The DTM Packet Service and Protocol Specification
Version 1.0

by

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The DTM Packet Service and Protocol

Specifications

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1.0 Introduction

The purpose of this document is to describe and specify the service of the DTM Packet Service (DPS) and a Segmentation and Reassembly (SAR) protocol, implementing the service. The document consists of two sections, one for the service and one for the protocol. The intent of the document is to specify, not to justify the design.

The relation between this service and protocol to underlying protocols and layers is depicted below in figure 1. The DPS is provided by two sublayers, one called the SAR sublayer and the other called the Slot Stuffing layer. There is an internal service interface between these two layers. The SAR protocol is the only user of it. The purpose of Slot Stuffing layer is encode and decode the different Protocol Data Units (PDUs) of the SAR protocol into units suitable for the DTM service. This layer makes the SAR protocol independent of the actual encoding which may have to be changed when the DTM Service evolves. The Slot Stuffing service and protocol is described in [Björkman92].
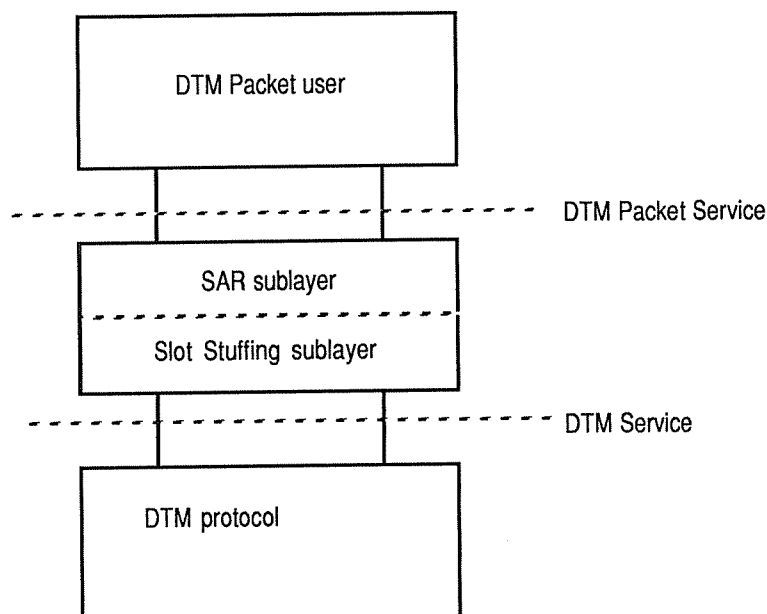
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                 ┌──────────────────────────┐
                 │                          │
                 │     DTM Packet user       │
                 │                          │
                 └──────────────────────────┘
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        ─ ─ ─ ─ ─ ─ ─ ─ ┼ ─ ─ ─ ─ ─┼ ─ ─ ─ ─ ─     DTM Packet Service
                 ┌──────────────────────────┐
                 │       SAR sublayer         │
                 │ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─│
                 │   Slot Stuffing sublayer   │
                 └──────────────────────────┘
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                 ┌──────────────────────────┐
                 │                          │
                 │       DTM protocol        │
                 │                          │
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Figure 1. SAR and Slot Stuffing sublayers.

1.1 Abbreviations and conventions

DPS - DTM Packet Service
DTM - Dynamic Synchronous Transfer Mode
SAR - Segmentation and Reassembly
SDU - Service Data Unit
PDU - Protocol Data Unit
PKT - Packet

1.2 General description of the service

DPS provides a connection oriented, asynchronous packet network communication service to the user. The smallest packet size is 64 bit long and there is no upper limit specified. The packet size can vary from connection to connection and also within a connection. There are three phases in a communication session, a connection

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establishment phase, followed by a data transfer phase and terminated by a connection release phase. The service provides a simplex connection with one, or several receivers. Ordering of packets is preserved between sender and receivers but there is no error guarantee with respect to lost or damaged packets.

1.3 General description of the SAR protocol

The SAR protocol provides two functions using the underlying Slot Stuffing and DTM services:
      1. segmentation/reassembly of packets into 64 bit segments, the size of DTM SDUs, and
      2. adaptation between the synchronous service of DTM and the asynchronous service offered by the layer.

