seen in Drawing GERAN-003, roughly
in order from bottom to top.

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To support voice-and-data multiplexing, the following should be added
to the physical-layer standards:

- 28
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 - Stealing-bit combinations to discriminate speech, data, and
control.

1 **3. Medium-Access-Control Layer**

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7 The MAC layer exposes various channels to the upper layers. Since
GSM combines the RLC and MAC layers, it exposes no channels; the
UTRAN MAC layer exposes *logical* channels. Why the *MAC* layer
doesn't expose *MAC* channels is a question best left for another time.
At some point, however, we need to choose a name: perhaps *MAC*
channel.

8 GSM 04.60 [4] § 8 specifies MAC procedures. §§ 5, 6, and 7 indicate
9 in their headings that they also specify MAC procedures, but in fact,
10 they really specify RRC procedures.

11 To support GERAN, the following should be added to GSM 04.60 § 8:

- 12 • Priority multiplexing of multiple radio bearers onto a physical
13 channel shared with other users. This is shared mode (SM).
- 14 • Priority multiplexing of multiple radio bearers onto a physical
15 channel dedicated to one user. This is dedicated mode (DM).
- 16 • Direct access to physical-layer channels. This is transparent
17 mode (TM).
- 18 • Encryption.
- 19 • New interfaces to the physical and RLC layers.

20 **3.1 Transparent Mode**

21 A MAC element operating in transparent mode passes higher-layer
22 information to a physical-layer channel without modifying the informa-
23 tion and without adding a header.

24 **3.2 Dedicated Mode**

25 A MAC element operating in dedicated mode handles priority
26 multiplexing of multiple data streams on a physical-layer channel.
27 Since the physical-layer channel isn't shared, no mobile-station
28 addressing need be added; however, a MAC header is needed to
29 identify the multiple data streams.

30 **3.3 Shared Mode**

31 A MAC element operating in shared mode is similar to one operating in
32 dedicated mode with the following exception: since the physical-layer
33 channel is shared, mobile-station addressing needs to be included in the
34 MAC header.

4. Data-Link-Control Layer

The data-link-control layer exposes various channels to the upper layers. The GSM DLC layer exposes unnamed channels; the UTRAN physical layer doesn't have a DLC layer. Why the *data-link-control* layer doesn't expose *data-link* channels is a question best left for another time. At some point, however, we need to choose a name: perhaps *data-link channel*.

GSM 04.05 [2] and 04.06 [3] specify the DLC layer. As specified, each DLC element operates in one of three modes: random access, unacknowledged, or acknowledged.

To support GERAN, nothing need be added to GSM 04.05 and 04.06.

5. Radio-Link-Control Layer

The RLC layer exposes various channels to the upper layers. The GSM RLC layer exposes unnamed channels; the UTRAN RLC layer exposes radio bearers. Why the *radio-link-control* layer doesn't expose *radio-link* channels is a question best left for another time. At some point, however, we need to choose a name: perhaps *radio bearer* to match the UTRAN terminology.

GSM 04.60 § 9 specifies RLC procedures. These procedures support acknowledged mode (AM) and unacknowledged mode (UM).

To support GERAN, the following should be added to GSM 04.60 § 9 or a document derived from it:

- Multiple RLC instances per mobile station.
- Limited-retransmission mode (LM) for streaming.
- Direct access to the MAC layer. This is transparent mode (TM).
- Encryption.
- New interfaces to the PDCP and MAC layers.

5.1 Transparent Mode

A TM RLC provides the following services to the higher layer:

- Data transfer.

Optimized speech uses this mode.

5.2 Acknowledged Mode

An AM RLC provides the following services to the higher layer:

- Data transfer.
- Segmentation and reassembly.
- Blocking (Note that X.200 [8] defines *blocking* as the mapping of multiple SDUs into a single PDU. The stage-2 description incorrectly calls this *concatenation*.)
- Padding.
- Backward error correction.
- In-sequence delivery.
- Encryption.

1 **5.3 Limited-Retransmission Mode**

2 An LM RLC provides the following services to the higher layer:

- 3 • Data transfer.
- 4 • Segmentation and reassembly.
- 5 • Blocking (Note that X.200 defines *blocking* as the mapping of
6 multiple SDUs into a single PDU. The stage-2 description
7 incorrectly calls this *concatenation*.)
- 8 • Padding.
- 9 • Limited backward error correction.
- 10 • In-sequence delivery.
- 11 • Encryption.

12 **5.4 Unacknowledged Mode**

13 A UM RLC provides the following services to the higher layer:

- 14 • Data transfer
- 15 • Segmentation and reassembly.
- 16 • Blocking.
- 17 • Padding.
- 18 • Sequence-number check.
- 19 • Encryption.

