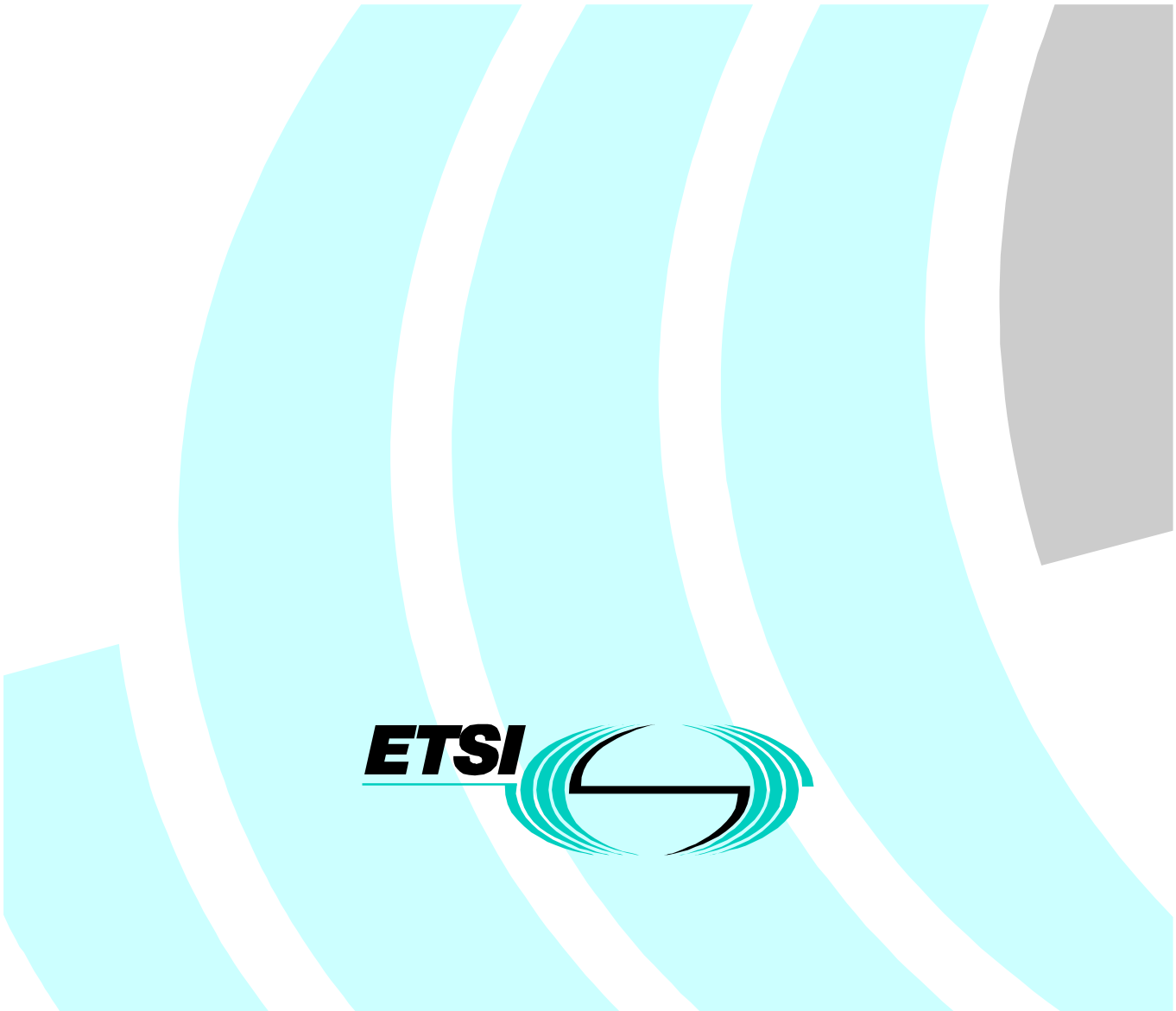
ETSI TS 101 377-3-12 V1.1.1 (2001-03)

Technical Specification

GEO-Mobile Radio Interface Specifications;
Part 3: Network specifications;
Sub-part 12: Technical Realization of Facsimile Group 3 Transparent;
GMR-2 03.045



Reference
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IPRs:

Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,715,365	US
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,754,974	US
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,226,084	US
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,701,390	US
TS 101 377 V1.1.1	Digital Voice Systems Inc		US	US 5,826,222	US

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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 377 V1.1.1	Ericsson Mobile Communication	Improvements in, or in relation to, equalisers	GB	GB 2 215 567	GB
TS 101 377 V1.1.1	Ericsson Mobile Communication	Power Booster	GB	GB 2 251 768	GB
TS 101 377 V1.1.1	Ericsson Mobile Communication	Receiver Gain	GB	GB 2 233 846	GB
TS 101 377 V1.1.1	Ericsson Mobile Communication	Transmitter Power Control for Radio Telephone System	GB	GB 2 233 517	GB

IPR Owner: Ericsson Mobile Communications (UK) Limited
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Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 377 V1.1.1	Hughes Network Systems		US	Pending	US

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Fax: +1 301-428-2802

Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	2.4-to-3 KBPS Rate Adaptation Apparatus for Use in Narrowband Data and Facsimile Communication Systems	US	US 6,108,348	US
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Cellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic ThroughputCellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic Throughput	US	US 5,717,686	US
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Enhanced Access Burst for Random Access Channels in TDMA Mobile Satellite System	US	US 5,875,182	
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,314	US
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,315	US
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Mutual Offset High-argin Forward Control Signals	US	US 6,072,985	US
TS 101 377 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Spot Beam Pairing for Reduced Updates	US	US 6,118,998	US

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The contents of the present document are subject to continuing work within TC-SES and may change following formal TC-SES approval. Should TC-SES modify the contents of the present document it will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version 1.m.n

where:

- the third digit (n) is incremented when editorial only changes have been incorporated in the specification;
- the second digit (m) is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

The present document is part 3, sub-part 12 of a multi-part deliverable covering the GEO-Mobile Radio Interface Specifications, as identified below:

Part 1: "General specifications";

Part 2: "Service specifications";

Part 3: "Network specifications";

Sub-part 1: "Network Functions; GMR-2 03.001";

Sub-part 2: "Network Architecture; GMR-2 03.002";

Sub-part 3: "Numbering, Addressing and Identification; GMR-2 03.003";

Sub-part 4: "Restoration Procedures; GMR-2 03.007";

Sub-part 5: "Organization of Subscriber Data; GMR-2 03.008";

Sub-part 6: "Handover Procedures; GMR-2 03.009";

Sub-part 7: "Technical Realization of Short Message Service (SMES) Point-to-Point; GMR-2 03.040";

Sub-part 8: "Location Registration Procedures; GMR-2 03.012";

Sub-part 9: "Discontinuous Reception (DRX) in the GMR-2 System; GMR-2 03.013";

Sub-part 10: "Security Related Network Functions; GMR-2 03.020";

Sub-part 11: "Functions Related to Mobile Earth Station (MES) in idle Mode; GMR-2 03.022";

Sub-part 12: "Technical Realization of Facsimile Group 3 Transparent; GMR-2 03.045";

Sub-part 13: "Transmission Planning Aspects of the Speech Service in the Public Satellite Mobile Network (PSMN) system; GMR-2 03.050";

Sub-part 14: "Call Waiting (CW) and Call Hold (HOLD) Supplementary Services - Stage 2; GMR-2 03.083";

Sub-part 15: "Multiparty Supplementary Services; GMR-2 03.084";

Sub-part 16: "Technical Realization of Operator Determined Barring; GMR-2 03.015";

Sub-part 17: "Call Barring (CB) Supplementary Services - Stage 2; GMR-2 03.088"; Part 4:"Radio interface protocol specifications";

Part 5: "Radio interface physical layer specifications";

Part 6: "Speech coding specifications";

Part 7: "Terminal adaptor specifications".

Introduction

GMR stands for GEO (Geostationary Earth Orbit) Mobile Radio interface, which is used for mobile satellite services (MSS) utilizing geostationary satellite(s). GMR is derived from the terrestrial digital cellular standard GSM and supports access to GSM core networks.

Due to the differences between terrestrial and satellite channels, some modifications to the GSM standard are necessary. Some GSM specifications are directly applicable, whereas others are applicable with modifications. Similarly, some GSM specifications do not apply, while some GMR specifications have no corresponding GSM specification.

Since GMR is derived from GSM, the organization of the GMR specifications closely follows that of GSM. The GMR numbers have been designed to correspond to the GSM numbering system. All GMR specifications are allocated a unique GMR number as follows:

GMR-n xx.zyy

where:

xx.0yy (z=0) is used for GMR specifications that have a corresponding GSM specification. In this case, the numbers xx and yy correspond to the GSM numbering scheme.

xx.2yy (z=2) is used for GMR specifications that do not correspond to a GSM specification. In this case, only the number xx corresponds to the GSM numbering scheme and the number yy is allocated by GMR.

n denotes the first (n=1) or second (n=2) family of GMR specifications.

A GMR system is defined by the combination of a family of GMR specifications and GSM specifications as follows:

- If a GMR specification exists it takes precedence over the corresponding GSM specification (if any). This precedence rule applies to any references in the corresponding GSM specifications.

  NOTE: Any references to GSM specifications within the GMR specifications are not subject to this precedence rule. For example, a GMR specification may contain specific references to the corresponding GSM specification.

- If a GMR specification does not exist, the corresponding GSM specification may or may not apply. The applicability of the GSM specifications is defined in GMR-n 01.201.

1 Scope

The present document specifies the procedures for the technical realization of the group 3 facsimile service, within the GMR-2 system, using transparent network support for mobile terminated and originated automatic facsimile connections. The scope of the present document is confined to Teleservice 62.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, subsequent revisions do apply.

[1] GMR-2 01.004 (ETSI TS 101 377-1-1): "GEO-Mobile Radio Interface Specifications; Part 1: General specifications; Sub-part 1: Abbreviations and Acronyms".

[2] GMR-2 02.003 (ETSI TS 101 377-2-1): "GEO-Mobile Radio Interface Specifications; Part 2: Service specifications; Sub-part 1: Teleservices supported by a GMR-2 Public Satellite Mobile Network (PSMN)".

[3] GSM 03.10 (ETSI ETS 300 528): "European digital cellular telecommunication system (Phase 2); GSM Public Land Mobile Network (PLMN) connection types" (V4.3.1).

[4] GMR-2 04.008 (ETSI TS 101 377-4-7): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 7: Mobile radio interface Layer 3 Specifications".

[5] GMR-2 04.021 (ETSI TS 101 377-4-10): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 10: Rate adaptation on the Mobile Earth Station - Gateway (MES - GW) interface".

[6] GSM 07.01 (ETSI ETS 300 582): "European digital cellular telecommunication system (Phase 2); General on Terminal Adaptation Functions (TAF) for Mobile Earth Stations (MES)" (V4.10.0).

[7] GSM 07.03 (ETSI ETS 300 584): "European digital cellular telecommunication system (Phase 2); Terminal Adaptation Functions (TAF) for services using synchronous bearer capabilities" (V4.5.1).

[8] GSM 09.07 (ETSI ETS 300 604): "European digital cellular telecommunication system (Phase 2); General requirements on inter-working between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)" (V4.12.1).

[9] ITU-T Recommendation T.35: "Procedure for the allocation of CCITT defined codes for non-standard facilities".

[10] ITU-T Recommendation F.160: "General operational provisions for the international public facsimile services".