The SAR protocol is a simplex protocol with one sender and one or several receivers.

For segmentation/reassembly function, the sending SAR provider accepts a packet of variable length and thereafter it segments the packets into 64 bit wide SDUs of the DTM. The receivers reassemble these segments into the original packet and deliver it to the users when it is complete. The protocol relies on the underlying DTM service for preserving the ordering of the segments. There are no mechanisms for error detection or any other mechanisms for delivery guarantee in the design.

The underlying DTM service provides a synchronous service. It cyclically expects the DTM user (ie the DTM Packet layer) to provide 64 bit PDUs according to the reserved slots of the synchronous time multiplexing scheme of DTM. Since the Packet layer service is asynchronous, the sending SAR provider may not have a packet segment when the DTM expects a SDU. At these situations the sender sends an "idle" protocol data unit instead which is discarded at the receiver side.

The protocol only provides data transfer services. There is no SAR-connection management protocol service. Instead the connection management service provided by the DTM layer is exported through the layer to the DPS user. In order not to violate the hierarchical layering principle, the DTM connection management service primitives are remapped into Packet layer service primitives. The SAR or the Slot Stuffing protocol does not change, remove or add anything to these primitives.

2. Service Specification

This specification defines the externally visible service provided by the DTM Packet layer in terms of:

      1. The service primitives and parameters associated with each primitive.
      2. The sequences of primitives, actions and events of the service.

2.1 Service Primitives

This section specifies the service primitives. The primitives are divided into two groups, one for the connection handling primitives and one for the data transfer primitives. The connection handling primitives are specified in [Elmstedt91] since they are identical with the corresponding DTM service primitives. Here we will only list them. For semantics and parameters, see [Elmstedt91].

2.1.1 Connection handling primitives

- *PKT_Conn.Req* corresponds to *DTM_Conn.Req*

- *PKT_Conn.Ind* corresponds to *DTM_Conn.Ind*

- *PKT_Status.Ind* corresponds to *DTM_Status.Ind*

- *PKT_Conn.Conf* corresponds to *DTM_Conn.Conf*

- *PKT_Disc.Req* corresponds to *DTM_Disc.Req*

- *PKT_Disc.Ind* corresponds to *DTM_Disc.Ind*

- *PKT_ChangeBW.Req* corresponds to *DTM_ChangeBW.Req*

- *PKT_ChangeBW*.Ind corresponds to *DTM_ChangeBW.Ind*

2.1.2 Data Transfer Phase primitives

- *PKT_Data.Req* - A request is made by the user to the sender entity to send a data unit to the receiver entities. Parameters are *connection_end_point_id* and *user_data*. The user_data field must be padded to a 64 bit boundary.

- *PKT_Data.Ind* - An indication to the user from a receiver entity that a data unit has been received. Parameters are *connection_end_point_id* and *user_data*.

2.2 Sequences of primitives

2.2.1 Relation of primitives at the two end-points

The relations between primitives in the connection establishment and connection release phases are specified in [Elmstedt91]. The relation between the *PKT_Data.Req* and *PKT_Data.Ind* is described by the time sequence diagram below. (See figure 2.)
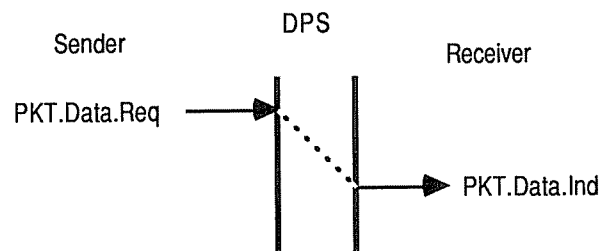

Figure 2. Time sequence diagram of the DTM Packet service, the data transfer phase.

3.0 The SAR Protocol Specification

This specification defines the behavior of the SAR protocol in terms of:

1. The protocol data units and parameters associated with them.
2. The interaction with the underlying communication service.

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3. Protocol entities and the sequence of events and actions at these entities.

