ATIS-1000102.v002

Invocation/Revocation of the National Security / Emergency Preparedness (NS/EP) Data Transport Service for the Evolved Packet System (EPS)

TECHNICAL REPORT

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ATIS-1000102.v002, *Invocation/Revocation of the National Security / Emergency Preparedness (NS/EP) Data Transport Service for the Evolved Packet System (EPS)*

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ATIS Technical Report on

Invocation/Revocation of the National Security / Emergency Preparedness (NS/EP) Data Transport Service for the Evolved Packet System (EPS)

Alliance for Telecommunications Industry Solutions

Approved May 22, 2024

Abstract

The National Security / Emergency Preparedness (NS/EP) Data Transport Service enables an NS/EP Service Provider to provide acceptable throughput and performance to the Service User for applications using the Default Bearer within a designated PDN Connection in the Evolved Packet System (EPS) during periods of severe network congestion when normal commercial data service is degraded.

This Technical Report (TR) analyzes NS/EP Data Transport Service invocation / revocation for several use case scenarios and identifies the implied requirements on the EPS, in order to facilitate a common approach for NS/EP Data Transport Service invocation / revocation across multiple NS/EP Service Providers.

Foreword

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The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages. The word *may* denotes an optional capability that could augment the standard. The standard is fully functional without the incorporation of this optional capability.

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At the time of consensus on this document, the PTSC, which was responsible for its development, had the following leadership:

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V. Shaikh, PTSC Vice Chair (Peraton Labs)

Table of Contents

Table of Figures

Table of Tables

ATIS Technical Report on –

Invocation/Revocation of the National Security / Emergency Preparedness (NS/EP) Data Transport Service for the Evolved Packet System (EPS)

1. Scope, Purpose, & Application

1.1 Scope

The proliferation of advanced data communications introduces new opportunities and challenges for National Security / Emergency Preparedness (NS/EP) communications. Expanded data capabilities enhance the ability for Service Users to carry out their NS/EP mission. At the same time, high data traffic volumes place significant demands upon Service Provider's networks and can hamper their ability to support the offered traffic load when these networks are impaired due to congestion and/or damage from natural or human-caused disasters. The NS/EP Data Transport Service is designed to address these needs.

This Technical Report (TR) analyzes NS/EP Data Transport Service invocation / revocation for an Evolved Packet System (EPS), including the associated user interactions with the NS/EP Service Provider, for several key use case scenarios as specified in TS 22.153 [Ref 1]. It describes support of the NS/EP Data Transport Service based on updated Policy and Charging Control (PCC) features for the EPS Bearer Service as specified in 3GPP Release 17, plus an enhancement that is recommended for 3GPP Release 18 deployments of the NS/EP Data Transport Service.

1.2 Purpose

The purpose of this TR is to use the TS 22.153 [Ref 1] use case scenarios to identify the implied requirements on the EPS and the Policy and Charging Control (PCC) architecture supporting the NS/EP Data Transport Service.

The objective is to facilitate a common approach for NS/EP Data Transport Service invocation / revocation across multiple NS/EP Service Providers.

1.3 Application

This TR is applicable to the public network infrastructure. It could also be utilized within a non-public network infrastructure.

2 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

3rd Generation Partnership Project (3GPP)

[Ref 1] 3GPP TS 22.153, Multimedia priority service (Release 17).

[Ref 2] 3GPP TS 23.203, Policy and Charging Control Architecture (Release 17).

[Ref 3] 3GPP TS 23.401, General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (Release 17).

[Ref 4] 3GPP TS 24.301, Non-Access Stratum (NAS) protocol for 5G System (5GS); Stage 3 (Release 17).

[Ref 5] 3GPP TS 29.212, Policy and charging control over Gx reference point (Release 17).

[Ref 6] 3GPP TS 29.213, Policy and charging control signalling flows and Quality of Service (QoS) parameter mapping (Release 17).

[Ref 7] 3GPP TS 29.214, Policy and charging control over Rx reference point (Release 17).

[Ref 7a] 3GPP TS 29.214, Policy and charging control over Rx reference point (Release 18).

[Ref 8] 3GPP TS 29.272, Evolved Packet System (EPS); Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on Diameter protocol (Release 17).

[Ref 9] 3GPP TS 29.274, Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3 (Release 17).

[Ref 10] 3GPP TS 36.331, Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification (Release 17).