[11] ITU-T Recommendation T.4: "Standardization of group 3 facsimile terminals for document transmission".

[12] ITU-T Recommendation T.30: "Procedures for document facsimile transmission in the general switched telephone network".

[13] ITU-T Recommendation V.21: "300 bits per second duplex modem standardized for use in the general switched telephone network".

[14] ITU-T Recommendation V.24: "List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) ".

[15] ITU-T Recommendation V.25bis: "Synchronous and Asynchronous Automatic Dialling Procedures on Switched Networks".

[16] ITU-T Recommendation V.25ter: "Serial Asynchronous Automatic Dialling and Control".

[17] ITU-T Recommendation V.27ter: "4 800/2 400 bit/s modem standardized for use in the general switched telephone network".

[18] ITU-T Recommendation V.29: "9 600 bit/s modem standardized for use on point-to-point 4-wire leased telephone type circuits".

[19] ITU-T Recommendation V.33: "14 400 bit/s modem standardized for use on point-to-point 4-wire leased telephone type circuits".

[20] ITU-T Recommendation X.300: "General principles for inter-working between public networks, and between public networks and other networks for the provision of data transmission services".

[21] GMR-2 04.201 (ETSI TS 101 377-4-13): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 13: Technical Realization of the Early Flag Technique".

3 Abbreviations

For the purposes of the present document, the abbreviations given in GMR-2 01.004 [1] and the following apply:

BCS	Binary Coded Signalling phase of facsimile transmission as per ITU-T T.30 [12]
CT105	Interchange Circuit 105 as per ITU-T V.24 [14], Request to Send
CT106	Interchange Circuit 106 as per ITU-T V.24 [14], Clear to Send
CT107	Interchange Circuit 107 as per ITU-T V.24 [14], Data Set Ready
CT108.2	Interchange Circuit 108/2 as per ITU-T V.24 [14], Data Terminal Ready
CT109	Interchange Circuit 109 as per ITU-T V.24 [14], Received Signal Detector
CT114	Interchange Circuit 114 as per ITU-T V.24 [14], Transmit Clock
CT115	Interchange Circuit 115 as per ITU-T V.24 [14], Receive Clock
FA/MT	The fax adapter specifically located at MT side
FA/IWF	The fax adapter specifically located at IWF side
MSG	Message phase of facsimile transmission as per ITU-T T.30 [12]
MT	Mobile Termination
REC	Receiving state
TA	Terminal Adapter
TRA	Transmitting state
TCE	Traffic Channel Equipment

All protocol entities from ITU-T facsimile Recommendations (T.4 [11] and T.30 [12]) apply; in the present document they are referenced in the same way as in the above ITU-T Recommendations (see annex A).

4 Service definition

The fixed network group 3 facsimile service, as basically defined in ITU-T Recommendation F.160 [10], is an international telematic service for ISO A4 document transmission between two facsimile stations.

The service specification is comprised of two parts:

- the control protocol described in ITU-T Recommendation T.30 [12]; and
- the document transmission coding described in ITU-T Recommendation T.4 [11].

The GMR-2 facsimile teleservice is intended to allow facsimile connections between group 3 apparatus on a list of manufacturer's models approved by GMR-2 using:

a) the GMR-2 system as a stand-alone facility, for mobile-to-mobile communication;

b) the GMR-2 system to gain access to fixed networks PSTN and ISDN, for mobile to/from land communication.

For this teleservice, the document coding is as ITU-T Recommendation T.4 [11] with no modifications. The protocol used is ITU-T Recommendation T.30 [12] modified within the GMR-2 system as detailed in the present document.

The inter-working between different networks is based on ITU-T Recommendation X.300 [20].

The particular features of this teleservice are:

a) it uses point-point communication;

b) the information transfer capability is "group 3 facsimile" only for teleservice 62;

c) both mobile originated and terminated calls are supported;

d) the information transfer mode is circuit, duplex, synchronous and symmetric;

e) different end-to-end transfer rates are used within the same call to take advantage of the better radio path error rates; (optional requirement);

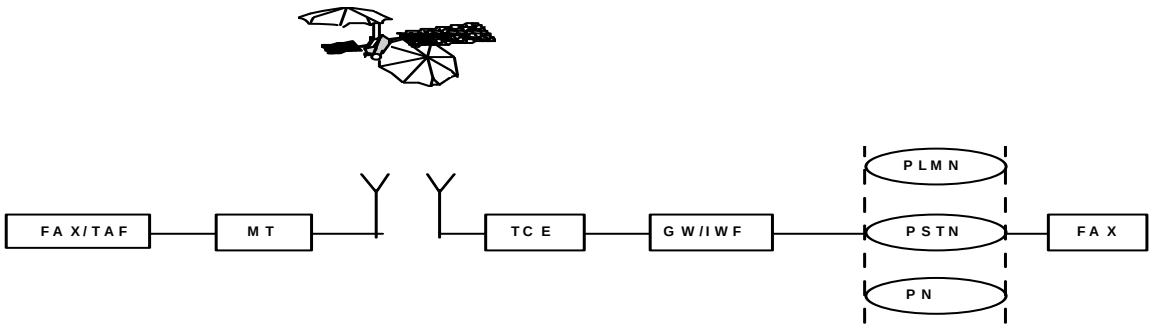
f) use of a GMR-2 specific synchronous terminal adaptation function (based on TS GSM 07.03 [7]) with the MES;

g) the T.30 [12] protocol, in conjunction with the technical specifications defined in GMR-2 03.045 and 04.201 [21], will support mobile-PSTN Group 3 fax for connections where round trip delay, within the PSTN network, is up to 310 ms. (This number is based on the command-response turn around time of the fax machines being at least 500 ms).

5 Network architecture

The network architecture applicable to this teleservice is shown in figure 5.1, below.

Mobile-PSTN Connection:



Mobile-Mobile Connection:

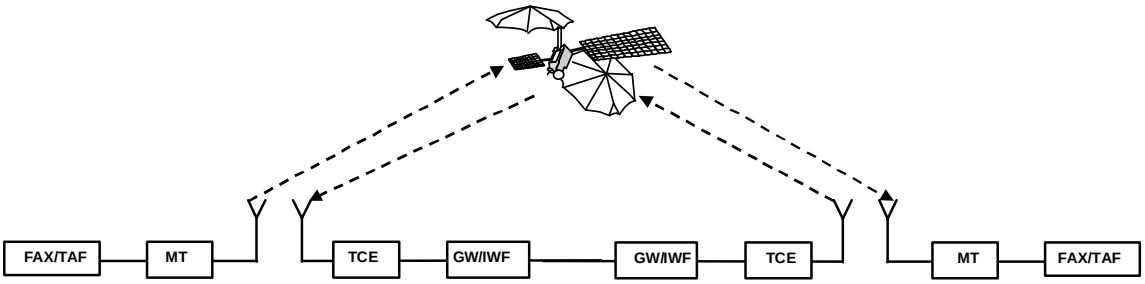


Figure 5.1: Network architecture

The figure shows the system configuration for mobile-to-fixed network and mobile-to-mobile calls. For mobile-to-mobile calls, there is effectively a loop back within the PSMN, using two IWFs. Specific reference configurations are shown in clause 6.

6 Reference configuration at the Mobile Earth Station (MES)

The mobile reference configurations described in this clause are defined as per common GSM usage.

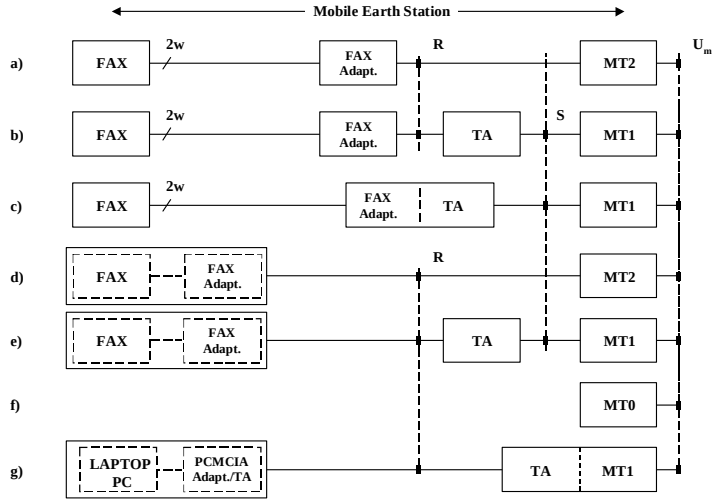


Figure 6.1: Reference configurations

The teleservice definition in GMR-2 02.003 [2] regards the group 3 facsimile terminal as a 2-wire analogue terminated equipment. In order to connect this to the MT2, a separate "fax adapter" device is necessary. This configuration, shown as item a) in figure 6.1, has to be considered as the standard configuration, so that all the existing group 3 facsimile apparatus can be connected to the GMR-2 system.

An alternative realization would be to combine a standard group 3 facsimile machine and the fax adapter into a specially developed "GMR-2 facsimile machine," directly providing a digital output.

Although such a device must appear to the MT2 as identical to the fax adapter (i.e., with an identical interface and protocol), it would allow for a significantly smaller and simpler facsimile machine. This configuration is shown as item d) in figure 6.1 and is regarded as a desirable alternative. In addition of course, it is always possible to realize an MT0, as per item f) in figure 6.1, where both the facsimile and mobile termination functions are considered to be part of one integrated unit.

Another possible GMR-2 specific configuration is shown as item g) in figure 6.1.

The remaining configurations concern the use of an S-interface or some GMR-2 specific interface and are considered as optional configurations.

The particular terminal adaptation functions used are those described in the appropriate MT specification based on GSM 07.03 [7] and the interface to the MT2 used is synchronous V.24 [14] with an option for support of V.25bis [15] or V.25ter [16] procedures for auto-calling and auto-answering.

6.1 Fax adapter functionality

The Fax adapter block, figure 6.1.1, is intended to specifically complement the group 3 facsimile apparatus in order to be able to communicate over a GMR-2 system.

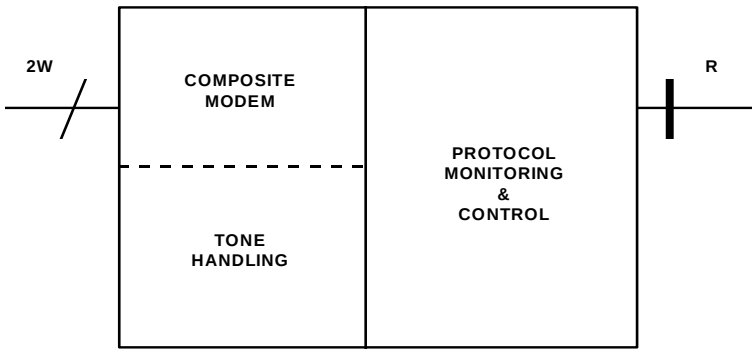


Figure 6.1.1: Fax adapter scheme

Whether it has to be a function internal to the GMR-2 system, or an external accessory associated with the group 3 apparatus, is beyond the scope of the present document, and in any case, does not affect at all the working of the procedure as here described.

It can be functionally partitioned in two sections:

a) an analogue section, dealing with:

   1) the modulation and demodulation processes according to ITU-T Recommendation V.21 [13], V.27ter [17] and V.29 [18] as explained in T.4 [11] and T.30 [12];

   2) handling of the signalling on the 2-wire path to the facsimile machine, including auto-calling and auto-answer functions.

b) a digital section, dealing with:

   1) monitoring and where necessary, manipulation of the T.30 [12] protocol as detailed in the rest of the present document;

   2) overall control of the adapter;

   3) connection over the synchronous V.24 [14] interface to the MT as described in the appropriate MT specification and based on GSM 07.03 [7];

   4) Auto-calling and auto-answering functions according to V.25bis [15] or V.25ter [16].

