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BISUP

The BISUP (Broadband ISDN User Part) was specified by ITU-T in Recommendation Q.2761 with an overview of the signaling capabilities and functions required to support basic bearer services and supplementary services for B-ISDN applications. General functions of messages and signals are described in Recommendation Q.2762, messages and codes in Q.2763, and basic call procedures in Q.2764.

1. Introduction

BISUP is part of a SS7 protocol stack and it includes the signaling functions for controlling connections, handling services, and managing connections within the B-ISDN. BISUP provides services for MTP-3 (Message Transfer Part) which is responsible for signaling network management and signaling message handling. Connectionless services can also be supported in the broadband network using the signaling connection control part (SCCP) and the transaction capabilities application part (TCAP).

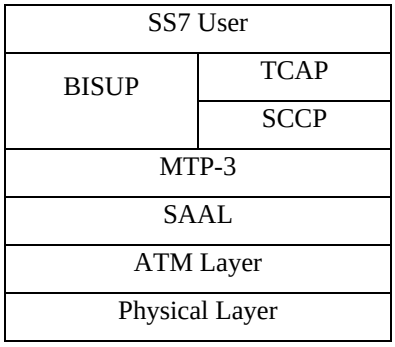


Figure 1. SS7 protocol stack

2. Architecture

TOVE protocol stack implements Call Control (CC) as the highest layer above BISUP. BISUP provides services for CC, and uses the services provided by MTP-3.

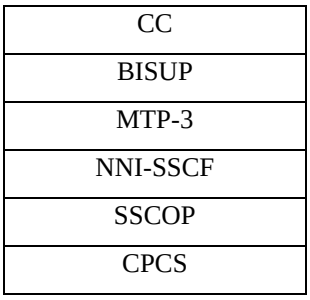


Figure 2. TOVE protocol stack using BISUP

BISUP is divided into two main parts: protocol functions and non-protocol functions. Non-protocol functions is referred as the application process which in this case is only call control. Other application processes could be maintenance and compatibility functions. The protocol functions are subdivided into five smaller parts: Bearer Connection Control (BCC) ASE, Call Control (CC) ASE, Maintenance Control (MC) ASE, Unrecognized Information (UI) ASE and Single Association Control Functions (SACF). Network Interface (NI) is the interface between MTP-3 and BISUP.

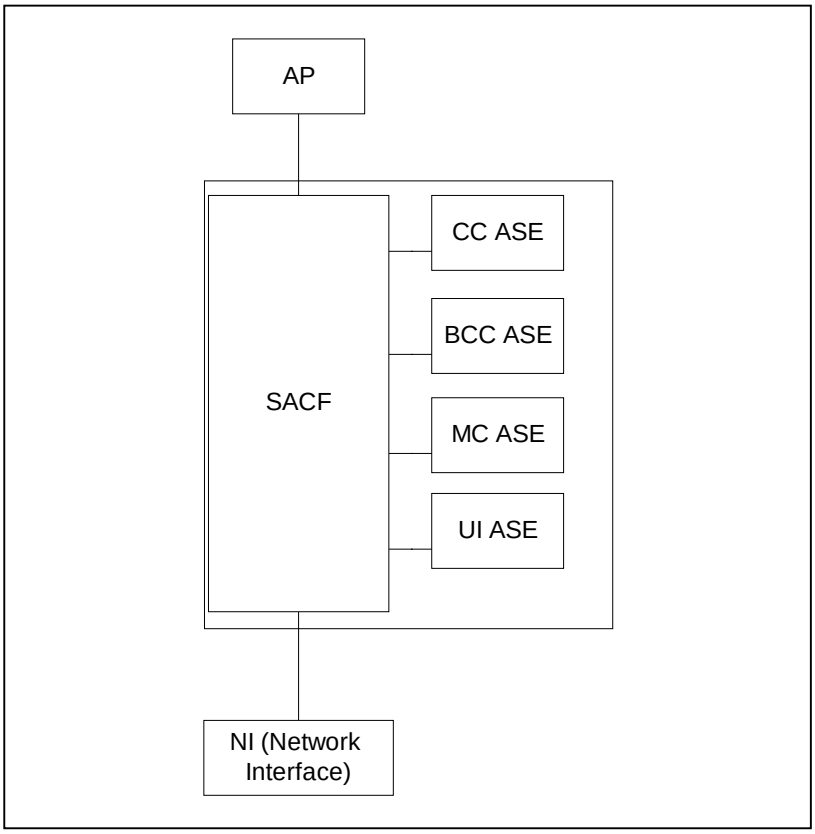


Figure 3. BISUP protocol architecture

3. Implementation details

Everything described in this chapter focuses to the first step developing BISUP protocol in TOVE project and what is currently under development. Further possible development areas (e.g. pdus not yet implemented) are not considered in this document.

3.1. BISUP protocol

This part in TOVE-implementation includes SACF with BCC ASE and CC ASE functionalities. Maintenance control and unrecognized information functionalities are not implemented. There is one instance of BISUP with every connection. This has the information about the destination signaling identifier (DSID) of the other end connected to the same link. DSID is included to every message except the SETUP request which has the origination signaling identifier (OSID) identifying BISUP on this side. On receiving a setup request, BISUP will get the SID of the other side, and store that, and sends it's own SID to the other in the response. Instance will have its SID assigned by the mux below creating and installing it.