Alliance for Telecommunications Industry Solutions (ATIS)

[Ref 11] ATIS-1000049.2011, End-to-End NGN GETS Call Flows.

[Ref 12] ATIS-1000065.2015, Emergency Telecommunications Service (ETS) Evolved Packet Core (EPC) Network Element Requirements.

[Ref 13] ATIS-1000079, National Security Emergency Preparedness Next Generation Network Priority Service (NS/EP NGN-PS): Transport Level Packet Marking and Packet Scheduling.

Internet Engineering Task Force (IETF)

[Ref 14] IETF RFC 2818, HTTP Over TLS.

[Ref 15] IETF RFC 7231, HyperText Transfer Protocol (HTTP/1.1): Semantics and Content.

[Ref 16] IETF RFC 7239, Forwarded HTTP Extension.

3 Definitions, Acronyms, & Abbreviations

For a list of common communications terms and definitions, please visit the *ATIS Telecom Glossary*, which is located at < http://www.atis.org/glossary >.

3.1 Definitions

Dedicated Bearer: An EPS bearer that is associated with uplink packet filters in the User Equipment (UE) and downlink packet filters in the Packet Data Network (PDN) Gateway (GW) where the filters only match certain packets. [Ref 4]

Default Bearer: An EPS bearer that gets established with every new PDN connection. Its context remains established throughout the lifetime of that PDN connection. A default EPS bearer is a non-Guaranteed Bit Rate (GBR) bearer. [Ref 4]

Designated APN: The Access Point Name (APN) which identifies the specific PDN that is the target for the NS/EP Data Transport Service.

Designated PDN Connection: The PDN connection for which the Quality of Service (QoS) of the Default Bearer is upgraded when the NS/EP Data Transport Service is invoked.

Non-NS/EP-subscribed UE: A UE that is not subscribed to NS/EP service.

NS/EP-subscribed UE: A UE that is subscribed to NS/EP service, including authorization for the NS/EP Data Transport Service.

PDN Connection: The association between a PDN represented by an APN and a UE, represented by one IPv4 address and/or one IPv6 prefix (for IP PDN Type) or by the UE Identity (for Non-IP and Ethernet PDN Types). [Ref 4]

3.2 Acronyms & Abbreviations

3GPP	3rd Generation Partnership Project
5GS	5G System
AC14	Access Class Value 14
AF	Application Function
APN	Access Point Name
ARP	Allocation and Retention Priority
ATIS	Alliance for Telecommunications Industry Solutions
AVP	Attribute Value Pair
DNS	Domain Name System
DoH	DNS over HTTPS
DRA	Diameter Routing Agent
DSCP	DiffServ Code Point
DTS	Data Transport Service
EPC	Evolved Packet Core
EPS	Evolved Packet System
ETS	Emergency Telecommunications Service
E-UTRA	Evolved UMTS Terrestrial Radio Access
E-UTRAN	Evolved UMTS Terrestrial Radio Access Network
GBR	Guaranteed Bit Rate
GPRS	General Packet Radio Service
GTPv2-C	GPRS Tunnelling Protocol for Control plane
GW	Gateway
HSS	Home Subscriber Server
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
HTTPS	HyperText Transfer Protocol Secure
IETF	Internet Engineering Task Force
IP	Internet Protocol
MAC	Medium Access Control
MME	Mobility Management Entity
MPS	Multimedia Priority Service
NAS	Non-Access Stratum
NAT	Network Address Translation

NGN	Next Generation Network
NGN-PS	Next Generation Network Priority Service
NS/EP	National Security and Emergency Preparedness
PCC	Policy and Charging Control
PCEF	Policy and Charging Enforcement Function
PCRF	Policy and Charging Rules Function
PDN	Packet Data Network
PDN-GW	PDN Gateway
QCI	QoS Class Identifier
QoS	Quality of Service
RAN	Radio Access Network
RRC	Radio Resource Control
SGSN	Serving GPRS Support Node
SIB2	System Information Block 2
SPR	Subscription Profile Repository
SSL	Secure Sockets Layer
STA	Session-Termination-Answer
STR	Session-Termination-Request
TCP	Transmission Control Protocol
TLS	Transport Layer Security
TR	Technical Report
UDP	User Datagram Protocol
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
URL	Uniform Resource Locator
USIM	Universal Subscriber Identity Module

4 Overview of the NS/EP Data Transport Service

4.1 General

The NS/EP Data Transport Service provides the Service User acceptable throughput and performance for applications using the Default Bearer within a Designated PDN Connection in periods of severe network congestion during which normal commercial data service is degraded. The Designated APN is determined by Service Provider policy for the NS/EP Data Transport Service subscription.