The present document will reference the fax adapter functionality, considering the most general case where it operates as a full-featured (see figure 6.1.1) separate block (see figure 6.1 configuration a), as this reference configuration is implicitly or explicitly exhaustive of all service related technical aspects.

6.2 GMR-2 Facsimile machine functionality

The special GMR-2 facsimile machine shown in the MS configuration d) of figure 6.1 has a similar functionality to the digital part of the fax adapter, but without any of the analogue portions.

It appears over the V.24 [14] interface as identical to the fax adapter, i.e., the MT2 needs to have no knowledge of the particular configuration used.

When necessary this reference configuration, will be explicitly referenced to in the following; otherwise all technical aspects relevant to the configuration implicitly apply.

7 Connection types

Table 7.1 shows the connection elements attributes applicable to this teleservice adapted from GSM 03.10 [3].

Table 7.1: Elements of connection types

Protocol Type of figure 6 of GSM 03.10 [3]	Access to TAF of the Mobile Earth Station (note 1)	Radio Interface Connection Element	Intermediate Rate RA1 to RA2	TCE-GW/IWF Connection Element
Model 5: Facsimile Group 3	C/D/S UDI - 9,6 kbit/s - 4,8 kbit/s - 2,4 kbit/s	C/D/S UDI - 12,0 kbit/s - 6,0 kbit/s - 3,0 kbit/s (note 2)	C/D/S UDI - 16 kbit/s - 8 kbit/s - 8 kbit/s	C/D/S UDI - 64 kbit/s - 64 kbit/s - 64 kbit/s
NOTE 1: The highest access rate actually supported in this Teleservice will be consistent with the highest access rate of the transparent bearer service provided by the Network Operator. NOTE 2: This rate deviates from GSM. Details of rate conversion are in GMR-2 04.021 [5]. C = Circuit switched S = Synchronous D = Full-duplex UDI = Unrestricted Digital Information				

Figures 7.1 and 7.2 show the scheme of a typical GMR-2 system connection for this teleservice, considering respectively R and S access at network termination.

To grant full support to the ITU-T Recommendation T.30 [12], requiring different transmission speeds, the following strategy shall be implemented:

a) the GMR-2 system provides for three access rate only, that is 9 600 bit/s, 4 800 bit/s, 2 400 bit/s;

b) radio channel modification procedures are used to select the suitable access rate (9 600/4 800/2 400 bit/s) within the facsimile phase, as resulting from the preliminary end-to-end negotiation between the terminals, as well as to support downspeed selection at the end of the facsimile message phase;

c) to transport Binary Coded Signalling (BCS) requiring a synchronous 300 bit/s bit-rate, speed conversion will be used at both the GMR-2 system ends.

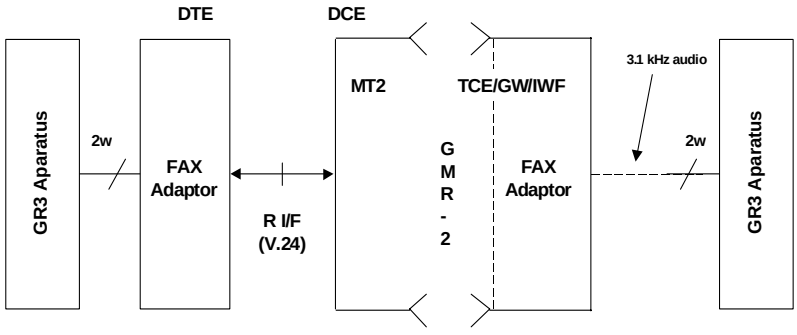


Figure 7.1: Standard teleservice connection

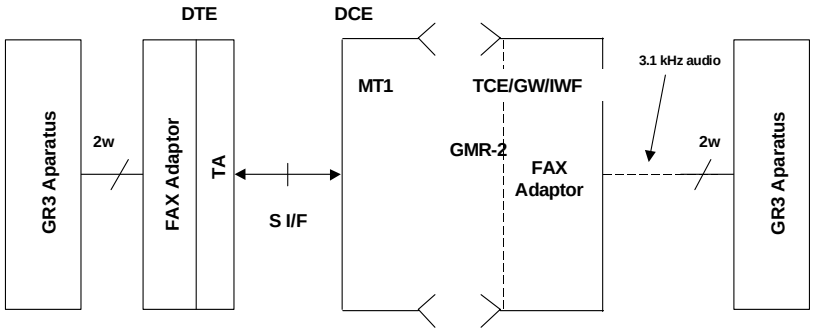


Figure 7.2: Optional teleservice connection

7.1 Information transfer protocol model

Figure 7.1.1 depicts the protocol model for this teleservice. The main point to be underlined is that all the protocol modules specific for this teleservice are confined in the fax adaptation functions at both the MT and IWF ends.

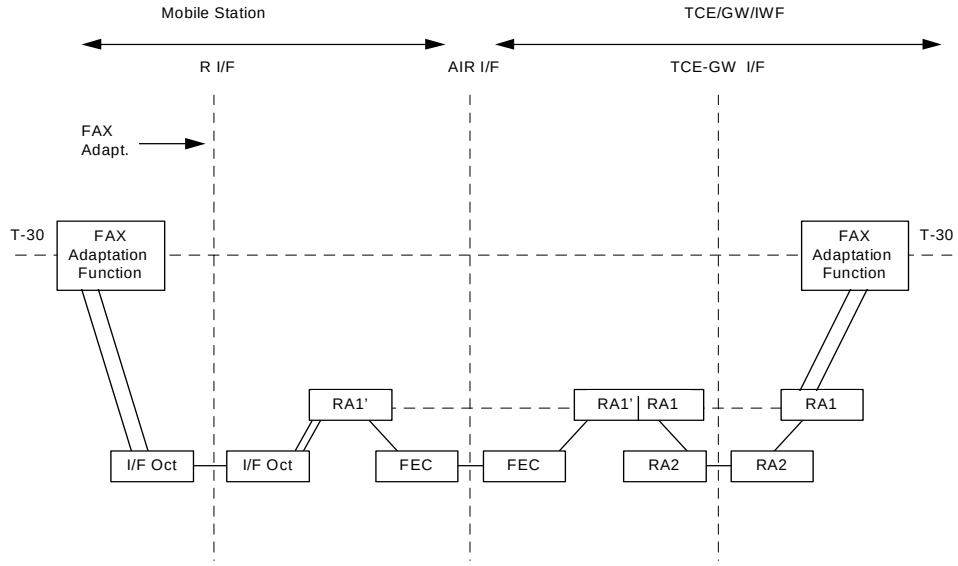


Figure 7.1.1: Information transfer protocol model

7.2 Interactions with T.30 [12]

The philosophy of the present document is to allow the T.30 [12] protocol to pass transparently wherever possible, through the fax adapters at both ends of the GMR-2 channel. Manipulations are only made to the protocol where necessary to overcome problems resulting from the differences between the PSTN and the GMR-2 system.

Basically, these problems fall into five categories:

a) supporting facsimile on a digital connection type;

b) bit errors during transfer of BCS frames;

c) the need to change speed to reduce the impact of bit errors during transfer of fax encoded messages (optional requirement);

d) the need to prevent timeout of T.30 [12] protocol timers due to link delays;

e) inability to support some features of T.30 [12].

7.2.1 Link control strategy

Though the T.30 [12] procedure is plain half-duplex, between the FAs at both the GMR-2 system ends a full-duplex mode connection will be established. Information transfer is structured in fixed length blocks, carrying either data received from the local modem, or idle synchronization patterns. Establishment, maintenance and release of the data circuit are performed autonomously by each FA, by properly handling the physical interface to its local modem.

Due to the rigid timeout constrains in T.30 [12] protocol procedure, which will be actually concatenated to the procedure defined here for the GMR-2 connection part, a strictly forward only approach is adopted for data link control; that is no retransmission means are explicitly introduced by the bearer channel to recover corrupted information blocks.

Although in the majority of cases the T.30 [12] protocol can take care of lost frames and easily recover, there are some particularly critical points where two consecutive segments in the procedure, without any interposed acknowledgement, require different transmission speeds (BCS speed/message speed). In these cases, to grant that a correct change-over from one modem type to another takes place at both the GMR-2 system ends, some additional protection is necessary in the GMR-2 environment.

This protection, actually at the beginning and at the end of the fax page transmission, is given by means of a confirmation mechanism, whereby the originating FA waits while transmitting a fixed pattern until an explicit acknowledgement is received from the terminating FA. In these cases an interruption of the normal T.30 [12] information flow may eventually result.

Aiming at minimizing any possible delay in the end-to-end transmission between the two facsimile apparatuses, the FAs will pass on information without error control of the message integrity.

NOTE: All V.21 [13] modems in the FAs shall use the faster response time provided by ITU-T Recommendation V.21 [13] (see V.21 [13], table 2) for on to off transition of CT109 and CT106.

To this regard, however, it is worth underlining that an essential requirement in this procedure is the detection of some key messages exchanged between the terminals, carrying basic control information. Hence, in parallel to the primary information passing process, a continuous monitoring of the information flowing across the FA is necessary, to detect these messages, fully checked in their logical integrity.

In addition, as detailed below, some fields in some frames may need to be changed.

7.2.1.1 Message detection

While in BCS, the following frames have to be detected:

a) DIS/DTC, to monitor all operational parameters proposed to the sender terminal by the receiver terminal;

b) DCS, to realize (see T.30 [12], table 2) the actual message transmission speed accepted by the sender terminal and the relevant message transfer direction;

c) NSF, to inhibit non-standard facilities, if explicitly required by the user fax adapter configuration;

d) DCN, to initiate the call release procedure.

During the message phase (C phase of T.30 [12]) a single bit pattern has to be detected, the EOL character, a unique codeword that can never be found within a valid line of fax coded data (see ITU-T Recommendation T.4 [11], clause 4.1.2), and therefore used to control the buffer level in each FA, as detailed in clause 8.2.6 of the present document.

7.2.2 Speed conversion for BCS phases

Given the signalling load caused by the channel mode modify procedure, rather than changing the radio channel speed to 300 bit/s to carry the BCS frames, a speed conversion mechanism is exploited at both the GMR-2 system ends, allowing the channel rate of the message phase (9 600/4 800/2 400 bit/s) to be maintained during BCS phases.

A speed conversion factor can be defined as:

$$\frac{\text{Fax message speed}\ (9\,600 \text{ or } 4\,800 \text{ or} 2\,400\ \text{bit/s})}{\text{Standard BCS speed}\ (300\ \text{bit/s})}$$

Which will assume the value 8 or 16 or 32, depending on the actual message speed negotiated between the terminals.

On the basis of the above speed conversion factor, in the originating FA up-conversion to message speed will be performed according to the repetition algorithm specified in clause 8.2.3.2.

In the terminating FA, down-conversion to the BCS speed will require a decimation algorithm (see clause 8.2.3.3). This algorithm is assumed implementation dependent, and hence its actual definition is beyond the scope of the present document. As the actual access rate over the S-TCH may change throughout the call, speed conversion factor needs to be updated in both FAs. The FA/IWF will update this value upon successful completion of a CMM procedure (see clause 7.3.2).