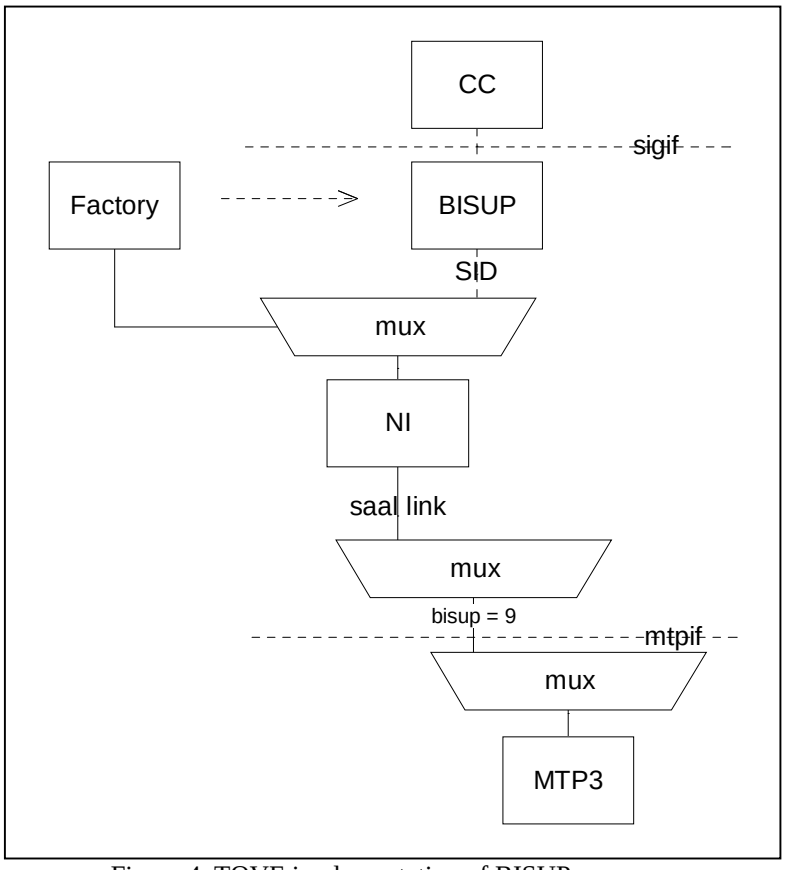


Figure 4. TOVE implementation of BISUP

3.2. BISUP states

Since CC ASE and BCC ASE are implemented as one protocol instance, their FSMs (Finite State Machines) had to be combined for simultaneous actions from their separate functionalities. Based on SDL diagrams [1] and text in recommendation [1], following eleven states were described for outgoing and incoming sides. These are similar to common signaling states for all signaling protocols and current implementation of BISUP uses signaling states at module SIG in TOVE. This architecture of using same states for different protocols is still under development and will be defined more exactly in the future.

- Idle (both sides)
  No connection present, or reserved resources.

- Await IAA (outgoing side)
  IAM sent to the other side. Waiting for resource acceptance (IAA) or rejection (IAR).

- Await ACM (outgoing side)
  All address information has been sent to the other side. Waiting for indication that the connection has been accepted (ACM/ANM).

- Await ANM (outgoing side)
  The other side has informed that the connection is accepted. Waiting for an answer (ANM) to establish the connection.

- Await Accepted req (incoming side)
  IAM received, setup indication sent to application (Call Control). Waiting for resource acceptance or rejection.

- Await Address Complete req (incoming side)
  Waiting for the application to confirm that all the address information has been received, and the connection has been accepted, or possibly an immediate answer.

- Await Answer req (incoming side)
  The application informed that all the address information needed has been received, and the other has been informed with ACM. Waiting for a final answer from the application.

- Call Answered (both sides)
  Call has been answered, and the connection established.

- Await RLC (both sides)
  This side sent REL pdu to the other side. Waiting for reply.

- Await Release resp (both sides)
  REL pdu sent to the other side, waiting for RLC to release all resources and to terminate the instances.

- REL Collision (both sides)
  Both sides sent REL pdus at the same time. Confirmation needed from the other side (RLC), and the application (release resp).

3.3. NI protocol

Network interface maps data indications from the lower layer (MTP3) to the correct BISUP instance defined by DSID in the message. If there is no DISD present in the message but an OSID is, or DSID does not correspond to any BISUP connected to the mux, a new instance of BISUP will be created by the factory connected to the mux above NI. This is usually the situation during the SETUP procedure. There is one NI instance for every SAAL-connection.

3.4. Factory

Has the prototype of the BISUP protocol instance. Further description of factory method can be found from OVOPS++ documentation and other documentations of design patterns [2].

3.5. Primitives

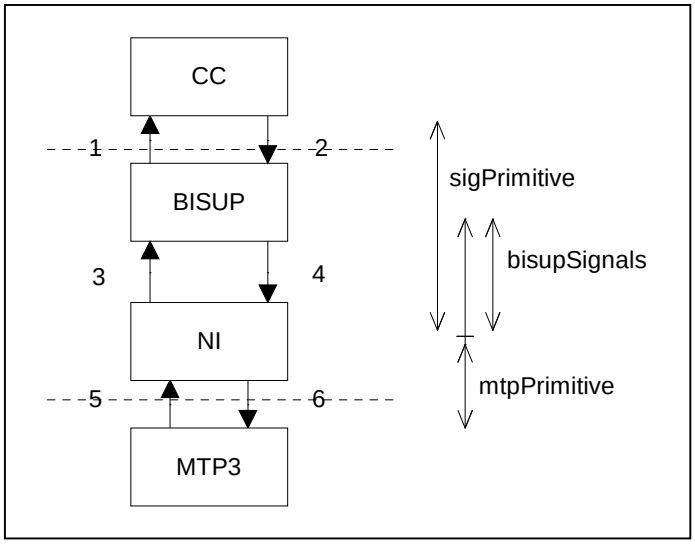


Figure 5. Primitives used with BISUP

No	Primitive/Message	Function
1.	sigSETUPind	Indicates receive of IAM pdu
	sigSETUPconf	Indicates receive of ANM pdu
	sigPROCEEDINGind	Indicates receive of IAA pdu

	sigALERTINGind	Indicates that all address information have been received
	sigRELEASEind	Indicates receive of REL pdu
	sigRELEASEconf	Indicates that signaling is terminated (RLC or IAR)
2.	sigSETUPreq	Causes call setup to begin → IAM will be sent
	sigSETUPresp	Sent after call is ready → ANM will be sent
	sigPROCEEDINGreq	After call is proceeding → IAA will be sent
	sigALERTINGreq	All address information reveived → ACM will be sent
	sigRELEASEreq	Causes a call release process to be started → REL
	sigRELEASEresp	Sent after releasing call is OK → RLC (or IAR)
3.	See primitives no 1.	
	bisupERRORind	Indicates error conditions at NI, BISUP decides actions
	mtpSTATUSind	
	mtpPAUSEind	Indicates the destination (DPC) that is unavailable.
	mtpRESUMEind	Indicates the destination (DPC) that is now available.
4.	See primitives no 2. (except sigRELEASEresp not for IAR)	
	bisupIARreq	Couldn't allocate resources for the call → IAR pdu
5.	mtpTRANSFERind	Data transfer indication from MTP3
	mtpSTATUSind	Indicates unavailibility of the signaling route.
	mtpPAUSEind	Unable to transfer message to the destination.
	mtpRESUMEind	Able to resume message transfer.
6.	mtpTRANSFERreq	Data transfer request primitive to MTP3

Table 1. Primitives used with BISUP.

4. Features implemented

Bisup specification includes maintenance functions and information compatibility functions. These functions are not implemented in this version yet, only basic call setup procedure was considered. So, all the messages implemented are closely related with the call setup procedure and CC ASE and BCC ASE functionalities.