3.1 Definition of Protocol Data Units (PDUs)

All PDUs consists of a 64 bit wide data field and an associated parameter which specifies the PDU type. The underlying Slot Stuffing layer will encode this type into a concrete representation which is transparent to the SAR protocol[Björkman92]. Note that the PDUs do not carry any connection identifier.

Protocol Data Units

• *UserInformation* - Holds 64 bit user data. The user data is a segment of a packet. The parameter to and from the Slot Stuffing layer is *user_information*.

• *EndOfPacket* - Holds 64 bit user data. It is the last segment of a packet. The parameter to and from the Slot Stuffing layer is *end_of_packet*.

• *Idle* - This PDU is used when DTM requests a data unit and when there is no segment available. It indicates to receiving sides that the data user field should be ignored. Parameter to and from the Slot stuffing layer is *idle*. Any 64 bit user data field is submitted at the sending side.

• *EndOfPacket&Idle* - This is a combination of Idle and EndOfPacket. It could be used to mark the end of a packet when no data is available.

3.2 Specification of the underlying Slot Stuffing and DTM service

The DTM service specification is provided in [Elmstedt91] and the Slot Stuffing service in [Björkman29]. Basically, DTM provides a synchronous service of transmitting segments of 64 bits. With synchronous service we mean that DTM cyclically expects a segment from the user according to reserved time slots in the synchronous time multiplexing scheme of the DTM signalling media. The asynchronous SAR protocol must respond to these DTM segment requests even when there is no user data. This synchronous behavior is described by the time sequence diagram in figure 3 below.
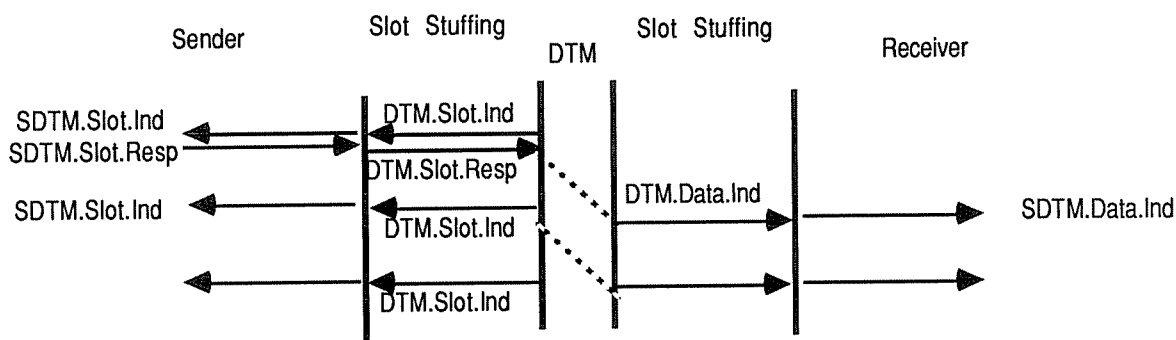

Figure 3. Time sequence diagram of the data transfer service.

3.3 Protocol entity operation definitions

The protocol provides a simplex data transfer. It has a sender entity and one or several receiver entities. For a duplex connection, two simplex connection has to be established.

3.3.1 Possible events at sender entity

The following table summerize the possible events. The service primitive SDTM.Slot.Resp is used when responding to the slot stuffing layer. Parameters with the primitive are the SAR PDU:s and flags indicating the type of PDU (*idle* and *end_of_packet*.

Name	Interface	Meaning
PKT.Data.Req	From Packet layer user	Request to send a packet
SDTM.Slot.Indication	From Slot/DTM	DTM requests a 64 bit data unit
UserInformation	To Slot Stuffing	SDTM.Slot.Resp. SDU is used. Parameters are 64 bit user data and user_information
Idle	To Slot Stuffing	No segments are available to send. Sender responses with any 64bit data unit and sends it with a SDTM.Slot.Resp. idle is sent as parameter.
EndOfPacket	To Slot Stuffing	Last segment in a Packet. Include this 64 bit segment and send with a SDTM.Slot.Resp
EndOfPacket&Idle	To Slot Stuffing	Combination of Idle and EndOfPacket. No user data.