The FA/MT, which does not have direct access to the GMR-2 signalling channel (except for MT0 configuration), shall estimate the actual access rate established over the S-TCH from the effective access rate of the MT data interface (or any other means in case of MT0). This check shall be performed whenever a BCS frame is sent towards the radio path after which a change for S-TCH access rate may be expected (e.g., DIS and DCS frames for normal fax mode, PPR and CTC frames for Error Correction Mode).

7.2.3 Compatibility checking

Some features of T.30 [12] cannot be supported in the GMR-2 environment. Fax adaptation function is in charge of dealing with such compatibility checking.

7.2.3.1 Group 1 and Group 2 support

Group 1 and Group 2 equipment are not supported by the teleservice as described in the present document. To this purpose, any tonal signalling specific to the above kind of fax apparatus will be ignored by the fax adaptation function at the MES and IWF.

7.2.3.2 2 400 bit/s handshaking

Only standard 300 bit/s binary coded signalling is supported. To this purpose, the FA will ignore this capability within the B segment of ITU-T RecommendationT.30 [12] procedure, looking for DIS frame, by default, from ITU-T Recommendation V.21 [13] modem only.

7.2.3.3 Non-standard facilities

Non-standard facilities are supported in so far as they are not in conflict with the standard procedure described in the present document.

All the relevant BCS frames are passed end-to-end, unless an explicit deletion is required by the user (e.g., by a specific input at the fax adapter associated with the mobile earth station (MES)). In this case, upon detection (see clause 7.2.1.1) of the NSF frame identifier (the facsimile control field octet according to ITU-T Recommendation T.30 [12] terminology), the whole HDLC frame shall be stripped and replaced by a GMR-2 specific NSF frame, containing a country code and a unique identification of the FA manufacturer, encoded as per ITU-T Recommendation T.35 [9] and according to national regulations; the information field of this NSF frame shall have a maximum length of 6 octets, and shall not require any specific functionality in the GMR-2 system.

7.2.3.4 Procedure interrupts

In the case of teleservice 62, any attempt to invoke procedure interrupts by the MMI on the MT (see clause 7.3.1) will be ineffective.

7.2.4 Speed checking

Upon receiving DIS/DTC frame, the FA/IWF shall perform a basic speed checking procedure, aiming at verifying compatibility between the bit-rate possibilities offered by the called fax apparatus (bit fields 11, 12, 13, 14 in the IF) and the actual access rates allowed on the GMR-2 system (2 400/4 800/9 600 bit/s). In addition, some of these bit rates may be inhibited during the call, if a speed lower than 9 600 bit/s has been chosen by the user in the call set up message (for example if a better error rate is required).

The following cases may occur:

a) Some of the bit-rates indicated in DIS/DTC are not allowed on S-TCH (e.g., the max speed indicated in set-up is 9 600 bit/s, while DIS/DTC requests ITU-T Recommendation V.33 [19]), a possible strategy to cater for this case is altering the indication in DIS/DTC to a compatible value (e.g., ITU-T Recommendation V.29 [18]) by forcing appropriately the relevant bits; other strategies are possible and allowed, as long as the same goal of supporting the progress of the call is pursued, by constraining the fax apparatuses to use as message speeds the access rates actually available in the GMR-2 system;

NOTE: It is beyond the scope of the present document to specify the implementation strategy adopted to recalculate the frame CRC after the manipulation. Additional delays, if any, shall not have a significant impact on ITU-T Recommendation T.30 [12] operability.

b) the full set of bit-rates indicated in DIS/DTC are not compatible with the allowed access rates on S-TCH (e.g., the max speed indicated in set-up is 2 400 bit/s while DIS/DTC requests ITU-T Recommendation V.29 [18] only); in this case the call shall be failed;

c) the full set of bit-rates indicated in DIS/DTC are compatible with the allowed access rates on S-TCH; in this case no action shall be taken, independently of the access rate actually established.

It should be noted that the "9 600 bit/s" as max speed indication in the SETUP message, does not preclude the establishment of a call towards a fax group 3 equipment supporting only 4 800 bit/s and 2 400 bit/s as message speed.

As a matter of fact, due to the multiplexing mechanism for BCS phases the initial access rate (9 600 bit/s) will affect only the connection part between the called MES and the associated IWF, whilst the appropriate message speed will be actually negotiated during the initial BCS phase, and settled upon reading the appropriate field in DCS frame (see clause 7.2.1.1).

Therefore, if a request for MSG transmission is received, without a valid DCS frame being detected in advance (hence the message speed is undefined), the FA/IWF shall release the call immediately.

7.3 Radio channel modification procedures (optional requirement)

There are two reasons why the characteristics of the radio channel may need to be changed during a call:

a) if a T.30 [12] speed is negotiated between the facsimile machines to a lower rate than the maximum supported by the MESs subscribed rate, which is the rate assigned to the bearer channel at the initial connection.

b) if a T.30 [12] speed drop back is requested at the end of the facsimile message phase, a channel mode modify procedure as detailed in GMR-2 04.008 [4] is initiated to match the radio channel rate to the facsimile transmission speed to optimize the error rate.

7.3.1 Channel Mode Modify (CMM) (optional requirement)

The channel mode modification procedure is only initiated by the FA/IWF. Its purpose is to adjust the radio channel bit rate to match the message speed negotiated end-to-end between the facsimile machines.

The FA/IWF enters the CMM routine upon detecting the DCS frame sent either from the MES or from the PSTN. In the first case, FA/IWF being actually the receiving side in the facsimile document transmission, the CMM procedure is executed as soon as the end of frame is detected. That is, FA/IWF monitors the DCS frame and, if the requested rate differs from the existing radio channel rate, then in sequence:

a) issues a CMM request to the new rate towards the GMR-2 signalling;

b) waits for the acknowledgement of CMM completed;

NOTE: Information sent/received to/from the S-TCH while waiting for CMM completed is considered irrelevant, and left implementation dependent in the context of this recommendation.

c) returns back to the usual information passing process.

In the second case, FA/IWF being actually the transmitting side in the facsimile document transmission, the CMM procedure is executed after a suitable delay assumed as the time for transferring the DCS frame across the radio channel.

That is, FA/IWF monitors the DCS frame and, if the requested rate differs from the existing radio channel rate, then in sequence:

a) waits for a fixed time of 150 ms;

b) issues a CMM request to the new rate towards the GMR-2 signalling;

c) waits for the acknowledgement of CMM completed;

d) returns back to the usual information passing process.

As it will be seen below (see clause 8.2.4), in both cases the execution of the CMM procedure has to be seen like an exception within the usual information passing process, even overlapping it to maintain the overall end-to-end fixed delay.

8 Use of terminal adaption functions

According to the connection types (see figures 7.1 and 7.2) there are two classes of TAFs to be considered.

8.1 Standard TAFs for synchronous service

Are those described in GSM 07.03 [7] for synchronous bearer capabilities in the transparent mode. The rate adaption functions shall comply with the GMR-2 04.021 [5].

The interchange circuit signalling mapping is in accordance with the GSM 07.03 [7].

8.2 Specific TAFs for facsimile service

Integral part of an end-to-end connection for this teleservice is the fax adaptation function, located at both the GMR-2 system ends and in charge of adapting the T.30 [12] protocol procedure to the GMR-2 system environment, as described in clause 7 of the present document.

The main features relevant to the adaptation function are detailed in the following. For a better clarification, the finite state machine approach will be adopted in the following description of FA functionality, considering it as a set of states defined by specific interactions with both the digital channel and the analogue channel.

8.2.1 Working principle

The working principle of the proposed solution is depicted in figure 8.2.1.1.

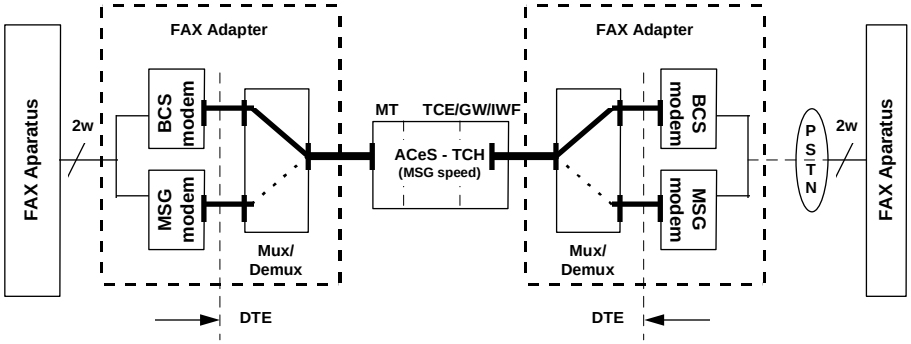


Figure 8.2.1.1: Fax adapter working principle

The fax adapter is split in its main functional blocks:

a) a BCS (300 bit/s) modem capability (half duplex);

b) a MSG (9 600/4 800/2 400 bit/s) modem capability (half duplex);

c) Mux/Demux capability, to connect the traffic channel (full duplex) to either of these modems.

Looking at the overall facsimile service architecture in GMR-2 (see figure 7.1.1), half-duplex transmission is initiated in either side of the connection by the actual request on the physical interface (CT109 ON on the local modem), is then continued on the traffic channel (S-TCH), and finally terminated on the appropriate modem at the remote side.

On the basis of the above assumptions, considering the fax adaptor a finite state machine, the whole adaptation process can be described by a set of 5 states:

a) IDLE state, when the FA is just connected to the GMR-2 TCH, sending synchronizing patterns over the radio path;

b) BCS-REC state, when the FA is receiving data from the V.21 [13] modem (BCS phases);

c) BCS-TRA state, when the FA is transmitting data over the V.21 [13] modem (BCS phases);

d) MSG-REC state, when the FA is receiving data from the MSG modem (2 400/4 800/9 600 bit/s);

e) MSG-TRA state, when the FA is transmitting data over the MSG modem.

8.2.2 Basic protocol structure

The protocol structure is based on a strictly synchronous approach, using 64-bit fixed length frames; that is each FA actually sends/receives information as 64 bit frames, in sequence and without interruption, during the whole duration of a call; the content of each frame depends on the specific state currently implemented.

The following set of frame types encompasses the full range of capabilities required:

a) SYNC frame, explicitly designed to slow synchronization at the remote end, even in the adverse transmission environment like the cellular radio channel. It is a unique frame, used even as idle frame whenever there is no information to be sent over the radio path;

b) STATUS frame, intended to carry both state identification codes. Along with state specific information; this frame has a unique structured format to allow synchronization checking at remote side. The actual information content is related to the specific state;

c) DATA frame which is fully unstructured, and carries Fax coded information during MSG phases.

8.2.2.1 Frame formats

To reduce complexity of finding synchronization over a 64-bit pattern, SYNC frames are obtained by concatenating two 32-bit sync codewords, the second one being the 1's complement notation of the first one.

The following codes shall be used for sync codewords:

- MSB;
- hex code 3E375096: first sync codeword;
- hex code C1C8AF69: second sync codeword.

To improve the probability of detecting synchronization, up to 3 errors are tolerated in each single sync codeword: in this condition the false sync probability is quite negligible.

STATUS frames have an internal 8-bit modularity (see figure 8.2.2.1.1), where odd octets contain state identification codes (IDENT), and even octets contain status specific information (INFO).

IDENT octets are split in two (four bit) fields, each one repeating the same code for status identification:

- hex code 1: BCS-REC state;
- hex code 3: MSG-REC state;
- hex code 4: MSG-TRA state.