Implemented messages:

- ACM (Address Complete Message):
  Indicates in the backward direction that all the address information needed have been received.

- ANM (Answer Message):
  Indicates in the backward direction that the call has been answered.

- IAM (Initial Address Message):
  A message sent in the forward direction to initiate seizure of an outgoing virtual channel and to transmit number and other information relating to the routing and handling of a call.

- IAA (IAM Acknowledgement message):
  A message sent in the backward direction in the response to an IAM message.

Indicates that the IAM has been accepted and the requested bandwidth on the incoming leg (both directions) is available.

- IAR (IAM Reject message):
  A message sent in the backward direction in the response to an IAM message indicating call refusal due to resource unavailability.

- REL (Release message):
  A message sent in either direction to indicate that call/connection is being released due to the reason (cause) supplied and that the resources are ready to be made available for new traffic on receipt of the release complete message.

- RLC (Release Complete message):
  A message sent in either direction in response to the receipt of a released message, when the resources of the call/connection concerned have been made available for new traffic.

5. Known limitations

6. Future development

The implemented protocol has not been tested in any way due to interoperability reasons with the current Call Control module in TOVE. Changes to needed in Call Control are on under development. First step is to test the protocol and its current supported functionalities. The next phase is to implement progress information exchange (CPG) which is part of CC ASE functionalities, and other not yet supported functionalities of CC and BCC ASE.

7. Statistics

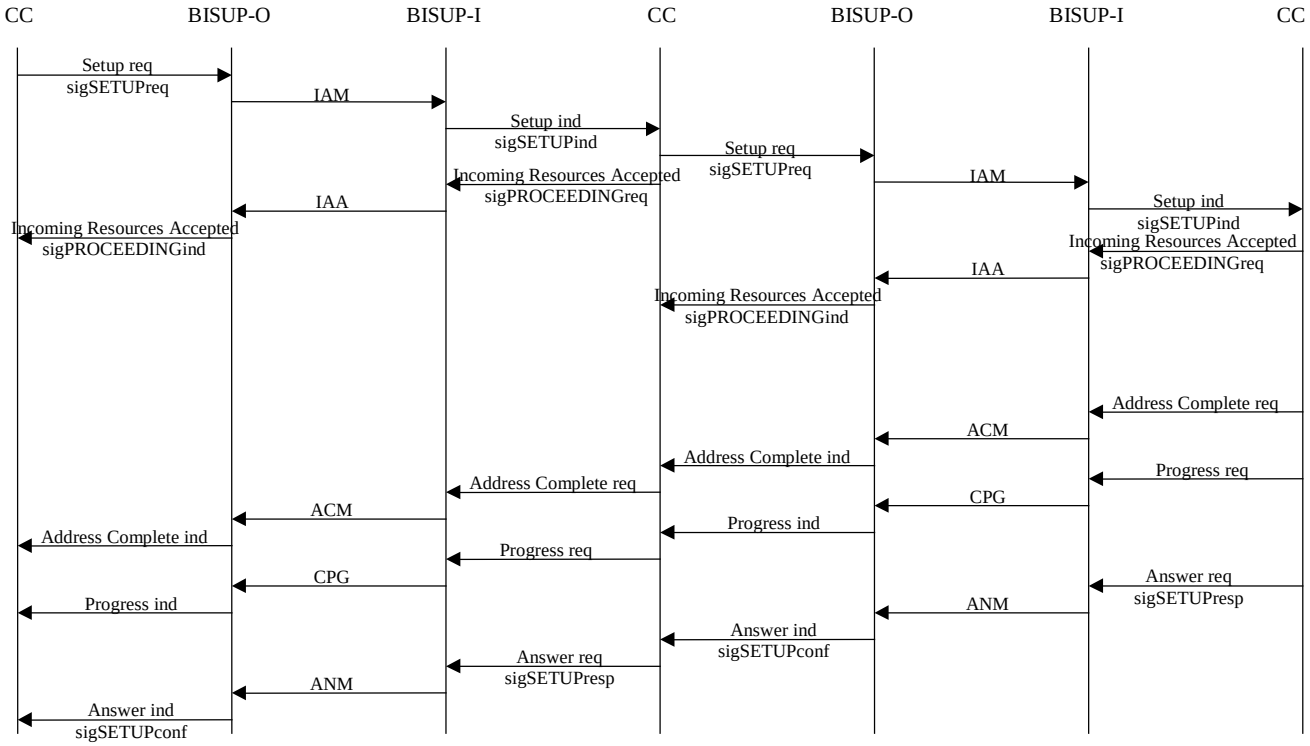
8. References

[1] ITU-T Recommendations Q.2761, Q.2762, Q.2763, Q.2764

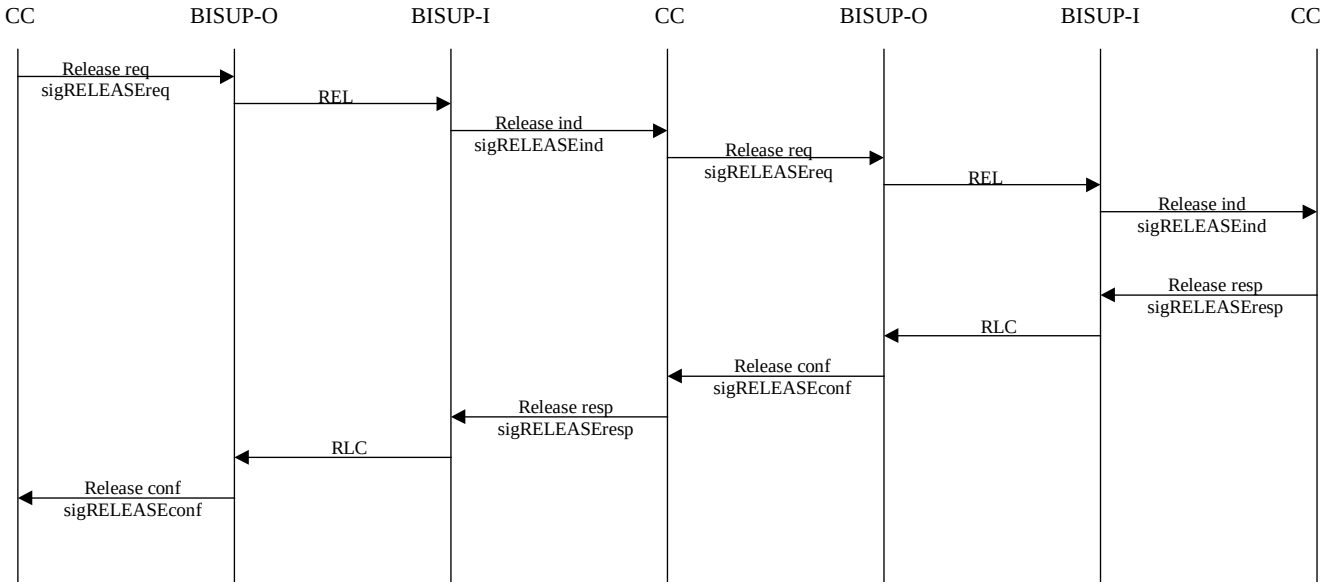
[2] Gamma, E., Helm, R., Johnson, R., and Vlissides, J. (1995). Design Patterns, Elements of Object-Oriented Software. Addison-Wesley

