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Technical Report

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Foreword

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Introduction

In the current 3GPP specifications, M3UA is the only choice when signalling over IP in 3GPP core network, in other words MAP, CAP and BICC can only base on M3UA/SCTP/IP for the IP based signalling network.

Now, IETF has changed M2PA draft into RFC 4165, which means the accomplishment of M2PA protocol definition. There may be possible improvements over the existing signalling protocol by using M2PA in 3GPP core networks.

1 Scope

The present document provides a study into the advantage and disadvantage of M2PA comparing with M3UA and provides a study into the possibility of introducing M2PA in 3GPP.

The present document also specifies the functionalities required on the protocol level to meet the requirements of BICC, MAP and CAP.

If necessary, the interactive between M2PA and M3UA should be studied.

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, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 29.202: "SS7 Signalling Transport in Core Network, Stage 3".

[2] RFC 3332:Signaling System 7 (SS7) Message Transfer Part 3 (MTP3) - User Adaptation Layer (M3UA)"

[3] RFC 4165:Signaling System 7 (SS7) Message Transfer Part 2 (MTP2) - User Peer-to-Peer Adaptation Layer (M2PA), September 2005

[4] 3GPP TR 21.905: "3G Vocabulary"

[5] ITU-T Recommendation Q.701: "Functional description of the message transfer part (MTP) of signalling system No. 7"

[6] ITU-T Recommendation Q.702: "Signalling data link"

[7] ITU-T Recommendation Q.703: "Signalling link"

[8] ITU-T Recommendation Q.704: "Signalling network functions and messages"

[10] ITU-T Recommendation Q.705: "Signalling network structure"

[11] 3GPP TR 29.903: "Feasibility Study on SS7 signalling transport in the core network with SCCP-User Adaptation (SUA) layerS7".

[12] 3GPP TS 29.205: "Application of Q.1900 series to bearer-independent Circuit Switched (CS) core network architecture; Stage 3"

[13] 3GPP TS 29.232: "Media Gateway Controller (MGC) - Media Gateway (MGW) interface; Stage 3"

[14] 3GPP TS 25.412: "UTRAN Iu interface signalling transport"

[15] 3GPP TS 25.422: "UTRAN Iur interface signalling transport"

[16] IETF draft: "M3UA SG-SG Communication draft-asveren-sigtran-m3uasgsg-00.txt" work in progress.

3 Abbreviations

3.1 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [4] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [4].

IP	Internet Protocol
MTP	Message Transfer Part
MTP1	Message Transfer Part layer 1
MTP2	Message Transfer Part layer 2
MTP3	Message Transfer Part layer 3
M3UA	MTP3-User Adaptation
M2PA	MTP2 - User Peer-to-Peer Adaptation
SCTP	Stream Control Transmission Protocol
SG	Signalling Gateway
SP	Signalling Point
STP	Signalling Transfer Point

4 Analysis of M3UA

4.1 Introduction

This clause provides a study into the current use of M3UA.

4.2 Status of M3UA

MTP3-User Adaptation (M3UA) is a protocol, currently developed by IETF, for the transport of any SS7 MTP3-User signalling (e.g. ISUP, SCCP and TUP) over IP using the Stream Control Transport Protocol (SCTP). M3UA can also work in diverse architectures, such as a Signalling Gateway to IP Signalling Endpoint architecture as well as a peer-to-peer IP Signalling Endpoint architecture [2], [11].

M3UA provides the service of MTP3 between SG and application server.

M3UA supports MTP3 users ISUP and SCCP.

M3UA replaces ss7 signalling link, signalling link set, combined link set and signalling routes.

M3UA is designed to allow legacy SS7 TDM nodes to communicate with SIGTRAN IP-capable nodes.

- Consists of Signalling Gateway Process (SGP) and Application Process (ASP) side;
- Supports a higher bandwidth like M2PA;
- Recreates limited MTP3 capabilities for network management and congestion;
- Carries enough MTP3 information to permit routing of received message to other nodes.

3GPP TS 29.202 mandates in 3GPP networks to use M3UA as IP-based SS7 signalling transport link at the A and the C interface. For the B interface, it mandates the use of Q.701-Q.705 [5],[6],[7],[8],[9] or Q.2210. Figure 2 shows the use of M3UA in 3GPP signalling network. The signalling gateways in this picture are pure MTP3/3B-M3UA signalling gateways. They do not include any M3UA users. Still there could be a node including an M3UA user (eg SCCP functions) and a M3UA signalling gateway functions. In that case the node will support all the interfaces A, B and C.

