Annex C
(normative)

Robbed-bit signaling state definitions for channelized DS1 interfaces

C.1 Robbed-bit circuit signaling

Some channelized DS1 applications use robbed-bit signaling to provide per-channel circuit signaling information. In these applications, eight bits are available for the payload in each channel during 5 out of 6 frames. Every sixth frame, the least significant (8th) bit of each time slot shall be used (robbed) to provide per-channel circuit signaling.

In the superframe format (SF), bits shall be robbed in the sixth and twelfth frame (see table 2) to derive the signaling channel. The bit from the sixth frame is called the A bit and the bit from the twelfth frame is called the B bit. In the extended superframe format (ESF), bits shall be robbed in the 6th, 12th, 18th, and 24th frames (see table 3) to derive the signaling channel. These bits are called the A, B, C, and D bits, respectively.

The contents and meaning of the signaling bits depend on the type of signaling used by the circuit provided over the channel. The robbed-bit signaling states for six types of circuit signaling are provided in this annex for both the SF and the ESF framing formats:

- loop-start signaling;
- ground-start signaling;
- loop-reverse-battery signaling (customer-installation-provided LCF);
- network-provided reverse-battery signaling;
- E & M signaling;
- customer-installation-provided loop-start supervision.

For interoperability, the network and the CI shall use compatible robbed-bit signaling states for each type of circuit signaling. The signaling state definitions provided in this annex shall apply when the signaling states received by the CI are generated by network equipment and the signaling states sent by the CI are meant to be acted on by network equipment. These definitions may not be applicable when both ends of a channel are terminated in CIs.

Under normal operation, undefined signaling states should only exist during the transition from one signaling state to another signaling state. The duration of these signaling state transitions should not exceed 3 milliseconds.

The following abbreviations are used in the robbed-bit-signaling state tables in this annex.

LCF	Loop Current Feed
RLCF	Reverse Loop Current Feed
LCFO	Loop Current Feed Open
LO	Loop Open
LC	Loop Closure
RG	Ring Ground

C.2 SF framing format

C.2.1 Loop-start signaling

The Network-to-CI signaling states are the same as those transmitted by an interface historically referred to as Foreign Exchange Office (FXO).

Network-to-CI

State	A	B
LCF	0	1
Ringing	0	0

The CI-to-network signaling states are the same as those transmitted by an interface historically referred to as Foreign Exchange Station (FXS).

CI-to-Network

State	A	B
LO (on-hook)	0	1
LC (off-hook)	1	1

C.2.2 Loop-start signaling with RLCF

The Network-to-CI signaling states are a super-set of those transmitted by an interface historically referred to as Foreign Exchange Office (FXO).

Network-to-CI

State	A	B
LCF	0	1
RLCF[1)2)]	0	1/0[3)]
LCFO[2)4)]	1	1
Ringing	0	0

NOTES

1) The RLCF state may be used for called-party answer supervision associated with a loop-start access line supplemental feature known as line-side answer supervision. This state cannot be produced by all network equipment.

2) Existing customer installation equipment may not recognize the RLCF and LCFO signaling states.

3) 1/0 indicates a signaling bit alternating between one and zero in successive superframes.

4) The LCFO state cannot be produced by all network equipment. A LCFO state longer than 600 milliseconds indicates a network disconnect. LCFO state durations less than 600 milliseconds may occur and serve no signaling function.

The CI-to-Network signaling states are the same as those transmitted by an interface historically referred to as Foreign Exchange Station (FXS).

CI-to-Network

State	A	B
LO (on-hook)	0	1
LC (off-hook)	1	1

C.2.3 Ground-start signaling

The Network-to-CI signaling states are the same as those transmitted by an interface historically referred to as Foreign Exchange Office (FXO).

Network-to-CI

State	A	B
LCF	0	1
LCFO	1	1
Ringing	0	0

The CI-to-Network signaling states are the same as those transmitted by an interface historically referred to as Foreign Exchange Station (FXS).

CI-to-Network

State	A	B
LO (on-hook)	0	1
LC (off-hook)	1	1
RG (service request)	0	0

C.2.4 Ground-start signaling with RLCF

The Network-to-CI signaling states are a super-set of those transmitted by an interface historically referred to as Foreign Exchange Office (FXO).

Network-to-CI

State	A	B
LCF	0	1
RLCF 1) 2)	0	1/0 3)
LCFO	1	1
Ringing	0	0

NOTES

1) The RLCF state may be used for called-party answer supervision associated with a ground-start access line supplemental feature known as line-side answer supervision. This state cannot be produced by all network equipment.

2) Existing customer installation equipment may not recognize the RLCF signaling state.

3) 1/0 indicates a signaling bit alternating between one and zero in successive superframes.

The CI-to-network signaling states are the same as those transmitted by an interface historically referred to as Foreign Exchange Station (FXS).

CI-to-Network

State	A	B
LO (on-hook)	0	1
LC (off-hook)	1	1
RG (service request)	0	0

C.2.5 Loop-reverse-battery signaling (customer-installation-provided LCF)

The Network-to-CI signaling states are the same as those transmitted by an interface historically referred to as Dial Pulse Originating

(DPO) in a direct-inward-dialing (DID) application.