Appendix I – Message sequences

Successful connection setup from originating Call Control to destination Call Control



Successful connection release from originating Call Control to destination Call Control



Appendix II – SDL Overview

This appendix defines state machines and messages for BISUP protocol in TOVE project including SACF, BCC ASE and CC ASE on the incoming and the outgoing side. Both sides have the same state when idle and after the call has been established, and also for call release process. Always after the state has gone to the idle state, the call will be cleared.

These eleven (11) states described at this appendix represents:

- Twelve (12) states for BCC ASEs, six different states for both sides. Allthough those six states are exactly the same for both sides.
- Four (4) different states for CC ASE at the incoming side.
- Four (4) different states for CC ASE at the outgoing side.

BISUP-O timers:

- T40b – Await IAA (4-6 seconds)
- T7b – Await ACM/ANM (20-30 seconds)
- T9b – Await ANM
- T1b – Await RLC (15-60 seconds)

Timer T9b is not defined in any FSM described in Q.2764. It is only covered int text.

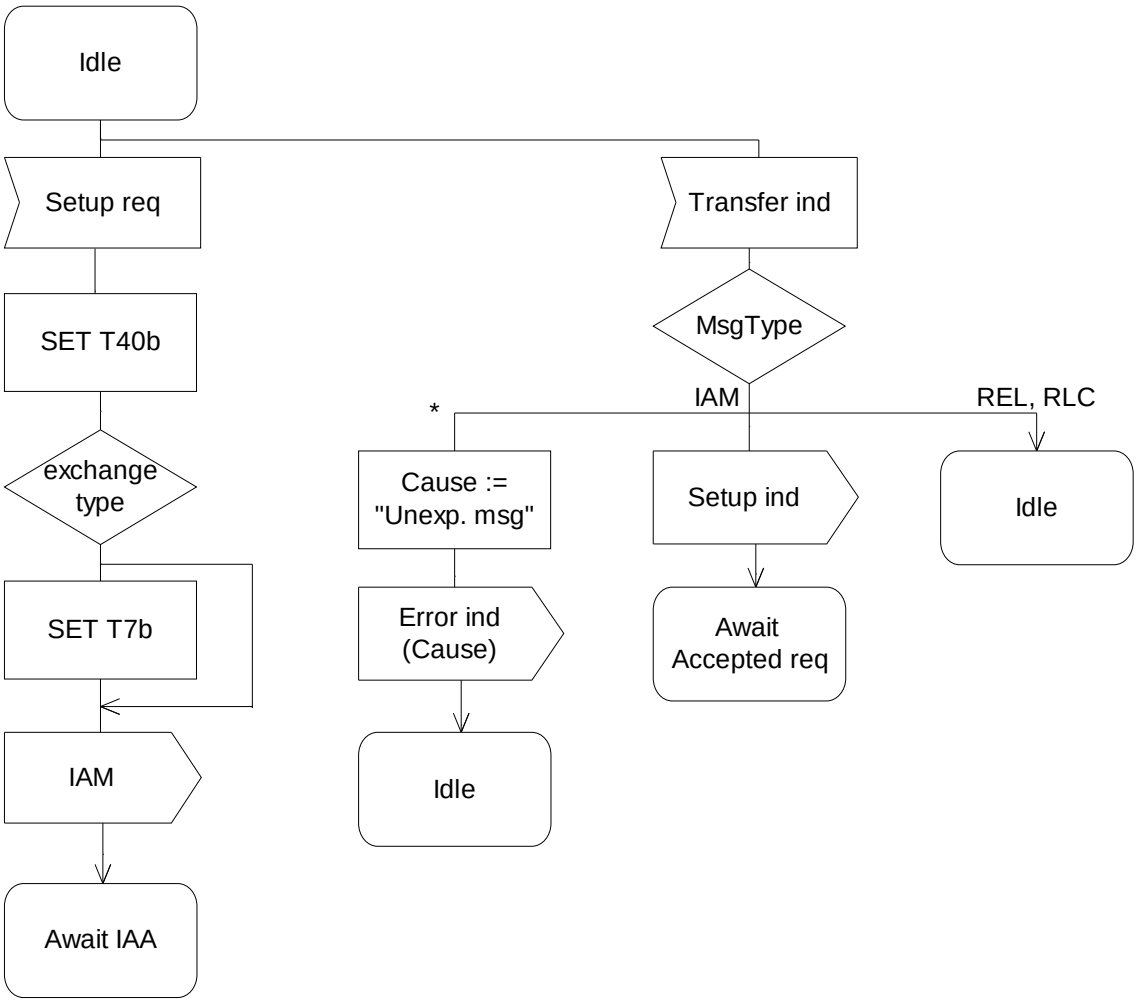
BISUP-I timers:

- T1b – Await RLC (15-60 seconds)