1 6. Radio-Resource-Control Layer

2 RRC configures the other layers to provide radio bearers, in effect
3 setting up each layer's functional elements and the interlayer plumbing:

- 4 • It establishes and releases control-plane radio bearers (*e.g.*,
5 PBCCH, PPCH, PACCH, and RB0) for transporting broadcast
6 information, common control, associated control, and signaling.
- 7 • It establishes and releases user-plane radio bearers (*e.g.*, RB1
8 and RB2) for transporting user speech and data.
- 9 • It establishes and releases TBFs (Temporary Block Flows) to
10 support the radio bearers.
- 11 • Based on information received from the various control
12 channels and from other layers, it configures the physical layer.
13 Configuration includes establishing one or more channels as
14 needed.
- 15 • Based on information received from other layers, it configures
16 the MAC layer. Configuration includes establishing one or
17 more MAC elements operating in the required modes: shared
18 (SM), dedicated (DM), or transparent (TM).
- 19 • It establishes RLC elements as needed. Each RLC element
20 manages a single radio bearer and can operate in one of four
21 modes: transparent (TM), acknowledged (AM), limited-
22 retransmission (LM), or unacknowledged (UM).

23 GSM 04.60 §§ 5, 6, and 7 (and GSM 04.18) specify RRC procedures.
24 To support GERAN, the following should be added:

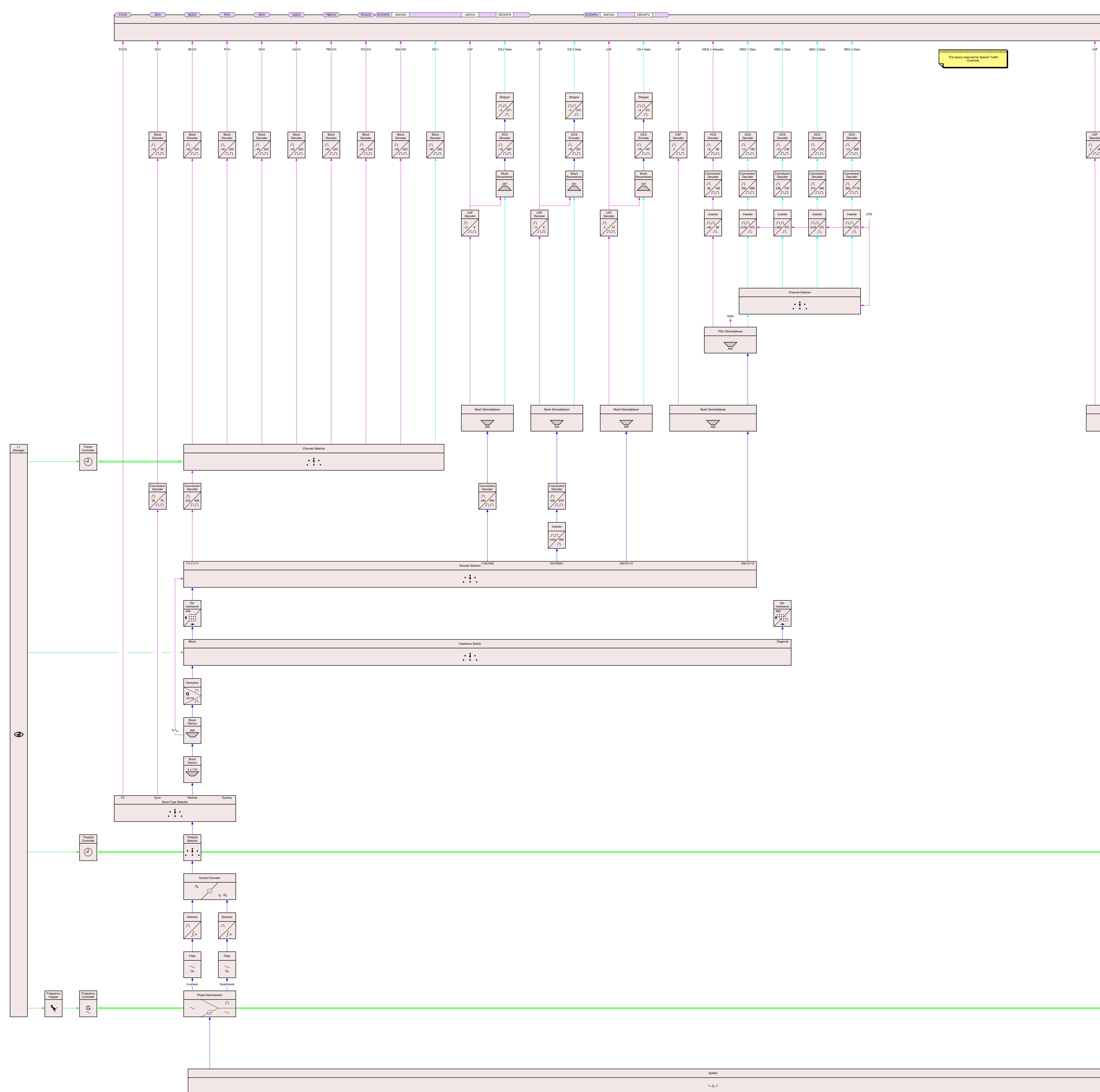
- 25 • Configuration and control of layer functions in support of new
26 radio bearers.
- 27 • Allocation of physical resources as needed to support new radio
28 bearers.
- 29 • Mapping of *RBid* to TFI as needed for each TBF.
- 30 • Automatically instantiating TBFs for radio bearers assigned to
31 dedicated resources.
- 32 • Configuration and control of radio bearers for signaling.