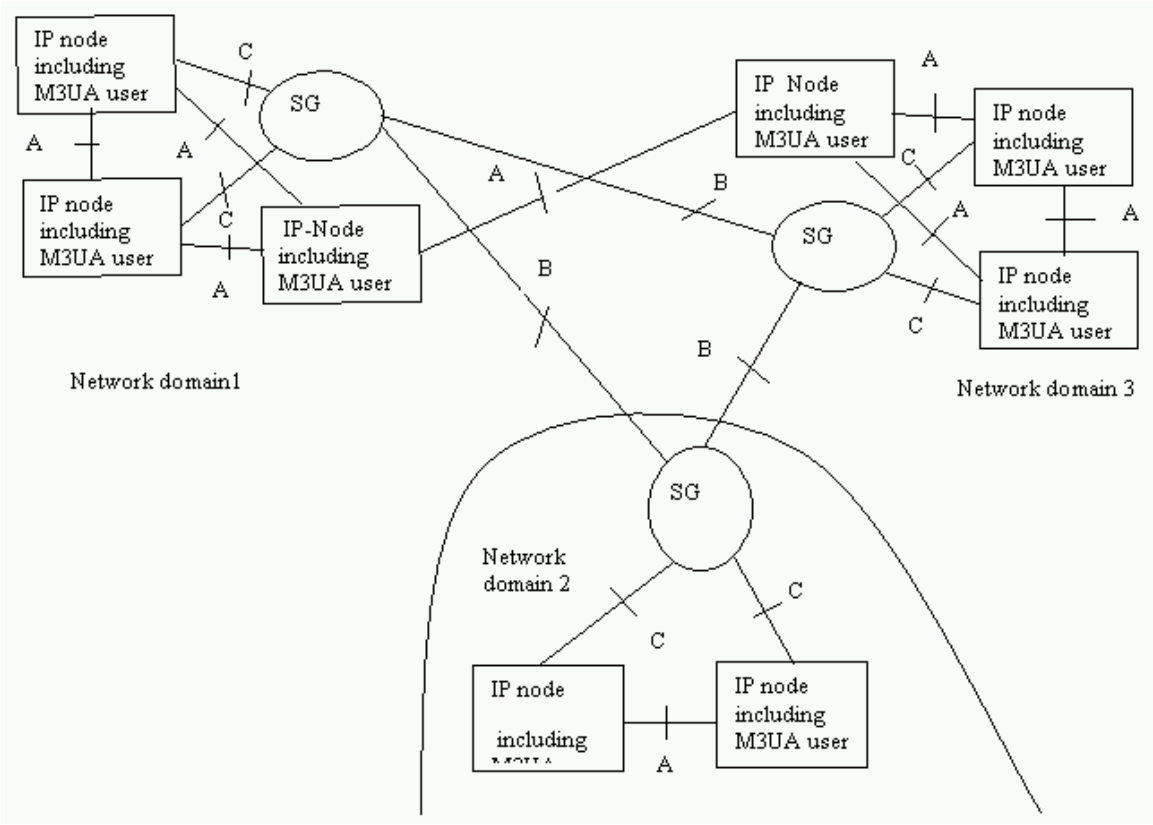


Figure 4-1: Use of M3UA in 3GPP core network

4.3 Protocol architecture and function of M3UA

The M3UA delivery mechanism provides the following functionality:

- Support for transfer of SS7 MTP3-User Part messages;
- Support for the management of SCTP transport protocol between a Signalling Gateway and one or more IP-based signalling nodes to ensure transport availability to MTP3 user signalling applications;
- Support for the seamless operation of MTP3-User protocol peers;
- Support for distributed IP-based signalling nodes; and
- Support for the asynchronous reporting of status changes to management.

M3UA provides function like Signalling Point Code Representation, Routing Contexts and Routing Keys, SS7 and M3UA Interworking , Application Server Redundancy, Flow Control, Congestion Management, SCTP Stream Mapping, Client/Server Model to initial the SCTP association.

Signalling Point Code Representation: Within an SS7 network, a Signalling Gateway might be charged with representing a set of nodes in the IP domain into the SS7 network for routing purposes. The SG itself acts as a signalling point in the SS7 network.

Routing Contexts and Routing Keys: A Routing Key describes a set of SS7 parameters and parameter values that uniquely define the range of signalling traffic to be handled by a particular Application Server. Routing Context is a value that uniquely identifies a Routing Key.

SS7 and M3UA Interworking: For SS7 and M3UA interworking, the M3UA adaptation layer is designed to provide an extension of the MTP3 defined user primitives. The SGP provides a functional interworking of transport functions between the SS7 network and the IP network by also supporting the M3UA adaptation layer.

Application Server Redundancy: The Application Server is the set of all ASPs associated with a specific Routing Key. Each ASP in this set may be active, inactive or unavailable. Active ASPs handle traffic; inactive ASPs might be used when active ASPs become unavailable. The failover model supports an "n+k" redundancy model, where "n" ASPs is the minimum number of redundant ASPs required to handle traffic and "k" ASPs are available to take over for a failed or unavailable ASP.

Flow Control: Local Management at an ASP may wish to stop traffic across an SCTP association to temporarily remove the association from service or to perform testing and maintenance activity. The function could optionally be used to control the start of traffic on to a newly available SCTP association.

Congestion Management: The M3UA layer is informed of local and IP network congestion by means of an implementation-dependent function. M3UA may resolve the congestion (by means of indicating congestion to local MTP3-Users or triggering SS7 MTP3 Transfer Controlled management messages to originating SS7 nodes or indicate local congestion to an M3UA peer with an SCON message etc.).

SCTP Stream Mapping: The M3UA layer at both the SGP and ASP also supports the assignment of signalling traffic into streams within an SCTP association. Traffic that requires sequencing SHOULD be assigned to the same stream.

Client/Server Model: SCTP association need to be initiated, client should always peer which take on the role of initiating the SCTP association to the server.

The usage of M3UA to transport MAP and TCAP messages is illustrated in Figure 4-2.

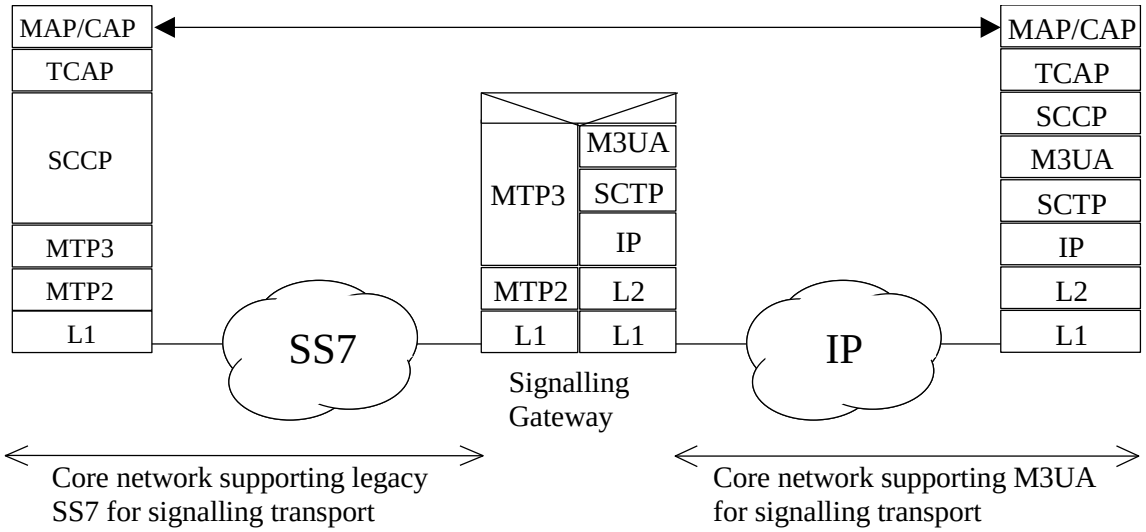


Figure 4-2: Transportation of MAP and CAP via M3UA

An example of SCCP transport between IPSPs is illustrated in Figure 4-3. SCCP messages are exchanged directly between two IP resident IPSPs with SCCP user protocol like TCAP, RANAP and RNSAP.