BISUP-O / BISUP-I

0 – Idle

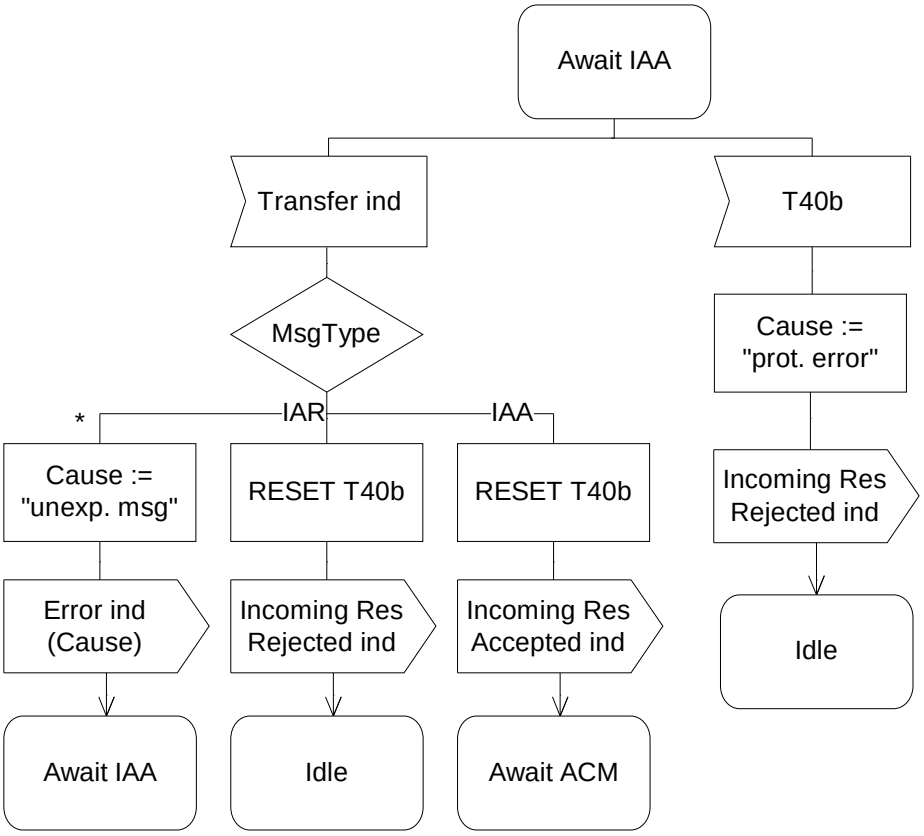
Covers:
- BCC-O 0-Idle
- BCC-I 0-Idle
- CC-O 0-Idle
- CC-I 0-Idle