7. Recommendations

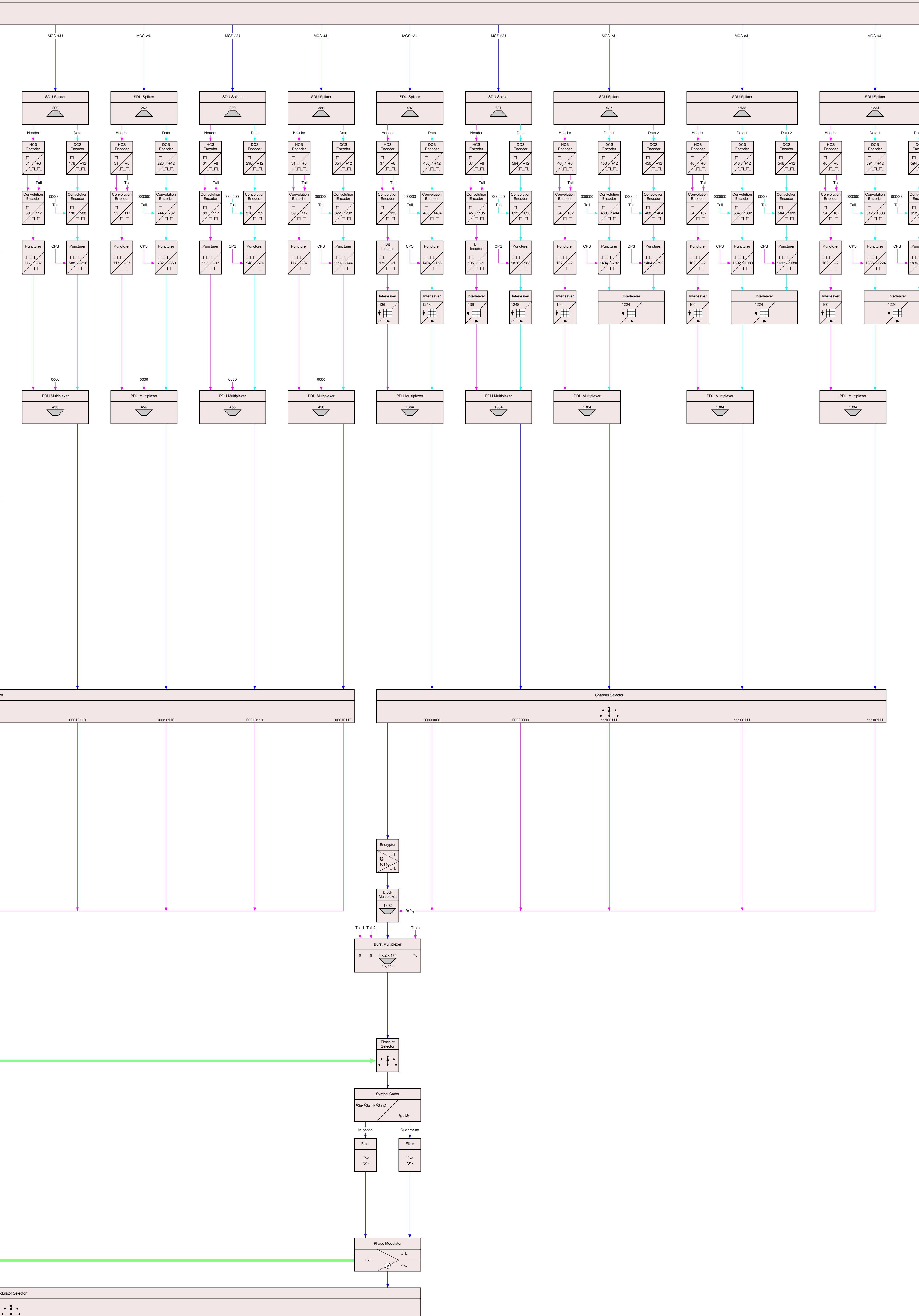
1. Adopt the proposed design as a basis for further development. Include Figure 1 in the stage-2 description.
2. Adopt names for the channels exposed at the top of each layer.

8. References

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Geneva: International Telecommunication Union, July 1994.
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GERAN Overall Description – Stage 2.
Helsinki: GERAN Workshop, August 2000.







ITEM	DWG NO	TITLE	REV
LIST OF REFERENCE DOCUMENTS			
DWN	ADS		
CHKD		Next Generation Site 19 • Box 8d • SS 1	
APVD		Calgary • Alberta • T2M 4K3	
GERAN MS Physical Layer			
		© 2000, Next Generation Consulting	
DWG NO	GERAN-003	REV	1
SCALE	SHEET 1 CONTINUED ON -		