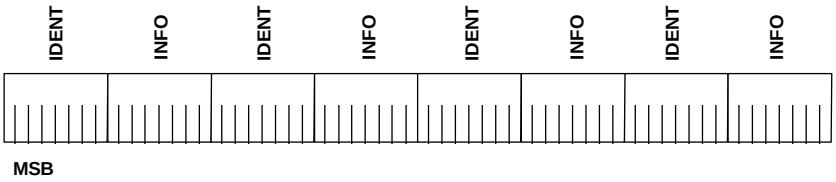


Figure 8.2.2.1.1: STATUS frame format

To improve the probability of detecting the correct state, up to 3 corrupted codes are tolerable in the total 8 instances repeated within a single STATUS frame. INFO octets contain the same code repeated 4 times within one frame; in particular:

- for BCS-REC state this octet contains 8 bits received from the BCS modem;
- in all other states an idle code (hex code 0F) is inserted.

DATA frames are 64-bit fully unstructured information blocks; the last DATA frame in a message phase will be truncated to the actual length of the bit stream to be transmitted.

A general rule concerning all the above frames is that most significant bits are transmitted first. In addition, a basic first-in first-out functionality will be implemented in the information passing process.

8.2.3 Protocol description

The above-defined finite state model will be used to fully describe the protocol procedure.

8.2.3.1 Idle state

In each FA this state implies a continuous transmission of SYNC frames towards the radio path, to allow frame synchronization at the remote end. This state is entered into immediately after the end of the synchronization process over S-TCH, and will be returned to whenever loss of synchronization is assumed.

8.2.3.2 BCS - REC state

The basic function of FA in this state is transferring BCS information from local modem to S-TCH. Transition to this state is triggered by CT109 ON condition of V.21 [13] modem.

Towards the radio path continuous transmission of STATUS frames is performed, according to the format described in the above clause 8.2.2.1, as soon as 8 bits at least are available from the modem. Information received from S-TCH is ignored while CT109 (local modem) is in the ON condition.

Every 8 bits received from the V.21 [13] modem, the appropriate number of STATUS frames (1, 2 or 4 depending on the current S-TCH access rate) will be originated. Following CT109 (local modem) OFF condition, padding bits (e.g. 1 s) will be inserted to assemble the last octet.

Monitoring the content of certain BCS frames is required. The DCS frame requires a specific procedure, detailed in clause 8.2.4.

Refer to the diagram in figure B.1.

8.2.3.3 BCS - TRA state

The basic function of FA in this state is transferring BCS information from S-TCH to its local V.21 [13] modem. Transition to this state is triggered by reception of BCS-REC code from S-TCH. Towards the radio path, continuous transmission of SYNC frames is performed, according to the format described in clause 8.2.2.1.

The information received from S-TCH, after proper decimation (a voting algorithm, implementation dependent), is passed to the V.21 [13] modem. Upon detecting a SYNC frame, the modem is turned OFF and a transition to the IDLE state is performed.

Monitoring the content of certain BCS frames is required. The DCS frame requires a specific procedure, detailed in clause 8.2.4. In addition, a supervisory function is required to check maintenance of synchronization by examining the inherently structured STATUS frame format.

Loss of synchronization will be assumed in case of reception of unstructured STATUS frames. That is, when the repetition mechanism for both the IDENT and the INFO octets does not allow unambiguous result to the voting algorithm. In this case an estimate of the INFO octet value in the received STATUS frames is passed on to the V.21 [13] modem, up to a maximum BCS-TRA duration of 2,5 s. At this point, if the correct synchronization has not been recovered yet, the modem is turned OFF and a transition to the IDLE state is performed.

In case of loss of V.110 synchronization on the GMR-2 system side, the FA shall transmit 0s towards the analogue interface, as long as no data is available.

Refer to the diagram in figure B.1.

8.2.3.4 MSG - REC state

The basic function of FA in this state is transferring MSG information from its local modem to S-TCH. Transition to this state is triggered by the MSG modem being trained. Towards the radio path, continuous transmission of STATUS frames interleaved with SYNC frames is performed.

Actual transfer of fax coded data over the radio path can be initiated only after the specific acknowledgement is received from the remote side, that is, reception of MSG-TRA indication in a STATUS frame, signifying the correct state transition. All data received from the MSG modem will be stored in the FA buffer, to be passed on the S-TCH (first-in first-out mechanism) as soon as this confirmation message is received. In the GMR-2 system, the configuration message will arrive after a delay of no more than 2 000 ms. Therefore, all data received from the MSG modem during this time interval shall be stored in the FA buffer.

Transmission is performed by means of unstructured DATA frames, aligned to the last SYNC or STATUS frame. In this phase, information received from the S-TCH is ignored.

Following CT109 OFF condition of MSG local modem, after all buffered data are transmitted (the last DATA frame is truncated if necessary), a transition to the IDLE state is performed. In this state the FA waits (meanwhile BCS data received from the local modem are ignored) for a minimum of 5 transmitted SYNC frames, in order to indicate to the remote FA the end of the message.

While waiting for the acknowledgement, re-synchronization shall be performed if necessary, following reception of unrecognisable SYNC frames or unstructured STATUS frames.

Refer to the diagram in figure B.2.

8.2.3.5 MSG - TRA state

The basic function of FA in this state is transferring MSG information from the S-TCH to its local MSG modem.

Transition to this state is triggered by reception of MSG-REC code from S-TCH; towards the radio path continuous transmission of STATUS frames interleaved with SYNC frames is performed.

The MSG modem is trained and a timer (300 ms) is started. After timeout, loss of synchronization in the information received from S-TCH will be assumed as the first Fax coded DATA frame. From the receipt of Message on, continuous transmission of SYNC frames is performed.

All data received from the S-TCH will be stored in the FA buffer, to be passed on to the MSG modem (First-In First-Out mechanism) as soon as the modem training terminates (CT106 ON).

From this time on, re-synchronization will be attempted continuously. When an IDLE state is recognized in the data stream received from the radio path, end of MSG phase will be assumed Then a transition to the IDLE state will be executed, where the FA will wait (ignoring data received from the S-TCH) until the buffered information has been fully transmitted to the local MSG modem. The procedure will then proceed in the normal way.

In case of loss of V.110 synchronization on the GMR-2 system side, the FA shall transmit 0s towards the analog interface, as long as no data is available.

Refer to the diagram in figure B.2.

8.2.4 DCS and TCF processing

Transmission of TCF is performed end-to-end between the two-fax apparatuses, and requires in both FAs a specific routine triggered by DCS command. As far as the originating FA is concerned, the general procedure as described above for MSG phase (MSG-REC state) applies, but no acknowledgement is required, both at the beginning and at the end, and so no buffering is necessary.

That is, just following CT 109 ON condition of the MSG modem, unstructured DATA frames are sent over the radio path, aligned to previous frames. Upon CT 109 OFF condition the last frame is sent (truncated if necessary), and a transition to the IDLE state is performed.

As far as the terminating FA is concerned, after passing DCS command and waiting for the appropriate delay (75 ms), transition to the MSG-TRA is executed. Here, modem training shall be pre-empted and, as soon as the modem is ready for sending (CT 106 ON), loss of synchronization on S-TCH will be assumed as the first DATA frame containing TCF information and will be passed to the MSG modem.

After 1,5 s timeout (standard TCF duration), the MSG modem will be turned OFF and the IDLE state entered as usual. Fill information (i.e., logical 0s) will be sent on the local modem if real TCF bit stream is not available.

When DCS frame requires a different message speed with respect to the actual access rate established on the GMR-2 channel, CMM procedure will be issued (at IWF side only) as detailed in clause 7.3.1, just upon detecting the end of DCS frame, before any other task.

To ensure that the time gap between the DCS and TCF is within 75 + /- 20 ms period as specified in ITU-T Recommendation T.30 [12], the training shall be pre-empted in the terminating FA, as defined above.

Refer to the diagram in figure B.3.

8.2.5 DCN (disconnect) frame

The FA/MT, upon detection of the DCN frame (see ITU-T Recommendation T.30 [12]) sent by the local terminal to indicate the end of facsimile transmission, passes this information to the S-TCH in the normal way and then initiates the disconnection procedure towards MES, as defined in clause 9.3.

When the DCN frame is received from the S-TCH, disconnection occurs immediately by the FA/MES, as defined in clause 9.3.

8.2.6 Clocking

At the mobile earth station, the fax adaptor or GMR-2 facsimile machine will acquire received data bit timing on CT115 (from MT). The transmitter element timing CT114 (from MT) shall be synchronized to CT115. Since a synchronous terminal adapter function is used, the clock rate over the V.24 [14] interface will always reflect the rate over the radio interface.

In this teleservice, the network independent clocking (NIC) mechanism is not used. To compensate against mismatching between GMR-2 system clock speed and local modem clock speed, a FIFO buffering technique shall be adopted in the FAs on both the GMR-2 system sides.

The strategy to manage the buffer queue has a direct impact on the overall delay of the MSG phase, and therefore on T.30 [12] operability in the ensuing post-message phase. Basically this procedure is regarded as implementation dependent, and hence is beyond the scope of the present document. A possible implementation is described below, aiming at minimizing the additional delay.

In the originating FA, when the modem speed is lower, according to T.4 [11] (.4 [11], clause 4.1.3) a pause may be placed in the message flow by transmitting a FILL sequence (variable string of 0s) between a line of data and an EOL character.

When the modem speed is higher, as no flow control is provided by T.4 [11] coding, the buffer will store excess data resulting from a fax page transmission.

In the terminating FA the same control means will be exploited.

8.2.7 Timeouts

The overall fax adaptation function has no intrinsic timeout, and so relies fully on the timing constraints associated to the end-to-end T.30 [12] procedure.

This means that, regardless of the reference configuration used at the mobile earth station, either the "standard" (configuration a) of figure 6.1) or the "GMR-2 facsimile machine" (configuration d) of figure 6.1), the progress of the call for this teleservice will be merely subject to the T.30 [12] typical timing protections, settled externally (physically and/or functionally) with respect to the procedure as described above. However, satisfactory service for Mobile-to-Mobile calls can be ensured through a technique known as 'Early Flag Technique'.

Mobile-to-Mobile calls are characterized by longer transmission delays due to the fact that two satellite hops are involved. A brief description of the Early Flag Technique is now given. The complete details including the parameter values are given in the GMR-2 04.201 [21].

During the BCS phase of the fax call, typically one of the two-fax machines sends a BCS command and waits for a response from the other fax machine. According to T.30 [12], timeout leading to a call disconnection can be caused if a response is not received within a specified period of time. In order to prevent this happening erroneously due to the increased transmission delays, the fax adaptor of the originating fax machine generates a stream of HDLC flag sequences (7E hexadecimal = 01111110 binary) and transmits them to the originating fax machine. Since the HDLC flag sequences constitute the so-called 'preamble' that precedes a valid BCS response, these 'early' flags will serve to prevent the fax machine from timing out. When the actual response is received, the fax adaptor appends it to the HDLC flags and sends them to the first fax machine.

NOTE: In the particular case of Mobile-to-Mobile calls, Early Flags are inserted only in the FA/MT and not in FA/IWF.

If a particular realization of the mobile fax equipment and its associated TAF allows the modification of the T.30 [12] software of the mobile fax equipment, then an alternative solution to the time out problem for Mobile-to-Mobile calls is to increase the value of the T4 timer in the T.30 [12] protocol to a value large enough to prevent time out. For example, T4 timer value of 5 s could be used.