BISUP-O

1 – Await IAA

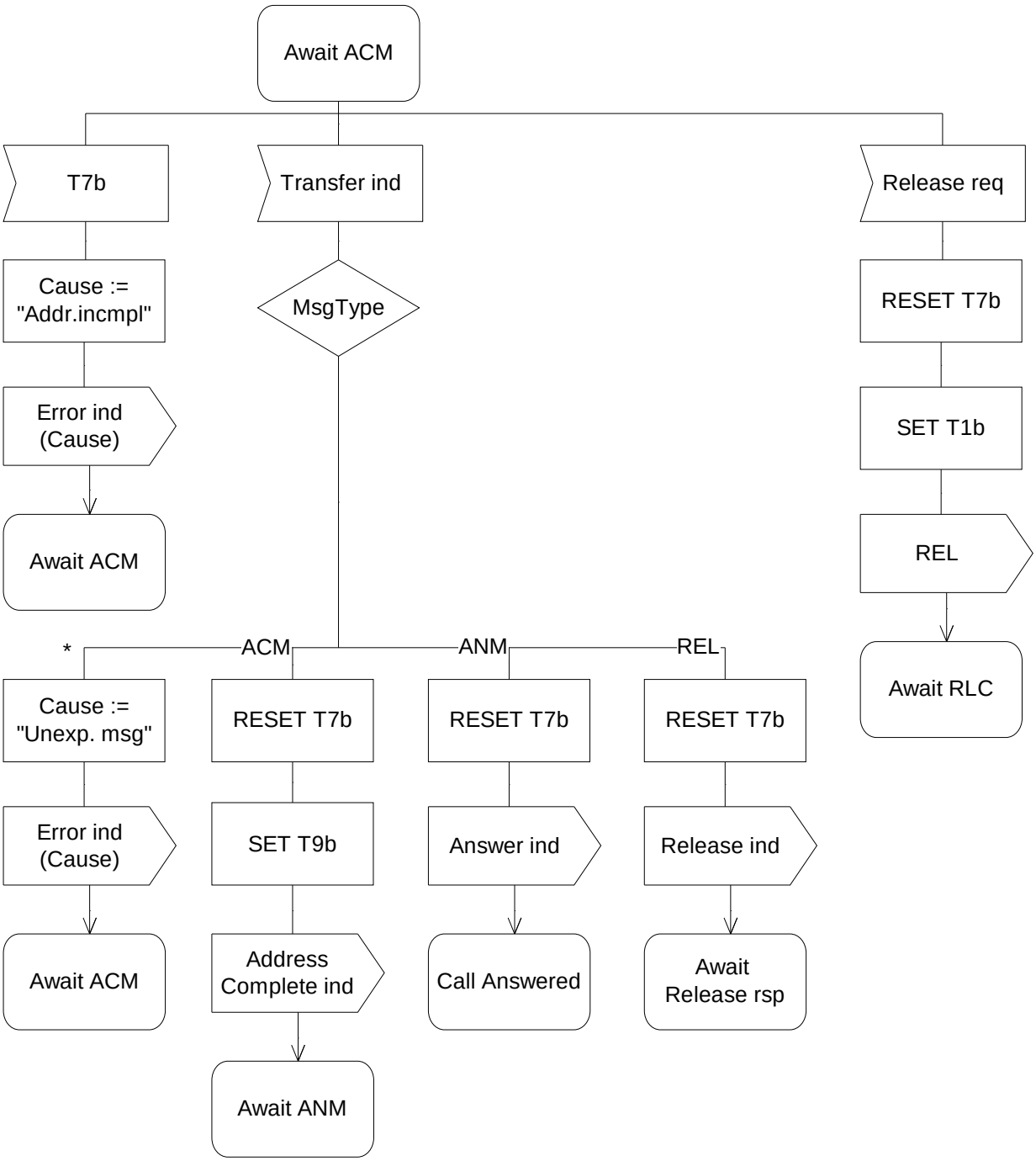
Covers: - BCC-O 1-Await IAA



BISUP-O

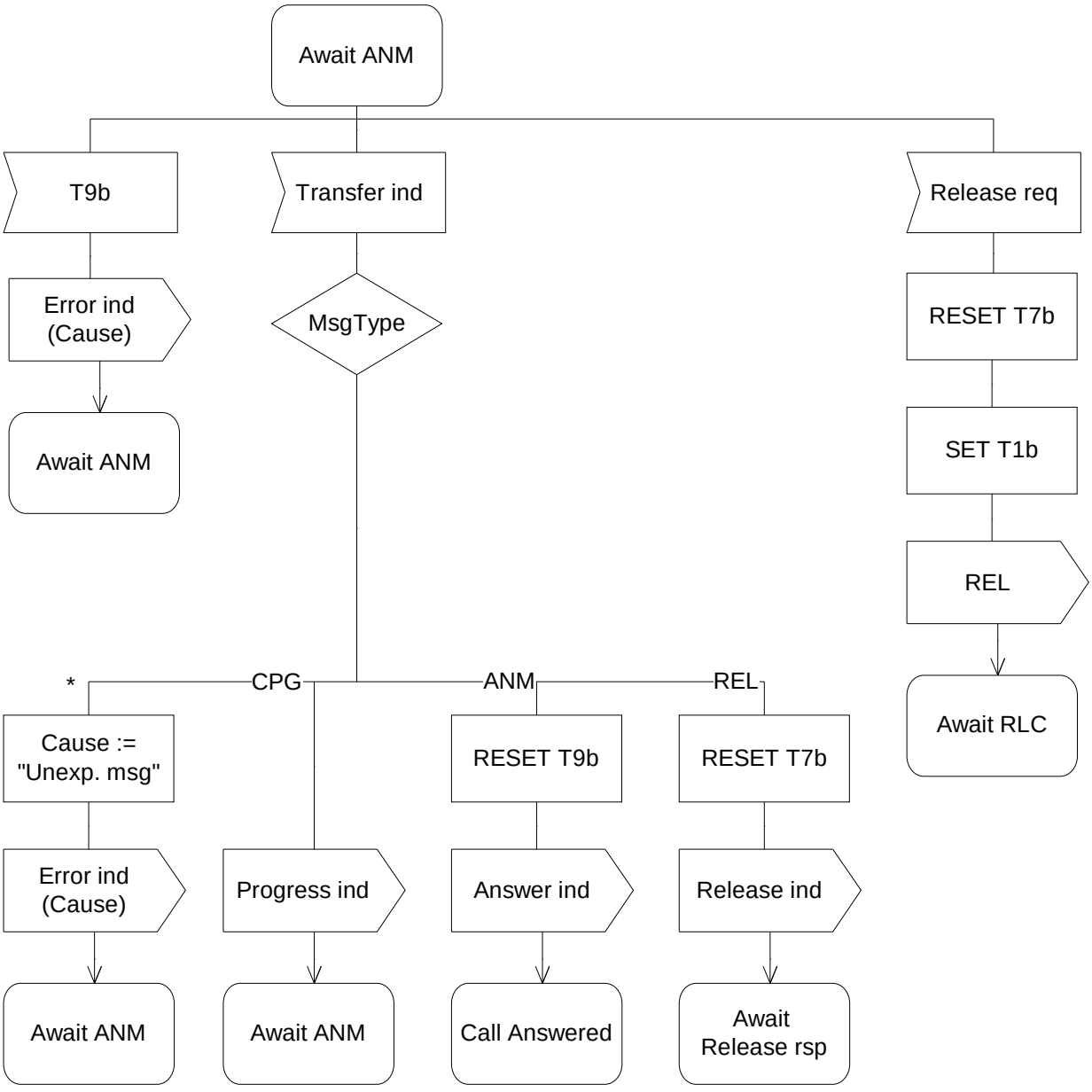
2 - Await ACM

Covers: - BCC-O 2-IAA Received
- CC-O 1-Await ACM



3 - Await ANM

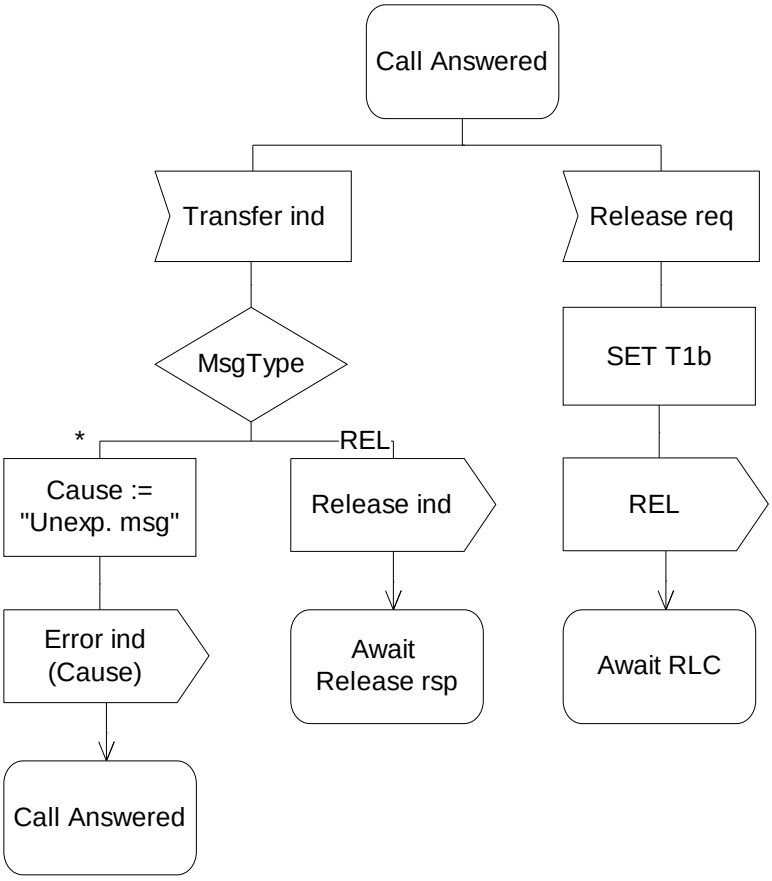
Covers: - BCC-O 2-IAA Received
- CC-O 2-Await ANM