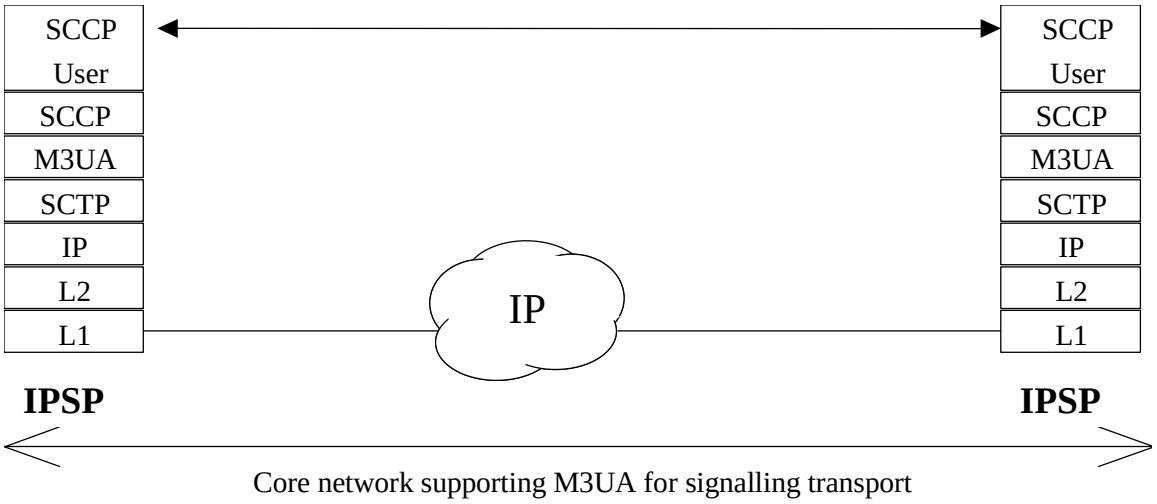


Figure 4-3: Transportation of SCCP-user messages via M3UA in all IP network

4.4 M3UA Adoption in 3GPP

SCCP/M3UA is the only specified protocol for IP based transportation of 3GPP SS7 like core network signalling. The transport of MAP & CAP messages in a 3GPP core network using M3UA is specified in 3GPP TS 29.202 [1]. The usage of M3UA in Mc interface between MSC and MGW is defined in 3GPP TS 29.205 [12] and 3GPP TS 29.232 [13]. Meanwhile, M3UA is specified as an option for RANAP in 3GPP TS 25.412 [14] and RNSAP in 3GPP TS 25.422 [15] to transport SCCP messages in a packet switched domain.

5 Analysis of M2PA

5.1 Introduction

This clause provides an introduction and study into the M2PA.

M2PA provides MTP3 with an interface and services similar to MTP2; in fact MTP2 and lower layers of the legacy SS7 protocol stack are replaced by an IP equivalent.

5.2 Status of M2PA

In November 2000 the first draft of M2PA was available where September 2005, M2PA became an RFC (RFC 4165) [3].

M2PA provides the service of MTP2 between two SG (peer to peer).

M2PA supports MTP3.

M2PA replaces ss7 signalling link and the core of the SS7 network by a SS7-over-IP-network.

The objective was here to take advantage of the high bandwidth an IP network can provide.

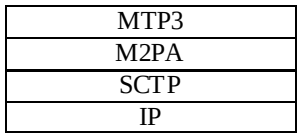
M2PA can be used as an adaptation protocol with the following characteristics:

- M2PA is a symmetric Peer-to-Peer protocol;
- M2PA recreates the qualities of MTP2 (e.g. Error Correction, Congestion Procedures);
- M2PA signalling point codes contain a MTP3 layer;
- All MTP3 network management procedures are available;
- Possible for connections to end points.

5.3 Protocol architecture and function of M2PA

The protocol architecture applicable in the case of IP-based SS7 signalling transport network is shown in Figure 5-1

Figure 5-1: Protocol architecture in the case of IP-based SS7 signalling transport network



MTP2 Functionality

M2PA provides MTP2 functionality that is not provided by SCTP, thus, together M2PA and SCTP provide functionality similar to that of MTP2.

M2PA functionality includes:

- Data retrieval to support the MTP3 changeover procedure;
- Reporting of link status changes to MTP3;
- Processor outage procedure;
- Link alignment procedure.

Procedures to Support MTP2 Features

- SCTP provides reliable, in-sequence delivery of user messages. Therefore the related functionality of MTP2 is not needed. SCTP does not provide functions related to Link State Control in MTP2.These functions must be provided by M2PA.

- Since SCTP provides delivery of messages, there is no need for M2PA to delimit its messages with a flag, as is done in MTP2. Furthermore, M2PA does not need to perform zero bit insertion and deletion on its messages.

- Since SCTP uses a checksum to detect transmission errors, there is no need for an M2PA checksum, as is needed in MTP2. This also eliminates the need for the error rate monitors of MTP2.

- Since SCTP provides reliable delivery and ordered delivery, M2PA does not perform retransmissions. This eliminates the need for the forward and backward indicator bits in MTP2 signal units.

- Acceptance of a message is indicated by a successful receipt of the message from SCTP.

Mapping of SS7 and IP Entities

- Each MTP link corresponds to an SCTP association. To prevent duplicate associations from being established, it is RECOMMENDED that each endpoint know the IP address (or IP addresses, if multi-homing is used) and port number of both endpoints. SCTP prevents two associations with the same IP addresses and port numbers from being established.

- It is necessary for at least one of the endpoints to be listening on the port on which the other endpoint is trying to establish the association. Therefore, at least one of the port numbers SHOULD be the M2PA registered port.

- If only one association is to be established between these two IP addresses, then the association SHOULD be established using the M2PA registered port at each endpoint.

- If it is desirable to create multiple associations (for multiple links) between the two IP addresses, different port numbers can be used for each association. Nevertheless, the M2PA registered port number SHOULD be used at one end of each association.

- Each combination of IP address/port for the two endpoints (i.e., each association) MUST be mapped to the same Signalling Link Code (SLC) at each endpoint, so that each endpoint knows which link is being created at the time the SCTP association is established. However, M2PA does not do any processing based on the SLC.

NOTE: A link is an SCTP association identified by two endpoints. Each endpoint is identified by an IP address and port number. Each association is mapped to an SLC.