8.3 Specific TAFs for facsimile service (T.30)

The optional error correction procedure, as defined in ITU-T Recommendations T.4 [11] and T.30 [12] (see annex A) recommendations may be fully supported, provided some specific features are added to the fax adaptation procedure as resulting from the previous clause 8.2.

These features are relevant to:

a) additional HDLC frame to be detected;

b) handling of the Message phase;

c) modification of the Channel rate (CMM request).

The error correction mode is entered upon detection of the relevant bits in the DIS/DTC frame.

8.3.1 Frame detection

During the BCS phases, beside the frames enlisted in clause 7.2.1.1, an additional frame (CTC) has to be detected, as it fixes the retransmission strategy chosen by the fax transmitting terminal.

8.3.2 Message phase

The same buffering approach as for standard T.30 [12] procedure (see clause 8.2.6) will be exploited to overcome the mismatching in clock speed between GMR-2 system and the local modem. In this case however, the HDLC flag code (hex 7E) will be used to control the buffer level, as the Fax coded data are structured in HDLC frames.

8.3.3 Additional CMM request

While in BCS, the CTC frame has to be detected, due to the possible (not mandatory) request of changing the transmission speed to a fallback bit-rate.

The CMM request towards the GMR-2 system (when appropriate) is issued at the IWF side, by exploiting the bit-rate indication in the CTC frame, similar to the indication in DCS frame.

Upon detecting the CTC frame, either sent by the PSTN or by the MES, provided the transmission speed indication is different from the existing channel rate, as soon as the end of frame is detected, a CMM request is issued, using exactly the same procedure as described for DCS in clause 7.3.1.

9 Signalling aspects

GSM 07.03 [7] identifies the BC/LLC/HLC requirements to be supported by the MES. In case of Teleservice 62, a single BC-IE ("Group 3 facsimile") is used. Interworking between Teleservice 62 is specified in GMR-2 02.003 [2] and GSM 07.01 [6].

9.1 Handling of tonal signals

Because the ITU-T defined service uses modems, there are some signals received from the analogue link at the IWF and (where used) the fax adapter which do not have a direct binary representation. These signals cannot therefore be passed across the radio interface in the same way as the T.30 [12] and T.4 [11] information.

These signals are the modem called (CED) and calling (CNG) tones sent at the start of each fax data phase of the call. They are generated locally by the FA/MT and FA/IWF, exploiting an end-to-end time alignment mechanism, triggered by appropriate messages on the GMR-2 signalling channel. The procedure is detailed in the following.

9.2 Call establishment

The PSTN facsimile apparatus may only be automatic calling.

9.2.1 Mobile terminated call - auto answer

Refer to the diagram in figure B.4.

A call received from the PSTN will cause the MES to turn on CT125 at the R interface. In the case where a GMR-2 facsimile machine is used, V.25bis [15] or V.25ter [16] auto answer process is handled directly by turning on CT108.2. In the case where a fax adaptor is used, CT125 will cause ring current to be sent to the mobile fax apparatus.

The fax adaptor will turn on CT108.2 when the mobile fax apparatus answers the call.

On receipt of CT108.2, the MES will answer the call and initiate the synchronization process over the radio interface.

On completion of the synchronization process over the radio interface, CT107 shall be turned on by the MT; in the case where a fax adaptor is used, on receipt of CT107 from the MT, the fax adaptor will initiate the tonal handshaking by sending CNG (mandatory).

The analogue link at IWF side shall be established in accordance with the ITU-T Recommendation T.30 [12]. The same considerations apply as detailed in clause 9.1 for CED transmission

NOTE: CT109 and CT106 at the R interface of the MT must be in the ON condition before any further procedure can be carried out end-to-end between the fax adapters. Therefore, as soon as the synchronization process over the radio interface is completed, both CT109 and CT106 (MT side) are clamped to the ON condition by the FA/IWF.

9.2.2 Mobile originated call - auto calling

Refer to the diagram in figure B.5.

Over the V.24 [14] interface the auto calling procedure of V.25bis [15] or V.25ter [16] is initiated, using the relevant HDLC format commands. This is done either directly from the GMR-2 facsimile machine or, in the case where a fax adapter is used, by loop disconnect or DTMF dialling information between the mobile fax apparatus and the fax adapter.

When the call is answered, a synchronization phase will take place over the radio interface.

On completion of the synchronization process over the radio interface, the modem at IWF will be automatically selected and send CNG (mandatory) to PSTN fax apparatus. Also CT107 shall be turned on by MT.

In the case where a fax adapter is used, the receipt of CT107 shall cause the fax adapter to connect to tine.

NOTE: CT109 and CT106 at the R interface of the MT must be in the ON condition before any further procedure can be carried out end-to-end between the fax adapters. Therefore, as soon as the synchronization process over the radio interface is completed, both CT109 and CT106 (MT side) are clamped to the ON condition by the FA/IWF.

9.2.3 Mobile originated call - manual calling

Refer to the diagram in figure B.6.

When the call is answered a synchronization phase will take place over the radio interface, provided CT108.2 is in ON condition. In the case where a fax adapter is used, the mobile fax apparatus must be connected to line by manual intervention at this stage, and will cause the fax adapter to turn on CT108.2 towards the MT.

In the case where a GMR-2 facsimile machine is used, CT108.2 shall be turned on when the GMR-2 facsimile apparatus is connected to line by manual intervention.

On completion of the synchronization process over the radio interface, the modem at IWF will be automatically selected and send CNG (mandatory) to PSTN fax apparatus. Also CT107 shall be turned on by MT.

In the case where a fax adapter is used, the receipt of CT107 shall cause the fax adapter to connect to line.

NOTE: CT109 and CT106 at the R interface of the MT must be in the ON condition before any further procedure can be carried out end-to-end between the fax adapters. Therefore, as soon as the synchronization process over the radio interface is completed, both CT109 and CT106 (MT side) are clamped to the ON condition by the FA/IWF.

9.3 Call release

The normal call release procedure will be initiated at the mobile earth station, either by the GMR-2 facsimile machine or by the FA/MT, forcing CT108.2 in OFF condition. This will follow a DCN frame (disconnect, see clause 8.2.5) occurrence, either sent over the S-TCH towards the remote fax terminal or received via S-TCH from the remote fax terminal.

In the former case CT109 will be actually turned OFF after a time delay of 500 ms from DCN being sent.

In the latter case, no delay is necessary before turning CT108.2 in OFF condition. When the received DCN is corrupted, and hence undetected in the mobile earth station by the FA, the call control entity in the GW / IWF will release the call over the GMR-2 system connection element, following the disconnection over the PSTN.

10 Interworking to fixed networks

PSTN and ISDN only are considered, both are used as a transit network to complement the GMR-2 system in the end-to-end connection between group 3 facsimile apparatus, as shown in figure 10.1.

As far as the signalling aspects are concerned, both general and facsimile teleservice specific requirements, as specified in GSM 09.07 [8], apply.

Clarifications given in the following deal with traffic channel aspects only.

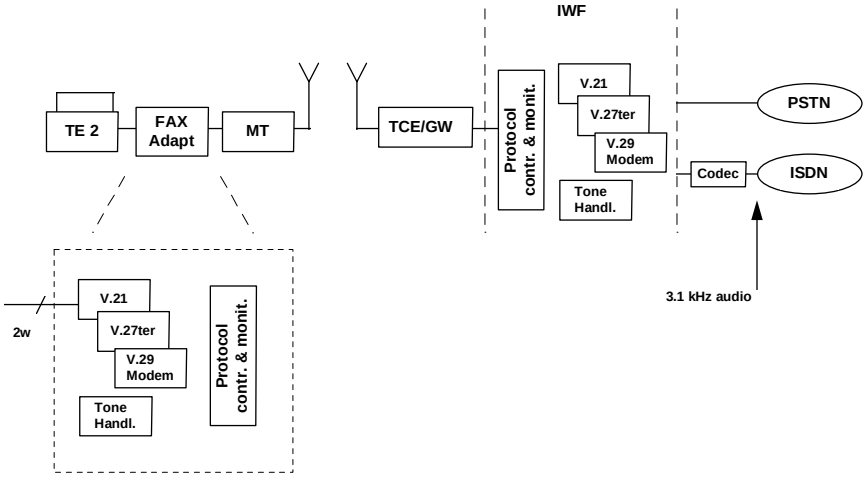


Figure 10.1: Network interworking

10.1 Interworking to PSTN

As the standard access of group 3 facsimile terminals for this teleservice is a 2-wire analogue interface, all the technical requirements for network interworking to PSTN are identical in principle to those encountered for the terminal connection to the MT.

The key functional block is the fax adapter described in clauses 7 to 9.

As far as network interworking is concerned, the main function to be performed by such block is the correct managing of a composite modem, in accordance with the requirements of ITU-T Recommendation T.30 [12]:

a) V.21 [13] synchronous mode, as standard facility for all BCS phases;

b) V.27ter [17] for message speeds of 4 800 and 2 400 bit/s;

c) V.29 [18] for 9 600 bit/s message speed.

The mechanism for selecting the right modem is the following:

a) The actual message speed is obtained by detecting the DCS frame (see table 2 / ITU-T Recommendation T.30 [12]) while in BCS phase;

b) On entering the Message phase, there is an interchange between the V.21 [13] modem and the actual modem agreed upon between the terminals for message transmission;

c) On exiting the Message phase the V.21 [13] modem is selected again.

Times for settling the modems will be in accordance with the requirements of T.30 [12].

10.2 Interworking to ISDN

The use of 3,1 kHz bearer capability of ISDN allows for an interworking of GMR-2 system very similar in practice to the scheme for PSTN (see figure 8.2.1.1).

The fax adapter function is in conformance with the description given in clauses 7 to 9, and operates as detailed in clause 10.1.

Annex A (informative): Protocol entities from ITU-T T.30 [12] and T.4 [11]

Table A.1: List of T.30 [12] signals

Abbreviation	Function	Signal format	T.30 [12] standard	T.30 [12] err.corr.
CED	Called station identification	2 100 Hz	X	X
CFR	Confirmation to receive	X010 0001	X	X
CRP	Command repeat	X101 1000	X	X
CIG	Calling subscriber identification	10001000	X	X
CNG	Calling tone	1 100 Hz	X	X
CSI	Called subscriber identification	0000 0010	X	X
CTC	Continue to correct	X100 1000		X
CTR	Response to continue to correct	X010 0011		X
DCN	Disconnect	X101 1111	X	X
DCS	Digital command signal	X100 0001	X	X
DIS	Digital identification signal	0000 0001	X	X
DTC	Digital transmit command	1000 0001	X	X
EOM	End of message	X111 0001	X	
EOP	End of procedure	X111 0100	X	
EOR	End of retransmission	X111 0011		X
ERR	Response to end of retransmission	X011 1000		X
FCD	Facsimile coded data	0110 0000		X
FCF	Facsimile control field	- - -	X	X
FCS	Frame checking sequence	16 bits	X	X
FIF	Facsimile information field	- - -	X	X
FTT	Failure to train	X010 0010	X	X
MCF	Message confirmation	X011 0001	X	X
MPS	Multi-page signal	X111 0010	X	
NSC	Non-standard facilities command	1000 0100	X	X
NSF	Non-standard facilities	0000 0100	X	X
NSS	Non-standard set-up	X100 0100	X	X
PIN	Procedural interrupt negative	X011 0100	X	X
PIP	Procedural interrupt positive	X011 0101	X	X
PIS	Procedure interrupt signal	462 Hz	X	X
PPR	Partial page request	X011 1101		X
PPS	Partial page signal	X111 1101		X
PRI	Procedure interrupt	X111 XXXX	X	
RCP	Return to control for partial page	0110 0001		X
RNR	Receive not ready	X011 0111		X
RR	Receive ready	X111 0110		X
RTN	Retrain negative	X011 0010	X	X
RTP	Retrain positive	X011 0011	X	X
TCF	Training check frame	0... 1,5 s	X	X
TSI	Transmitting subscriber identification	X100 0010	X	X