BISUP-O / BISUP-I

4 – Call Answered

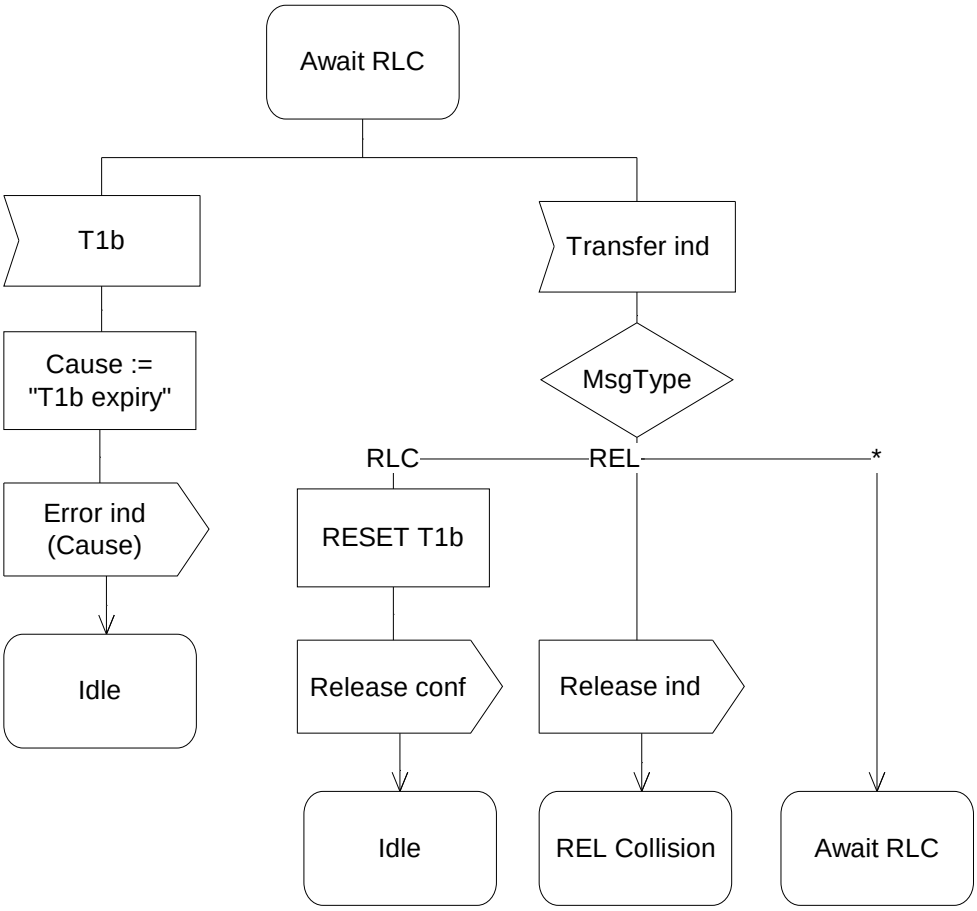
Covers:
- BCC-O 2-IAA Received
- BCC-I 2-IAA Sent
- CC-O 3-Call Answered
- CC-I 3-Call Answered



BISUP-O / BISUP-I

5 – Await RLC

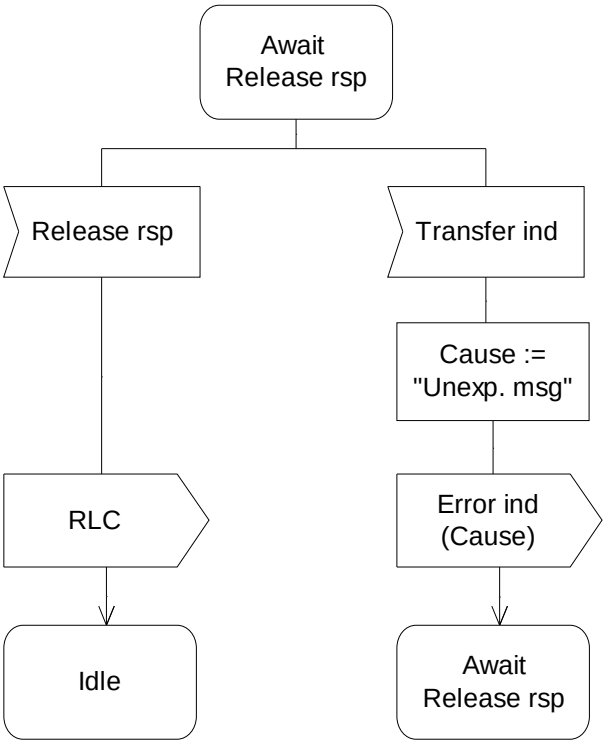
Covers: - BCC-O 3-Await RLC
- BCC-I 3-Await RLC



BISUP-O / BISUP-I

6 – Await Release rsp.

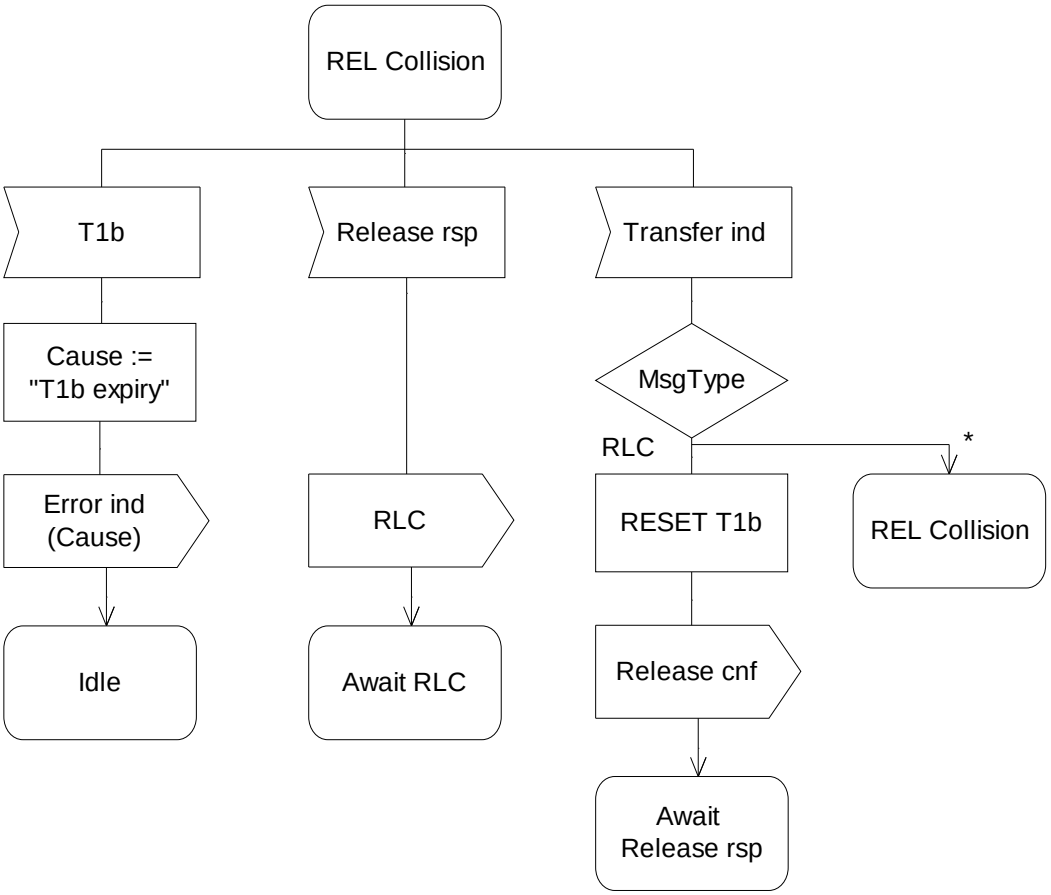
Covers: - BCC-O 4-Await Release rsp.
- BCC-I 4-Await Release rsp.