SCTP Association Management

SCTP allows a user-specified number of streams to be opened during the initialization. It is the responsibility of the M2PA layer to ensure proper management of the streams allowed within each association.

M2PA uses two streams in each direction for each association. Stream 0 in each direction is designated for Link Status messages. Stream 1 is designated for User Data messages, as well as Link Status messages that must remain in sequence with the User Data messages. Separating the Link Status and User Data messages into separate streams allows M2PA to prioritize the messages in a manner similar to MTP2.

Retention of MTP3 in the SS7 Network

M2PA allows MTP3 to perform all of its Message Handling and Network Management functions with IPSPs as it does with other SS7 nodes.

SCTP Association Problems

The SCTP association for a link may become unusable, such as when one of the following occurs:

- SCTP sends a Send Failure notification to M2PA.

- SCTP sends a Communication Lost notification to M2PA.

- SCTP sends a Communication Error notification to M2PA.

- The SCTP association is lost. If the SCTP association for a link becomes unable to transmit or receive messages, M2PA SHALL report to MTP3 that the link is out of service and enter the OUT OF SERVICE state.

6 Scenarios of SS7 signalling transport network

6.1 STP in IP based SS7 signalling network

This clause discusses possible protocol scenarios of signalling networks with STP. Then there will be a compare of there scenarios and a conclusion. There will be three possible scenarios.

6.1.1 Introduction

Currently, 3GPP defines an IP based SS7 signalling network using M3UA/SCTP/IP as transport layer, SPs such as HLR, MSC can communicate with each other directly by accessing to this IP based signalling network. Because it is not needed to configure physical TDM link between each SP, IP based signalling network is easier to deploy and manage than TDM based signalling networks. Address translation, GTT management, SCTP Association configuration are handled separately from the basic signalling transport. In IP domain several mechanisms exist to enhance address translation (e.g. ENUM).

6.1.2 Address translation

With M3UA, 2 translation tables are required to be maintained (Global Title ->Point Code and Point Code ->IP-address). The first table is the same as for existing SS7 implementations. The second can be realized by external equipment (i.e. outside the network entities, e.g. HLR), which does the Point Code->IP-address translation, without needing to change the legacy system itself. The mapping ofr PointCode->Ip address replaces the mapping of PointCode->LinkSet in a legacy system.

6.1.3 Addressing Principles and Global Title Management

In case of SCCP/M3UA/SCTP the addressing is done as follows: First the SCCP performs the Global Title Translation for the address it gets from the application protocol (e.g., E.164 and SSN) to resolve the associated SS7 Signalling Point Code (mapping function#1). Then the SPC is passed to M3UA that maps it to an IP address and SCTP association (mapping function#2). Once the SCTP association has been determined, the signalling message can be passed to SCTP to be transported to its peer M3UA node.In case of SCCP/M3UA the Signalling Point Code configuration and management introduces a need in each node to configure not only the Signalling Point Codes but also the IP addresses and mapping between the two.

If the signalling protocol is SCCP/MTP3/M2PA the Signalling Point Code and Link/Link Set configuration and management introduces a need to not only configure Signalling Point Codes, but also Link Sets, and Links and IP addresses and the mapping between all of them thus there are MORE objects to manage than for M3UA.

In a heterogeneous network environment, where multiple IP networks are interconnected with SS7 networks, it is possible that the originating node does not know whether the destination signalling point is in the IP domain or in the SS7 domain. So it is possible that the originating signalling node shall use the services of a gateway to route the message to the destination. Hence, the gateway (Note: This gateway can be a SG or a separate entity) providing the GTT services should be able to determine, based on Global Title, the location of the destination (IP or SS7), and route the message to the appropriate entity.

Both M3UA and MTP3/M2PA provide good solutions for this as the originating node only needs to know the SPC of the "gateway" doing the GT translation, but not the SPC of the destination nor the domain where it is. Also, between gateways doing GTT it is possible to use M3UA as each gateway terminates the MTP3/M3UA layer to execute GTT on SCCP level).

6.1.4 SCTP association configuration

SPs need to configure SCTP association to the other SPs if they have IP connection with each other. The SCTP association should be pre-configured statically.

When modifying the signalling network, such as adding or deleting a SP, the other SPs in the network should have the corresponding modifications by adding a new SCTP association or deleting one.

6.1.5 Introduction of STP in IP based SS7 signalling network

When the number of SP in the signalling network increases to a large amount, such as one thousand or more, some problems will occur.

- every SP needs to configure a large number of SCTP association data and GTT data. This will probably affect the performance of SP and bring difficulty of network configuration and management. When the number of SP keeps increasing, the requirement of SCTP association is likely to overstep the capability of SP.

- if the operator is adding or modifying a SP, every SP in this IP based signalling network need to cooperate this action by adding a new SCTP association and GT data or modifying one. It will bring much difficulty in network management.

So it seems difficult to use SP – SP mode when deploying a large scale signalling network based on IP. It is better to separate the network into several sections, keep the number of SP in each section in an appropriate degree. SCCP Relay Points (SRP) are needed between different sections to simplify the GT data and converge the SCTP association data.

This will be more flexible and give more choices to operator in their signalling network architecture.

In additional, SPs in IP based signalling networks may need to interwork with legacy signalling networks. It is not possible for every SP to have the ability to transform the IP signalling message into TDM one. So SRP/SG is also needed for interworking with legacy signalling networks.

In conclusion, when deploying an IP based signalling network, operators may have some requirements:

- separate the network into several sections, keep the number of SP in each section in an appropriate degree. SRPsare needed between different sections to simplify the GT data and converge the SCTP association data. The SG functions may reside within other nodes in the network such as MSC/MGW, HLR, STP.

- SRP/SG is needed for interworking with legacy signalling networks as described in TS 29.202.

- The signalling link between SRP/SGs should be reliable, because this is the only route between signalling sections. As such the use of SCTP multihoming support provides robustness against IP network failures on these connections.

6.2 Protocol used between STPs

6.2.1 Introduction

As stated in TS29.202, M3UA is proposed to be used at interface A and C.

Currently, the signalling protocol between STPs is outside the scope of 3GPP, only the function of SGs is described. However in the following scenarios where naturally conversions between transport technology and signalling relaying occur the function is greater than a SG alone.

In case of interface B, two possible choice is described in the following section.