3.3.2 Possible events at receiver entity

The following table summerize the possible events. The SAR PDU is a parameter to the slot stuffing service primitive SDTM.Data.Ind.

Name	Interface	Meaning
PKT.Data.Ind	To Packet layer user	Indicate that a packet is available.
UserInformation	From Slot Stuffing	With a SDTM.Data.Ind. A 64 bit user data to reassemble.
Idle	From Slot Stuffing	Do not care - discard 64 bit data unit.
EndOfPacket	From Slot Stuffing	Last 64 bit segment in a Packet.
EndOfPacket&Idle	From Slot Stuffing	No more segments in packet. Discard 64 bit data unit.

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3.3.3 State variables and enabling conditions

The behavior of the sender and receiver entities are specified as finite state machines below.

The sender has the following two states:

- *WPDR* - Wait for next PKT.Data.Request. If a DTM.Slot.Ind happens when the entity is in this state, then an *Idle* PDU will be sent.

- *SS* - Send Segment. In this state, 64 bit segments of a packet are sent.

The receiver has the following two states:

- *WS* - Wait for Segment. The receiver will be in this state until the first 64 bit segment arrives.

- *AEOP* - Assemble until *EndOfPacket*. The receiver stays in this state until a whole packet is reassembled.
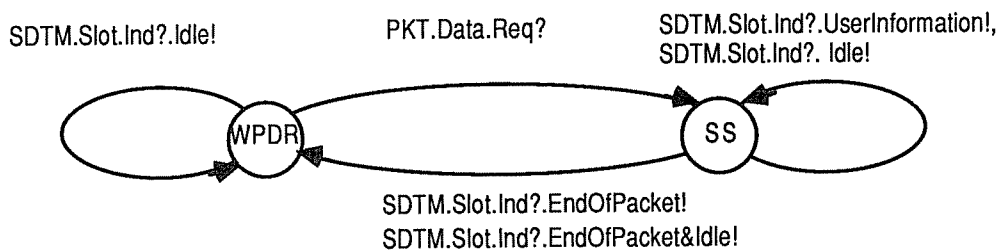
SDTM.Slot.Ind?.Idle!   PKT.Data.Req?   SDTM.Slot.Ind?.UserInformation!,
SDTM.Slot.Ind?. Idle!

WPDR   SS

SDTM.Slot.Ind?.EndOfPacket!
SDTM.Slot.Ind?.EndOfPacket&Idle!

Figure 4. The Sender automaton

Idle?   UserInformation?   UserInformation?, Idle?

WS   AEOP

EndOfPacket?.PKT.Data.Ind!,
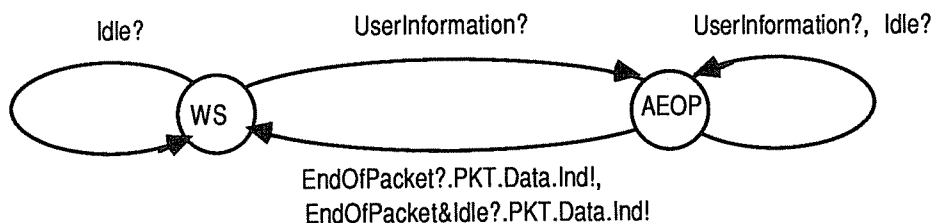EndOfPacket&Idle?.PKT.Data.Ind!

Figure 5. The Receiver automaton

4.0 References

[[Ahlgren91] Bengt Ahlgren, Stephen Pink, Per Lindgren, Lars Håkansson, Per Gunningberg, Lotten Elmstedt, Christer Bohm & Mats Björkman, "A Host Interface to the DTM Network", 3:rd MultiG Workshop, 1991.

[Björkman92] Mats Björkman, "DTM slot-stuffing specification", Draft SICS Technical report, 1992.

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[Elmstedt91] Lotten Elmstedt, Per Gunningberg, Lars Håkansson, "The DTM Service Specification" Version 1.0, Draft SICS Technical Report, 1991.