BISUP-O / BISUP-I

7 – REL Collision

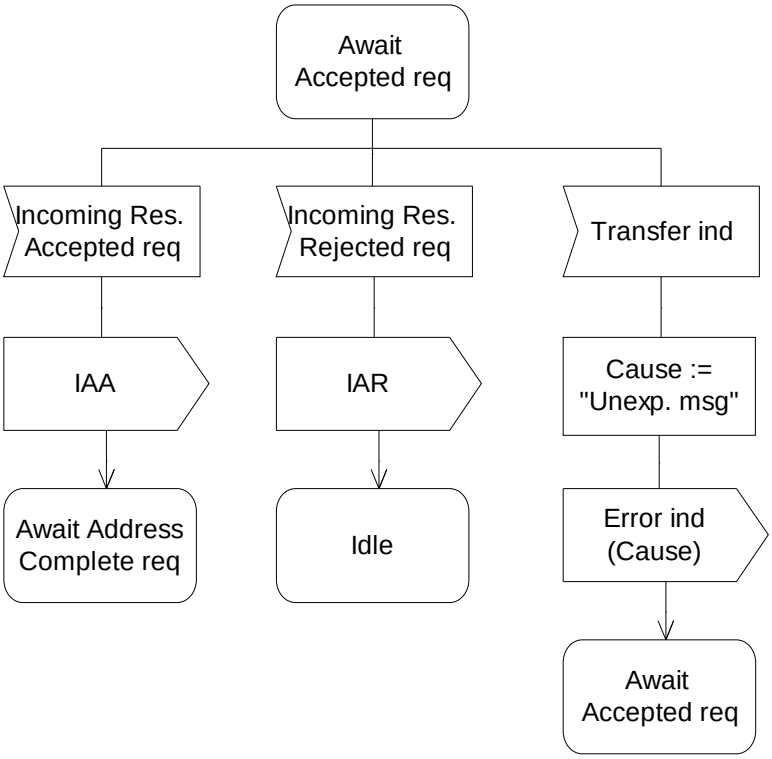
Covers: - BCC-O 5-REL Collision
- BCC-I 5-REL Collision



BISUP-I

1 – Await Accepted req

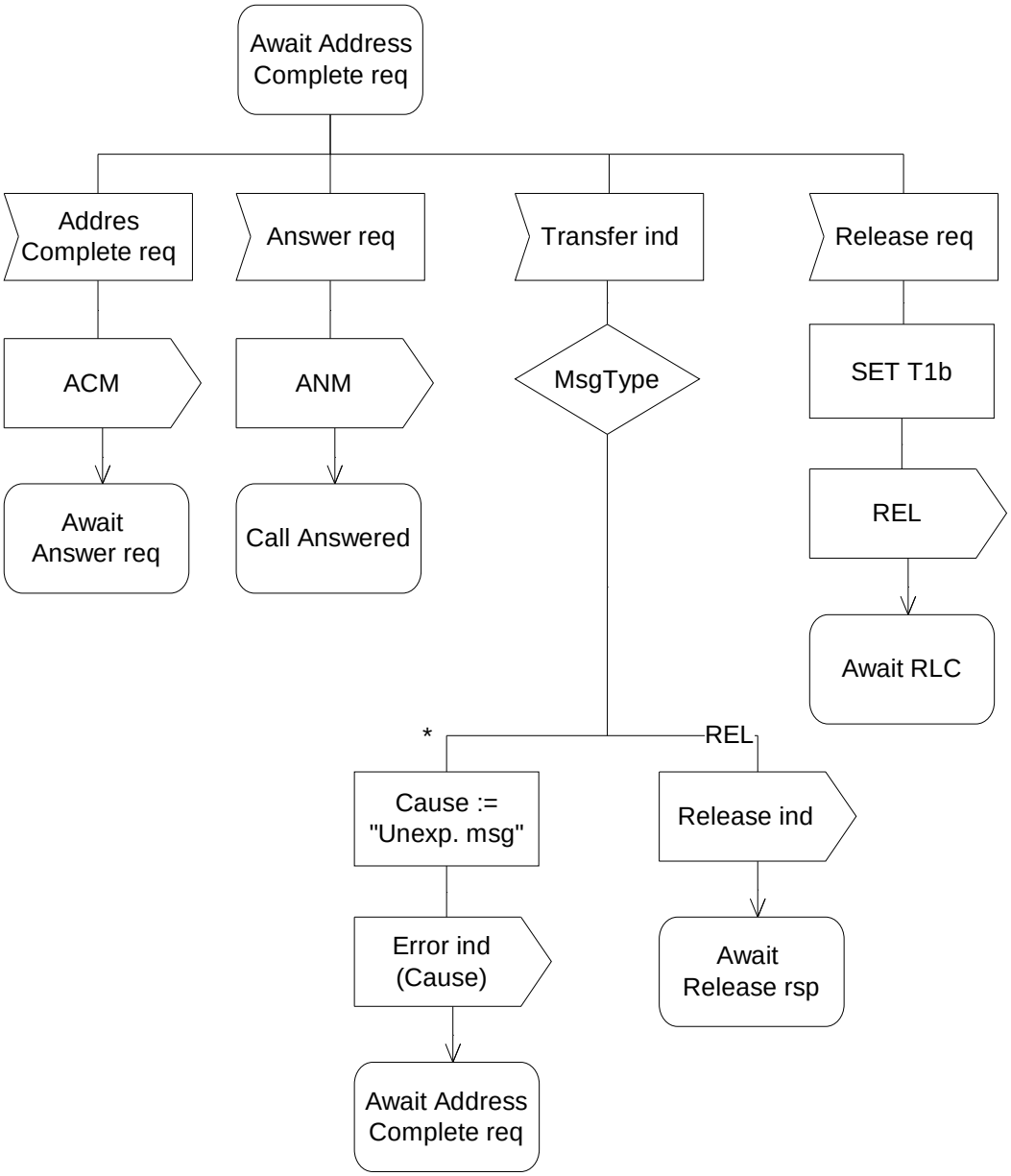
Covers: - BCC-I 1-Await Accepted req.



BISUP-I

2 – Await Address Complete req

Covers: - BCC-I 2-IAA Sent
- CC-I 1-Await Address Complete req.



BISUP-I

3 – Await Answer req

Covers: - BCC-I 2-IAA Sent
- CC-I 2-Await Answer req.