6.2.2 M3UA

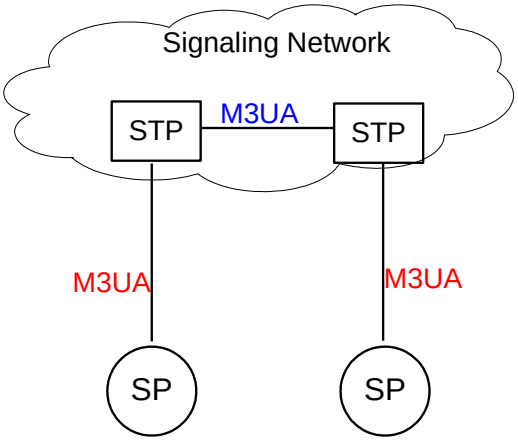


Figure 6-1: M3UA used on the A and the B interface

Notice that in the legacy 3GPP signalling network, the protocol used between SP and STP is M3UA which is based on IP, but between STP and STP, it is MTP3 which is based on MTP or ATM. This means that in the signalling network, it needs to use different physical transport link. This makes the maintaining of a network becoming more complex. So it is expected to use the same signal protocol between these two signal links.

It is of interest in this TR to discuss the STP-STP interface from the perspective that if reuse of M3UA as defined in 3GPP between STPs may minimise the interworking for certain network configurations. M3UA may not fulfil the function of an STP in all cases and so M3UA is currently being extended in IETF.

The main reasons why M3UA is being extended are:

- M3UA has not defined routing management functions for SP-SP case,
- Some parameters are missing for supporting signal relaying,
- M3UA does not support Congestion handling procedures.

NOTE: it is FFS whether due to lack of such features means it cannot be used between STPs or if these deficiencies can be solved via other means. Also it should be noted that with SRPs (GTT Gateways) the scenario could look quite different, so the problems associated to management of entities on SCCP level (GT management) need to be kept independent of what protocol is below the SCCP layer.

6.2.3 M2PA

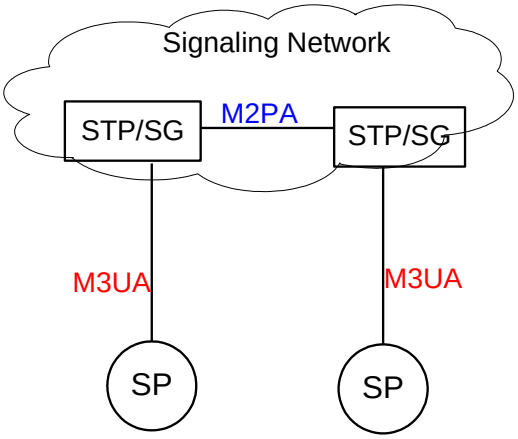


Figure 6-2: M3UA on the A interface and M2PA on the B interface

When establishing an all IP signalling network, M2PA could be used between STP and STP. This scenario describes the signalling network where the SP accesses the STP by using M3UA, and MTP3/M2PA is used between STPs. The STPs embed the function of SG. This scenario is similar to the scenario that is described in 3GPP TS 29.202. In 3GPP TS 29.202, the signalling protocol between STP and STP is MTP3/MTP2/MTP1 or MTP3B/SSCF/SSCOP/AAL5 and in this scenario, the signalling protocol between STP and STP is MTP3/M2PA/SCTP/IP. Only the transport protocol is different to what is specified in 3GPP TS29.202.

6.3 The Interaction of IP based & TDM signalling networks

IP based signalling transport can be applied in 3G core networks while 2G networks are mainly based on TDM signalling. As the updating of 2G networks to 3G networks takes a long time, there should be scenarios for IP networks that interact with TDM networks while 3G and 2G exist at the same time.

Scenario 1: Two Signalling Nodes are connected through TDM network, when they are updated to have IP interface, IP connection is added between them. As TDM network resources should be kept rather than wasted or discarded, the TDM network and the IP network may work in a load share mode or be set with different priorities by the network operator so one works as the backup to the other.

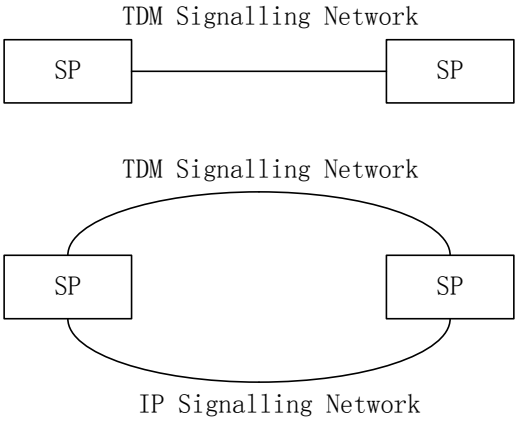


Figure6-3: Scenario 1 of the interacting of IP based & TDM signalling network

Scenario 2: Two STPs are updated to have an SG function. They may be connected with both a TDM network and an IP network and can work in a load share mode or be set different priorities by the network operator so that one works as the backup to the other.

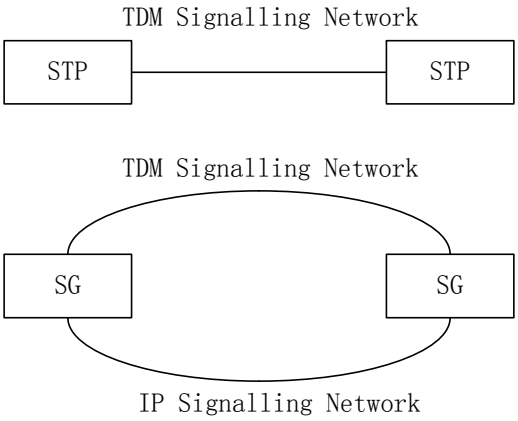


Figure6-4: Scenario 2 of the interacting of IP based & TDM signalling network

Scenario 3: One Signalling Node (SP A) is updated to have IP interface, It can be connected to SP B through TDM network (STP) as well as IP network (SG) and they can work in a load share mode or be set different priorities by network operator so that one works as the backup to the other. However, if M2PA is used here, the backhauling functionality can not be applied.