Table A.2: List of T.4 [11] signals

Abbreviation	Function	Signal format
EOL	End of line	0000 0000 0001
RTC	Return to control	6 * EOL

Annex B (informative): Procedure examples

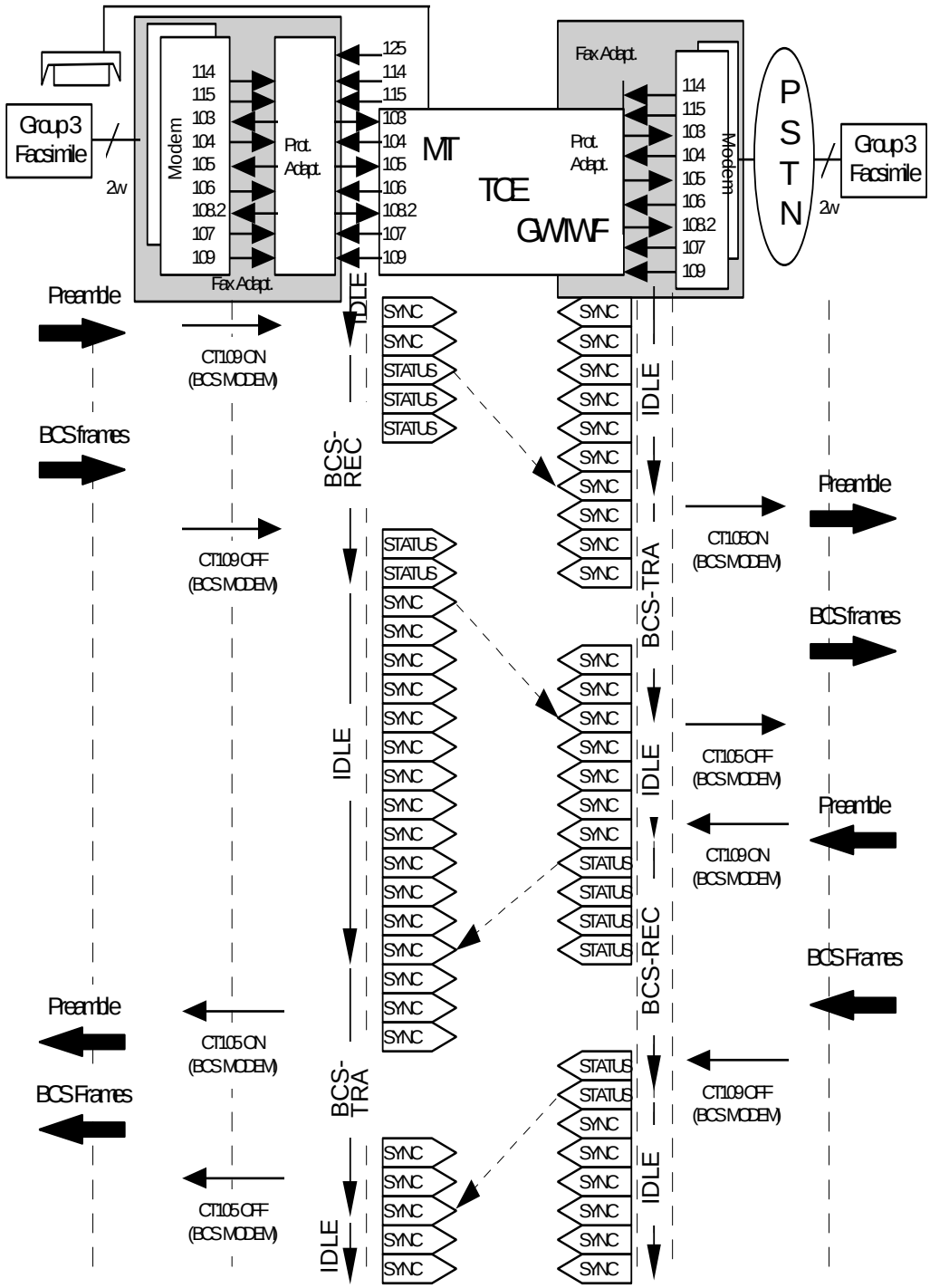


Figure B.1: Mobile originated facsimile transmission - typical BCS phase (command/response)

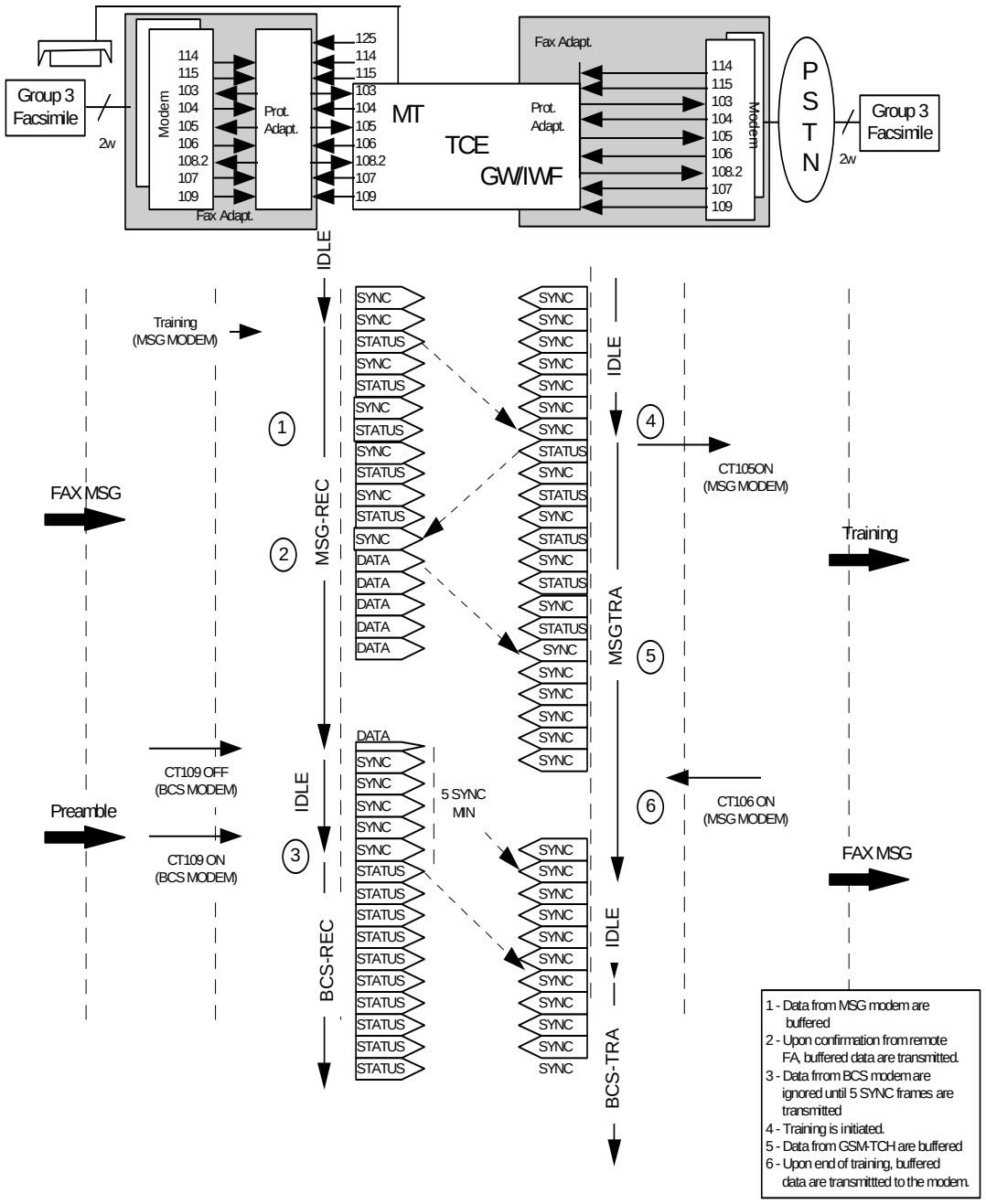


Figure B.2: Mobile originated facsimile transmission - typical MSG phase

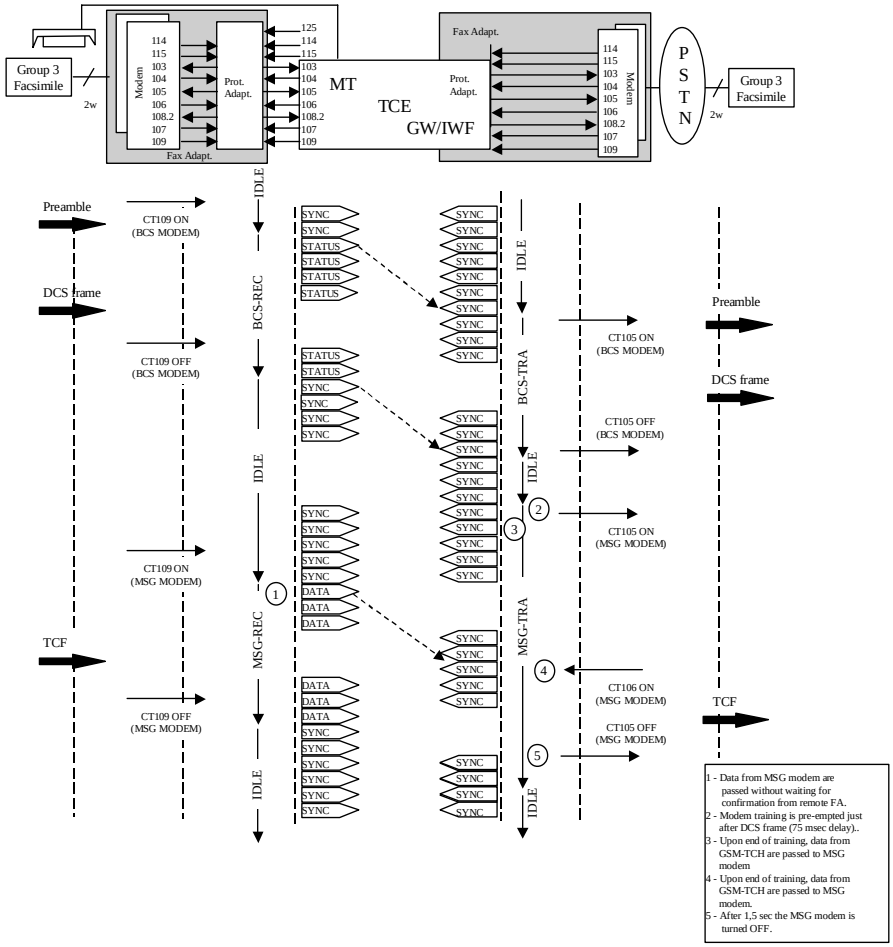


Figure B.3: Mobile originated facsimile transmission - processing DCS frame and TCF message

