On the Specification of the MTP

Besides the developments at the user level a further development of the MTP took place during the White Book study period. On the one hand, this was necessary due to new requirements at the user level. On the other hand, problems with the MTP procedures were identified and solved. Finally, we recognized important problems with the MTP, which were solved by the introduction of new procedures.

In the following we describe this development of the MTP not only with the objective of describing the philosophy and the function of the MTP procedures but also to show that the solution of most of the problems caused other and sometimes more difficult problems that had to be solved. This is why the stability of the MTP is one of the most important objectives. Finally, this knowledge about the problems and the corresponding solutions is important regarding the discussions on PSTN and IP network convergence and the question of whether in an overall IP-based network the MTP-3 functionality is needed or not.

3.1 Flow Control

The objective of the SS 7 flow control is to reduce signalling traffic at its source in the case that the signalling network is not capable of transferring all signalling traffic because of congestion situations. On the one hand, local congestion situations can occur within a digital exchange and the surrounding network due to bottlenecks towards a specific destination. These bottlenecks occur if the amount of signalling traffic towards the considered destination point cannot be transferred via the available route set due to outages of local links and/or exchanges, and thus signalling routes, as well as an awkward network planning. On the other hand, digital exchanges have a finite processor speed and capacity. Thus, if the amount of user signalling messages to be handled or the network management activities to be performed by the exchange are increasing, then the exchange can become congested. This means that the internal buffers fill up, leading to serious problems.

As a first problem a loss of messages may occur. A loss of message signal units (MSUs) may cause problems with the User Parts whilst a loss of network manage-
ment messages means that the MTP procedures do not work properly, leading to outages and congestion situations within other network areas (see Chap. 8). In addition, the loss of important internal messages or other faulty internal processes caused, for example, by faulty software or hardware failures, leads to the fact that the internal processor communication does not work properly so that the exchange may run into an undefined state which may be ended merely by an out of service of the exchange followed by a restart. Furthermore, a congestion situation may cause a failure of single links. If a congestion situation at the receiving end of a signalling link does not terminate within 3–6 s, then the Level 2 timer T6 (see Appendix A) expires, which leads to an out of service of the concerned link.

Congestion situations are also of importance concerning an outage of an exchange. Due to the load sharing mechanism there is a high probability that, in a high signalling traffic load situation, not only one but many, if not all, links within a route set are congested. Due to the fact that both directions of a route are nearly equally loaded, a lot of links of an exchange may be involved. Note that a Level 3 congestion may lead to a congestion of all links of the exchange. Related link failures lead to the fact that, in a high signalling traffic load situation, the status of the exchange gets worse, so that more and more links are taken out of service. Thus, at some stage, the exchange is completely isolated or performs a restart because of too many failed links. Finally, due to the nature of SS 7, local congestion situations will spread throughout the whole SS 7 network if no specific actions are taken to remove the congestion situation. The consequences are a reduction of signalling performance, an outage or isolation of wide network areas, or an outage of the whole SS 7 network (see Chap. 8).

In order to avoid those problems the SS 7 flow control has been introduced within the Red Book specification with the objective to reduce temporarily the user traffic streams so that link or route set congestion and the congestion of exchanges are removed before the congestion situations spread within the network. In the case of a congestion situation MTP STATUS primitives with cause CONGESTION are created by the Message Transfer Part (MTP) for local User Parts and transfer controlled (TFC) messages are created by the MTP, addressed to the originating nodes of the concerned signalling traffic.

For the relevant User Parts, the congestion indication (CI) primitive rate contains the information about how much they should reduce their traffic towards the concerned destination point. Thus, the User Part congestion control is based on a stepwise reduction of the user traffic controlled by the received CI primitive rate (see Sects. 9.2 and 9.3).

In order to keep the SS 7 flow control as simple as possible it was based on the following fundamental assumptions:

- **All traffic streams are of about the same characteristics**
  The traffic streams created by the early telephone (TUP) and data (DUP) User Parts had nearly the same characteristics. Thus, at that time, it was not considered necessary to distinguish between the different User Parts. As a consequence, all User Parts within an exchange are informed with the same congestion indica-