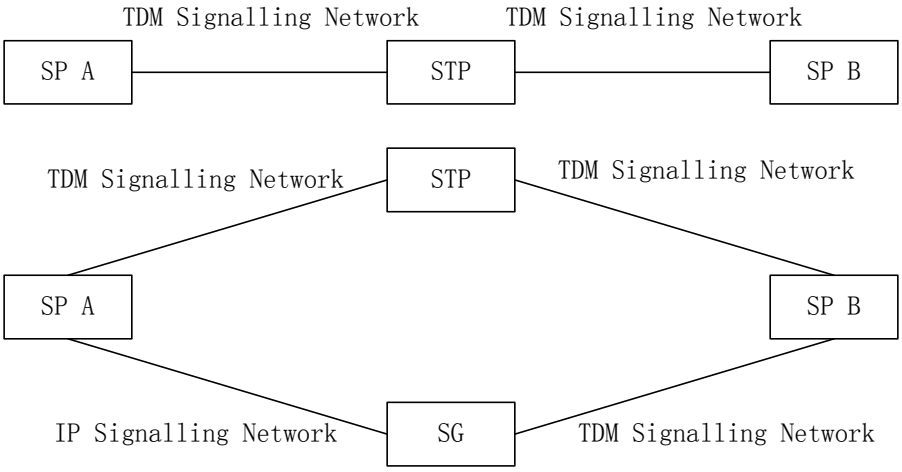


Figure6-5: Scenario 3 of the interacting of IP based & TDM signalling network

7 Comparison of M2PA and M3UA

7.1 Advantages and disadvantages of M2PA

7.1.1 Advantages of M2PA compared to M3UA

In a migration towards IP-based network architecture it is important to consider certain aspects like degree of complexity, reliability mechanisms, latency in the choice of user adaptation sub-layer protocols on some interfaces. Table xx shows the advantages of M2PA compared to M3UA considering these aspects.

Table 7-1: Comparison between M2PA and M3UA

Aspects	**M2PA**	**M3UA**
Routing aspects (reliability)	M2PA relies on MTP3 for routing procedures M2PA replaces ss7 signalling link and the core of the SS7 network by a SS7-over-IP-network SG is an SS7 node with a point code IP signalling-point processes MTP3-to-MTP2 primitives M2PA replaces a SS7-Link by IP connection Full MTP3 management procedures are supported M2PA keeps SS7 Link set structure.	In M3UA the message is handled from point code to point code. M3UA (Point to Point) in the all IP scenario as M3UA needs to be routed on point codes, With M3UA, flexibility of IP routing cannot be easily utilised without maintaining large amounts of network wide data at each node. So messages are sent hop by hop when point codes addressing mechanism is used. M3UA replaces a SS7 linkset by a IP stream. M3UA provides a pseudo-link set structure to enable easy transition between SS7 link set structure and M3UA for OAM personnel. In M3UA the message is handled from point code to point code.

	Sequence numbers provides lossless changeover without use of SCTP multi-homing Congestion procedures conform to MTP3, M2PA and SCTP standard.	M3UA uses SCTP service for reliability.M3UA multi homing provides a same level of reliability Similar congestion procedures are provided by M3UA
Implementation and management (complexity)	M2PA relies on MTP3 for management procedures (Message Handling and Network Management functions with IPSPs as it does with other SS7 nodes). MTP2/MTP3 interface boundary , management of SCTP transport associations , and traffic instead of MTP2 links Following Interfaces have to be configured: • SCTP transport associations • M2PA as interface between SCTP and MTP3 • MTP3 parameters • MTP2 parameters on STP side.	M3UA requires management of two mapping tables to find out the IP address of the peer signalling end point (add complexity). M3UA needs the SCCP Services Using M3UA each IP node is required to have both the IP address and point code assigned to it . M3UA requires SCCP node to be configured with both the point code and the IP address even in all IP case. Following Interfaces need be configured: • SCTP transport associations M3UA parameters and routing key management • MTP2 parameters on STP side. • MTP3 parameters on STP side.
Transfer (latency)	SG is an SS7 node with a point code, and acts as an STP. MTP specification requires that each node with an MTP3 layer will be represented by an SS7 point code. Thus, each IP signalling point must have its own SS7 point code. GTT needs one step more. (SCTP->M2PA->MTP3->SCCP->MTP3->MTP2->MTP1)	There are some function redundancies in SCCP/M3UA/SCTP stack mode e.g. message segmentation and reassembling mechanism are specified at both SCTP layer and SCCP layer Fewer Steps by GTT: (SCTP->M3UA -> SCCP->MTP3->MTP2->MTP1)

7.2 Advantages and disadvantages of M3UA

7.2.1 Support for failover due to link failure

7.2.1.1 Support for Failover due to link failure in M2PA

As M2PA supports the transport of MTP3 messages it is able to support the MTP3 Changeover procedure, as described in Q.704 [8], should SCTP link failure occur.

7.2.1.2 Support for Failover due to link failure in M3UA

In the M3UA protocol architecture, the receipt of traffic from the SS7 network is enabled through the use of Signalling Gateways. The performance and reliability requirements for such transport are provided by M3UA in conjunction with SCTP.

In addition to the multi-homing capability of SCTP (SCTP also enables the paths for SCTP associations between SCTP End Points to be QoS-bounded), which makes SCTP associations robust and insensitive to IP network failure, M3UA is flexible enough to support various physical configurations that enable Network Operators to meet their performance and reliability requirements. Consequently, M3UA supports:

- The use of redundant SG and AS processes;
- Distribution of processes over redundant hosts

This is illustrated below:

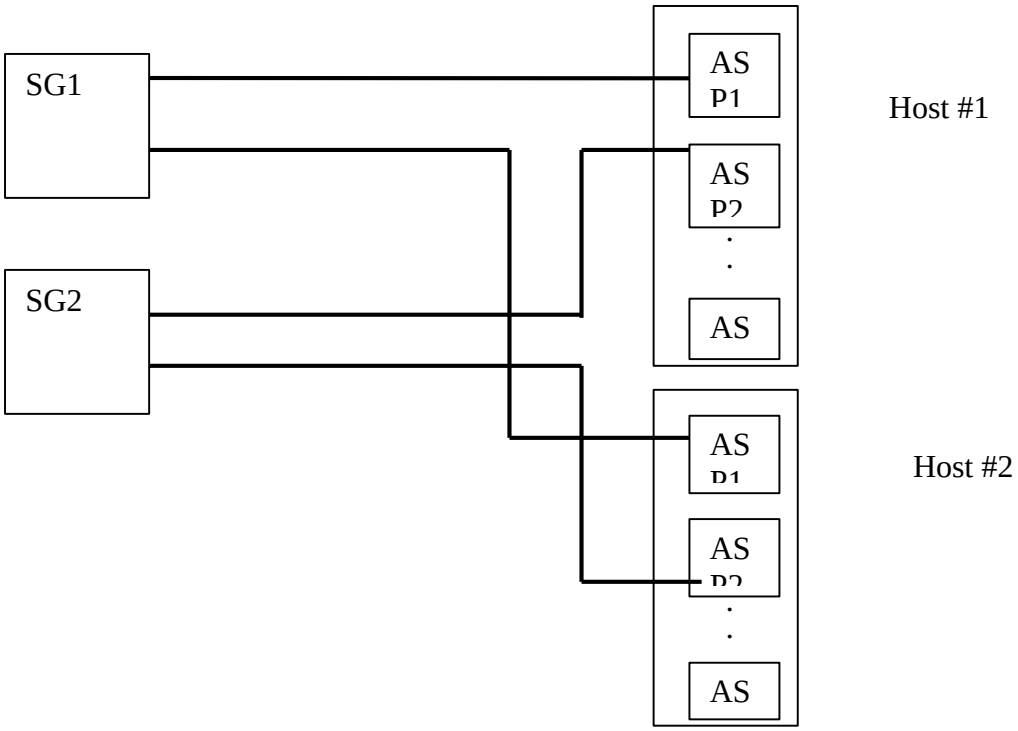


Figure 7.2.1.2.1

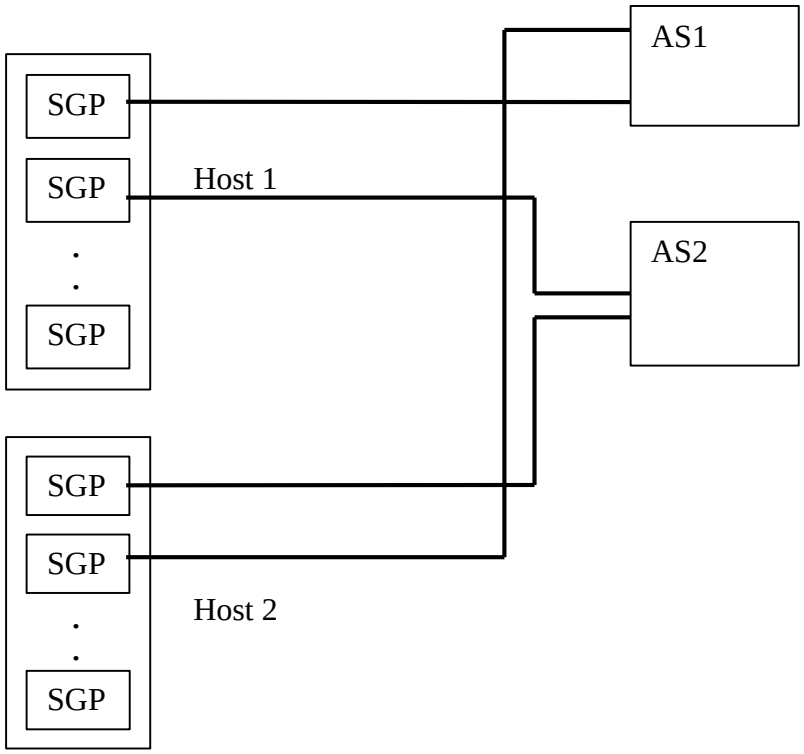


Figure 7.2.1.2.2

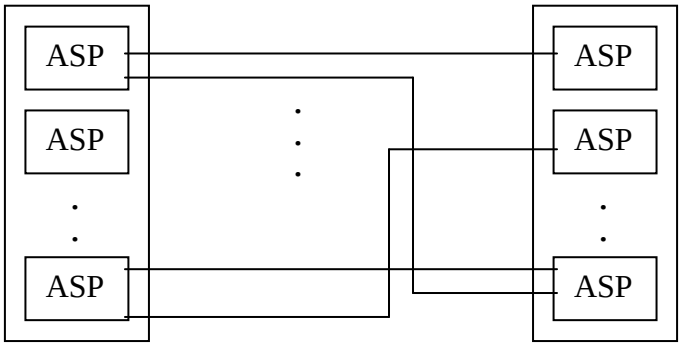


Figure 7.2.1.2.3

Figures 7.2.1.2.1, 7.2.1.2.2 and 7.2.1.2.3 above, illustrate both the use of redundant SG and AS processes and the distribution of processes over redundant hosts. For example, ASP1/Host 1 and ASP2/Host 2 in figure x are both part of the same AS. Failure of the SCTP link between SG1 and ASP1/Host1 will cause a failover to the SG1-ASP1/Host2 link.

The M3UA **Routing Key** feature facilitates the support of these configurations. Consequently, a signalling or application process is able to support the distribution of M3UA messages to many simultaneously active associations. This message distribution function is based on the status of provisioned Routing Keys, the status of the signalling routes to signalling points in the SS7 network, and the redundancy model (active-standby, load sharing, broadcast, n+k) of the remote signalling processes.

M3UA is able to provide ample failover capabilities for both SG-AS and AS-AS interactions. In these types of interactions, the support of the MTP3 Changeover isn't possible (or required) as service primitives between M3UA and its user (SCCP) are being transported between the nodes, and not MTP3 primitives.

8 Proposed solution

8.1 Introduction

Base on the requirements discussed in chapter 6, it is proposed to add STPs in IP based SS7 signalling networks. Currently 3GPP TS 29.202 assumes that interface B is using - Q.701-Q.705 or Q.2210. According to the requirements identified in this report there are two possible solutions, one is to introduce M2PA in 3GPP signalling network and the other one is to improve the functionality of M3UA.

8.2 Solution 1: Introducing M2PA in 3GPP signalling networks

This chapter describes the scenarios when M2PA is introduced into the signalling network.

M2PA defines a protocol supporting the transport of Signalling System Number 7 (SS7) Message Transfer Part (MTP) Level 3 signalling messages over Internet Protocol (IP) using the services of the Stream Control Transmission Protocol (SCTP).The protocol operates in a manner similar to MTP Level 2 so as to provide peer-to-peer communication between SS7 endpoints.