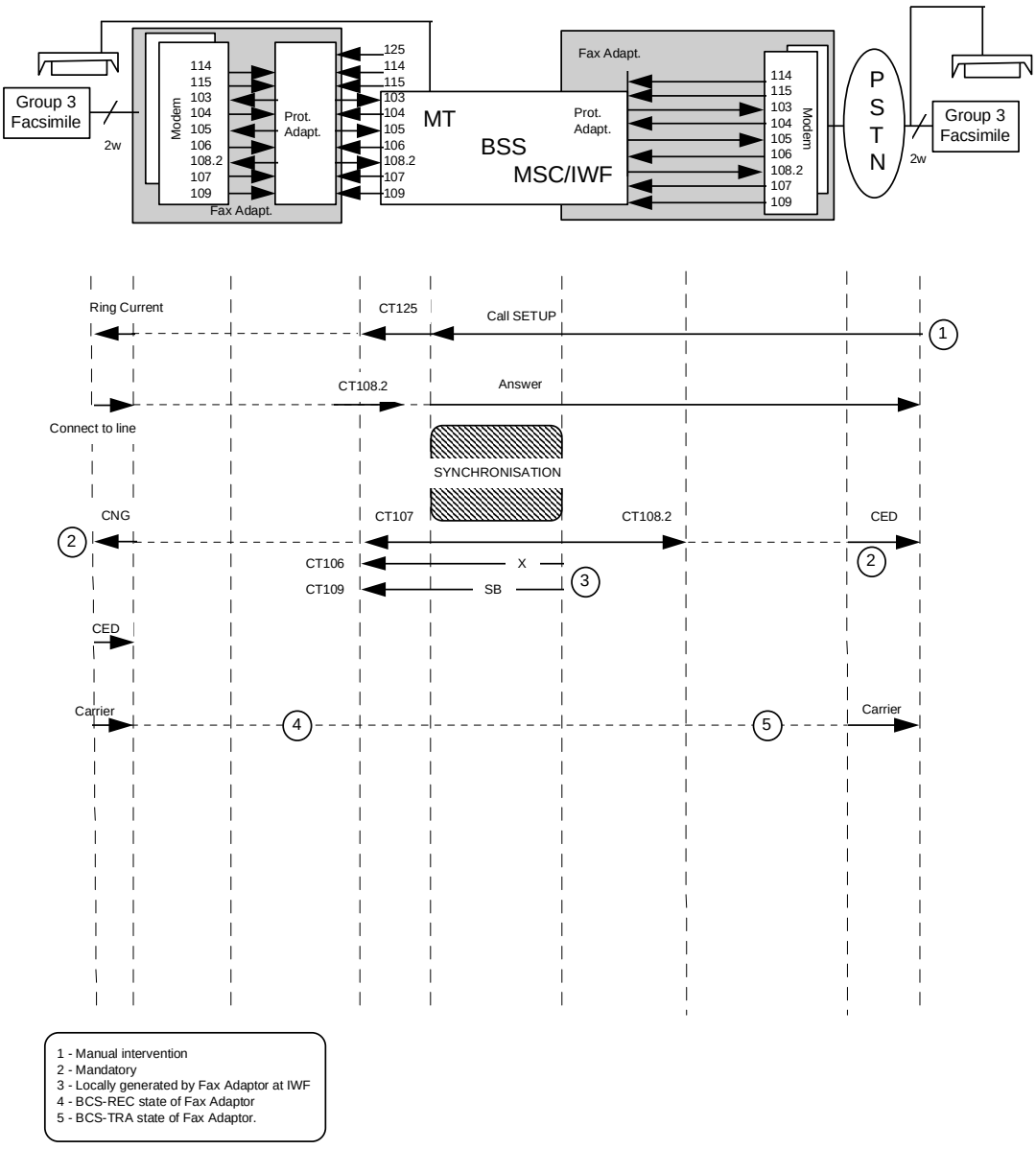


Figure B.4: Mobile terminated call - auto answer

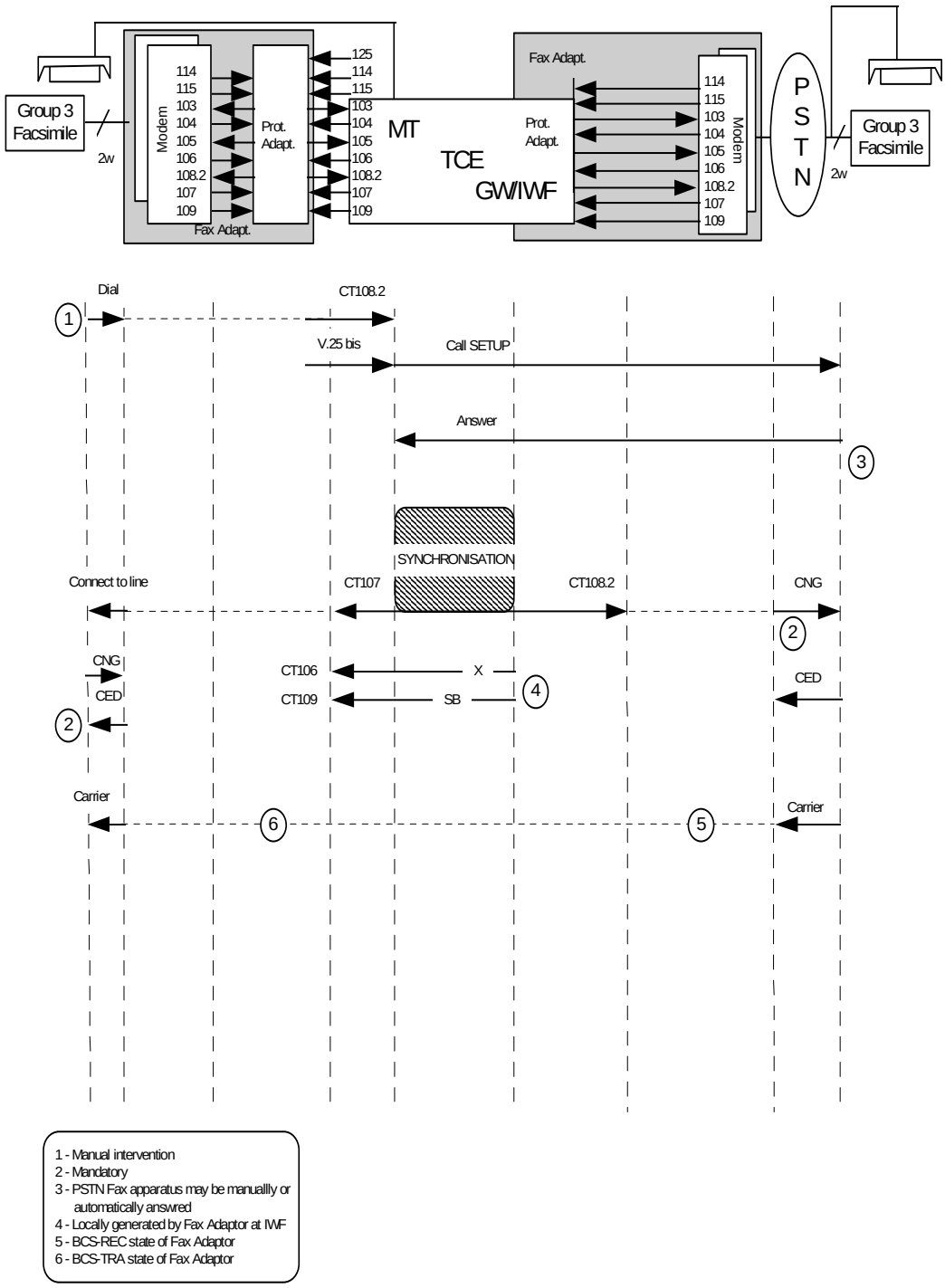


Figure B.5: Mobile originated - Auto calling

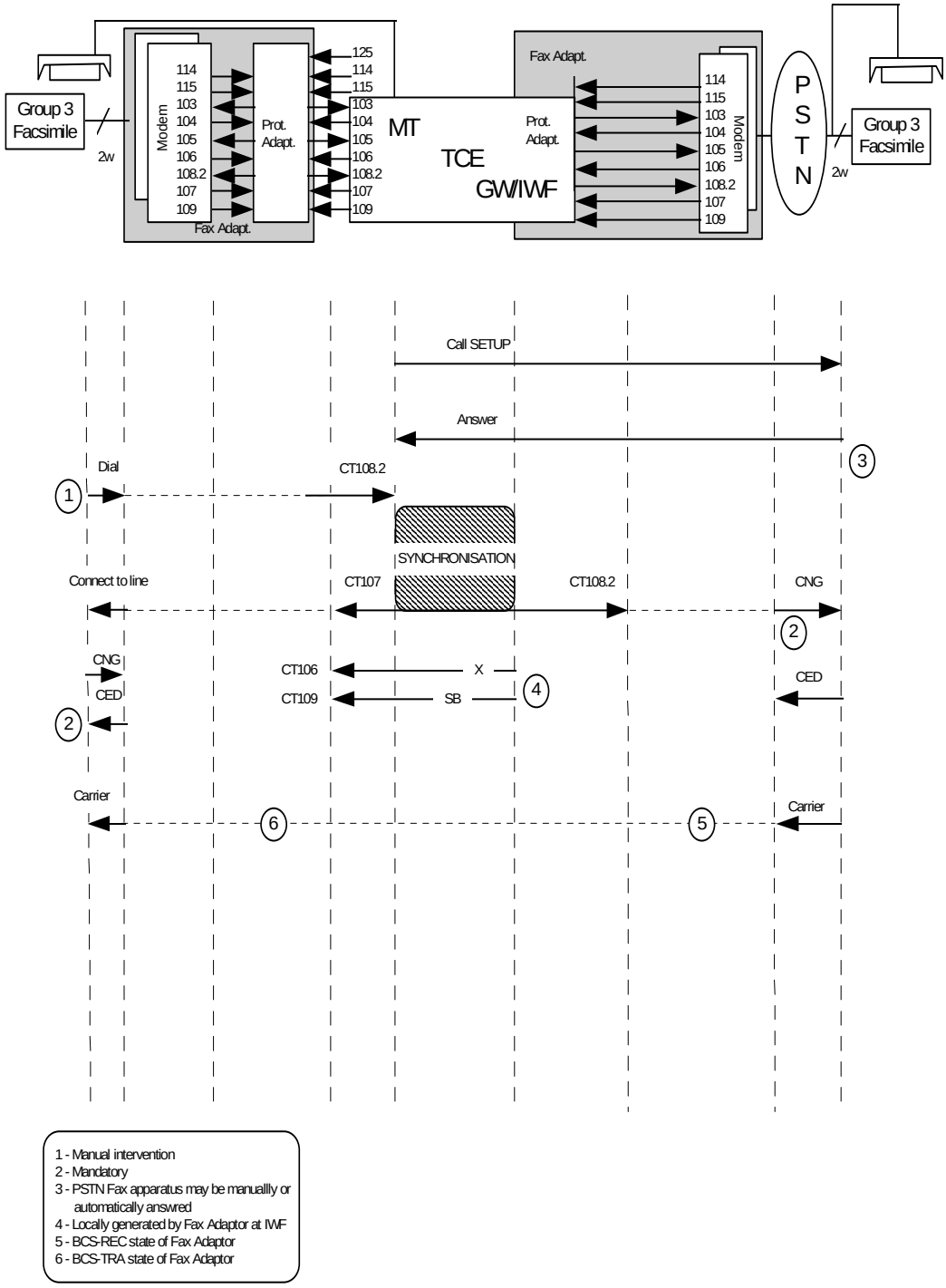


Figure B.6: Mobile originated call - manual calling

History

Document history		
V1.1.1	March 2001	Publication