Network-to-CI

State	A	B
LO (on-hook)	0	0
LC (off-hook)	1	1

The CI-to-Network signaling states are the same as those transmitted by an interface historically referred to as Dial Pulse Terminating (DPT) in a direct-inward-dialing (DID) application

CI-to-Network

State	A	B
LO (on-hook)	0	0
LC (off-hook)	1	1

C.2.6 Network-provided reverse-battery signaling

The Network-to-CI signaling states are the same as those transmitted by an interface historically referred to as Dial Pulse Terminating (DPT) in an enhanced 911 application.

Network-to-CI

State	A	B
LCF (on-hook)	0	0
RLCF (off-hook)	1	1

The CI-to-Network signaling states are the same as those transmitted by an interface historically referred to as Dial Pulse Originating (DPO) in enhanced 911 application.

CI-to-Network

State	A	B
LO (on-hook)	0	0
LC (off-hook)	1	1

C.2.7 E & M Signaling

Network-to-CI

State	A	B
On-hook	0	0
Off-hook	1	1

CI-to-Network

State	A	B
On-hook	0	0
Off-hook	1	1

C.2.8 Customer-installation-provided loop-start supervision

The Network-to-CI signaling states are the same as those transmitted by an interface historically referred to as Foreign Exchange Station (FXS) in an off-premises-station (OPS) application.

Network-to-CI

State	A	B
LO (on-hook)	0	1
LC (off-hook)	1	1

The CI-to-Network signaling states are the same as those transmitted by an interface historically referred to as Foreign Exchange Office (FXO) in an off-premises-station (OPS) application.

CI-to-Network

State	A	B
LCF	0	1
Ringing	0	0

C.3 ESF framing format

It may appear that the ABCD structure of ESF repeats the AB structure of SF (e.g., ABAB), however this is not always the case.

C.3.1 Loop-start signaling

Network-to-CI

State	A	B	C	D
LCF	0	1	0	1
Ringing	0	0	0	0

CI-to-Network

State	A	B	C	D
LO (on-hook)	0	1	0	1
LC (off-hook)	1	1	1	1

C.3.2 Loop-start signaling with RLCF

Network-to-CI

State	A	B	C	D
LCF	0	1	0	1
RLCF	0	1	0	0
LCFO	1	1	1	1
Ringing	0	0	0	0

CI-to-Network

State	A	B	C	D
LO (on-hook)	0	1	0	1
LC (off-hook)	1	1	1	1

C.3.3 Ground-start signaling

Network-to-CI

State	A	B	C	D
LCF	0	1	0	1
LCFO	1	1	1	1
Ringing	0	0	0	0

CI-to-Network

State	A	B	C	D
LO (on-hook)	0	1	0	1
LC (off-hook)	1	1	1	1
RG (service request)	0	0	0	0

C.3.4 Ground-start signaling with RLCF

Network-to-CI

State	A	B	C	D
LCF	0	1	0	1
RLCF	0	1	0	0
LCFO	1	1	1	1
Ringing	0	0	0	0

CI-to-Network

State	A	B	C	D
LO (on-hook)	0	1	0	1
LC (off-hook)	1	1	1	1
RG (service request)	0	0	0	0

C.3.5 Loop-reverse-battery signaling (customer-installation-provided LCF)

Network-to-CI

State	A	B	C	D
LO (on-hook)	0	0	0	0
LC (off-hook)	1	1	1	1

CI-to-Network

State	A	B	C	D
LO (on-hook)	0	1	0	1
LC (off-hook)	1	1	1	1

C.3.6 Network-provided reverse-battery signaling

Network-to-CI

State	A	B	C	D
LCF (on-hook)	0	0	0	0
RLCF (off-hook)	1	1	1	1

CI-to-Network

State	A	B	C	D
LO (on-hook)	0	0	0	0
LC (off-hook)	1	1	1	1

C.3.7 E & M Signaling

Network-to-CI

State	A	B	C	D
On-hook	0	0	0	0
Off-hook	1	1	1	1

CI-to-Network

State	A	B	C	D
On-hook	0	0	0	0
Off-hook	1	1	1	1

C.3.8 Customer-installation-provided loop-start supervision

Network-to-CI

State	A	B	C	D
LO (on-hook)	0	1	0	1
LC (off-hook)	1	1	1	1

CI-to-Network

State	A	B	C	D
LCF	0	1	0	1
Ringing	0	0	0	0

C.4 DS0 alarms in the ESF format

The following DS0 robbed-bit alarm states may appear at a DS1 NI. These alarm states apply to all ESF circuit signaling methods.

Network-to-CI

State	A	B	C	D
DS0 AIS	0	0	1	0
DS0 yellow	0	1	1	1

CI-to-Network

State	A	B	C	D
DS0 AIS	0	0	1	0
DS0 yellow	0	1	1	1

Correction

Please note that due to a printing error, the following corrections need to be made to annex C of ANSI T1.403-1995. Corrected numerals appear in bold type.

Subclause C.2.1:

CI-to-Network

State	A	B
LO (on-hook)	0	**1**
LC (off-hook)	1	1

Subclause C.2.2:

Network-to-CI

State	A	B
LCF	0	1
RLCF[1)2)]	0	**1/0[3)]**
LCFO[2)4)]	1	1
Ringing	0	0

CI-to-Network

State	A	B
LO (on-hook)	0	**1**
LC (off-hook)	1	1