8.2.1 The use of M2PA on the interface B

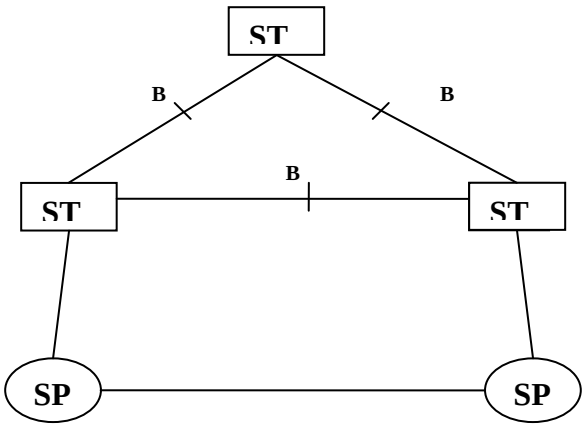


Figure 8-1: use M2PA on the interface B

8.2.2 Connection to a traditional SS7 node/network

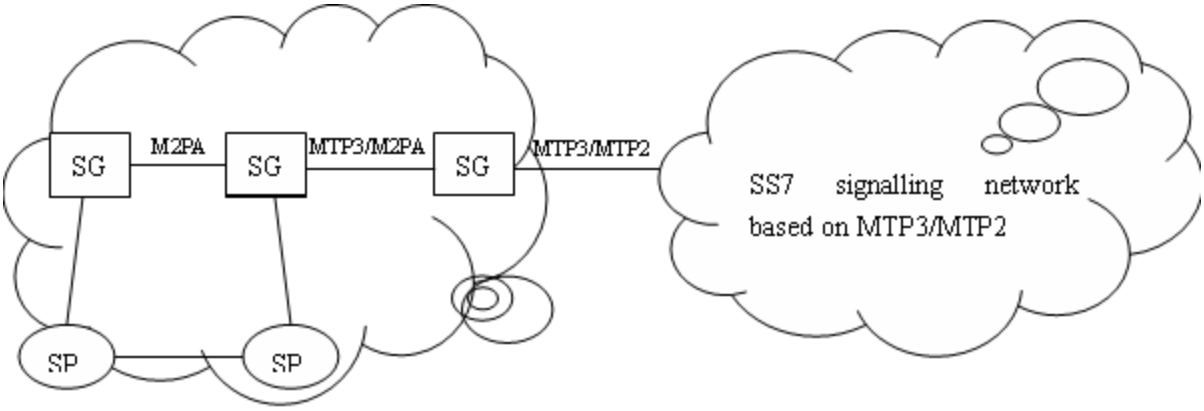


Figure 8-2: connect with traditional SS7 node/network

This scenario describes a MTP3/M2PA based SS7 signalling network connecting to a MTP3/MTP2-SP or a traditional MTP3/MTP2 based SS7 signalling network. The SG which supports the interworking between MTP2/MTP2 and MTP3/M2PA/SCTP/IP is needed in this solution. In this case MTP3 is used between both sides.

8.3 Solution 2: Introducing enhanced M3UA

Currently, M3UA cannot fulfil the requirement of being used between STPs(see section 6.3.1). IETF is developing a draft named M3UA SG-SG Communication [16] to describe a protocol to support the communication between M3UA SGs in IP domain.
This document defines a communication mechanism between M3UA SGs. The main motivation for such a mechanism is allowing message relaying on SGs.

Here are a series of excerpts from this IETF draft named M3UA SG-SG Communication [16]

Functional improvement includes:

- If a SG controls a SPMC, it SHOULD control it as a whole. When a SPMC becomes available, SG will broadcast DAVA to all adjacent SGs. Similarly when a SPMC becomes unavailable DUNA and when SPMC becomes restricted DRST SHOULD be sent

- SCTP with multihoming feature MUST be used as transport protocol for SG-SG communication.

- There is no client/server relationship between SGPs. SCTP associations MAY be initiated by any SG. A collision, which might happen if both sides try to establish SCTP association concurrently is handled by SCTP protocol itself.

- After a SCTP association is established, peers MUST declare the availability of their M3UA layer with ASPUP message. After the availability of M3UA layers is confirmed, SGs will exchange SSNM to update to update the remore peer about the status of PCs, which are configured as reachable on them. SSNM and ASPAC/ASPAC-ACK SHOULD be sent via stream 0, to prevent problems which may arise due to missequencing.

- DATA messages SHOULD be sent to SGs, via which the destination pointcode of the message to be sent is in available status. If there is no such peer SG, DATA messages SHOULD be sent to SGs, which declared the destination as restricted. If no such SG exists, the message SHOULD be dropped.

- Congestion handling procedures as defined in relevant MTP3 standards SHOULD be followed.

Message and protocol impact includes:

- Three new message types are defined as new SSNM in addition to existing ones in M3UA: Congestion Test Message (CGT), Changeover Request Message (COR), Changeover Request Acknowledgement Message (CORA)

- Some parameters are added in addition to the ones defined in M3UA: Forward Sequence Number, Signalling Link Code.

- A new field is introduced to DUPU. Concerned PC: Destination PC, which has caused DUPU to be generated. This parameter is mandatory.

- For SG-SG communication, Concerned DPC parameter is mandatory. It contains the point code for the signalling point, which originated the message causing SCON to be generated. There will be two Affected PC fields present. The first one contains the point code of the originator of the SCON -or the corresponding TFC-message and the second one contains the point code for the congested destination. Those two Affected PC fields MUST be sent in this order.

- CGT is used to support Signalling Route Set Congestion Test(National Option) procedures as defined by MTP3. It is used instead of RCT MTP3 message.

- SG-SG communication does not rely on a mechanism similar to M3UA changeover mechanism for redundancy purposes , but a SG may relay MTP3 changeover mechanism related messages. These messages are COR and CORA. COR is used to relay changeover order/emergency changeover order information to/from a peer in TDM domain. CORA is used to relay the FSN information for the last accepted MSU on a failed link between a peer SG and a conventional SS7 node as an answer to COR.

9 Conclusion and recommendations

It is proposed that solution 1"introducing M2PA" is a recommended option that can be used in 3GPP IP based signalling networks for interface B. For solution 2 "introducing enhanced M3UA", this depends on the progress of IETF.

Finally, a CR to 3GPP TS 29.202 [1] may be considered to add use of M2PA in 3GPP IP based signalling networks for interface B.

Annex <A>:
Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
06-2007	CT#36	CP-070335			V7.0.0 approved in CT#36	1.0.0	7.0.0