At the time the NS/EP Data Transport Service is invoked, the Policy and Charging Rules Function (PCRF) upgrades the Quality of Service (QoS) of the Default Bearer within a Designated PDN Connection, and also upgrades the QoS for any PCC rules for that PDN Connection that have the same QoS settings as for that Default Bearer. These QoS adjustments involve modifications to the Allocation and Retention Priority (ARP) and the QoS Class Identifier (QCI) values assigned to the Default Bearer within the Designated PDN Connection, as required. Corresponding QoS adjustments are also applied for PCC rules that were assigned the same QCI/ARP values as applied to that Default Bearer prior to invocation of the NS/EP Data Transport Service. This allows all traffic, as transported via that Default Bearer prior to invocation of the NS/EP Data Transport Service, to be given priority treatment upon successful invocation of the NS/EP Data Transport Service.

4.2 Assumptions

The following general assumptions are applicable to the NS/EP Data Transport Service.

- ***Relationship to 3GPP Priority EPS Bearer Service*:** NS/EP Data Transport Service builds upon functionality as specified in TS 29.212 Clause 4.5.19.1.2 [Ref 5] for the Priority EPS Bearer Service. This functionality applies appropriate updates to the ARP and QCI values assigned to the Default Bearer within the Designated PDN Connection, and also modifies the settings for particular PCC rules (with the same QCI/ARP as that Default Bearer). NS/EP Data Transport Service extends those PCC capabilities by introducing into 3GPP Release 17 a new 3GPP Diameter Attribute Value Pair (AVP) to explicitly support the dynamic on demand invocation and revocation of the NS/EP Data Transport Service in a 3GPP specified manner. It also extends the PCC event notification capabilities, to enable the originating Service User to be notified of the successful or unsuccessful invocation/revocation of the NS/EP Data Transport Service. Other Release 17 extensions are discussed in Clause 7.1.1.
- ***Priority signalling between the UE and the Data Transport Service (DTS) Server:*** This TR describes the functionality of a DTS Server that interacts with the UE to control the dynamic invocation and revocation of the NS/EP Data Transport Service. In order to support communications between the UE and the DTS Server when network congestion is experienced, an Application Function (AF) Signalling Flow can be established to support priority signalling between the UE and the DTS Server. Clause 6.3 describes flows that illustrate the establishment of a Dedicated Bearer for this priority signalling prior to or during the invocation of the NS/EP Data Transport Service, as may be applicable to particular use case scenarios.

  NOTE: Priority signalling between the UE and the DTS Server can be established [a] at the time a Packet Data Network (PDN) connection is established, [b] when the user activates (opens) a DTS application on their UE, or [c] when the user invokes the NS/EP Data Transport Service. This topic is discussed further in Clause 7.1.2.

- ***Mechanism used for UE interactions with DTS Server*:** A variety of mechanisms can be used to invoke and revoke NS/EP Data Transport Service. Whereas the specific mechanisms, and details concerning particular interactions, are considered to be implementation and deployment choices, this TR considers two general types of mechanisms that can be used: use of a UE browser to access the DTS Server and use of a special DTS application that is installed on the UE to facilitate the Service User's access to the DTS Server. Further assumptions and considerations, as applicable to each of these mechanisms, are described in Clauses 6.1 and 7.1.3.
- ***User Authorization*:** Various forms of user authorization are considered in this TR. The choice of particular mechanism(s) can vary based on the particular use case. Whereas a browser-based mechanism may allow the Service User to enter NS/EP credentials into a HyperText Markup Language (HTML) form that is sent to the DTS Server, a simplified process can be enabled for UEs with network-resident NS/EP subscription information and does not require NS/EP credentials to be entered by the user. Further discussion of this topic is provided in Clauses 6.1 and 7.1.4.
- ***Access to DTS Server*:** The selection of a particular DTS Server by the UE (and routing of messages to that DTS Server) can be based on configuration of specific IP address(es) for the DTS Server or assignment of a unique Uniform Resource Locator (URL) to reach the appropriate DTS Server. Clause 6.1 considers a use case involving a UE with a special DTS application that is configured with specific IP address(es) for the DTS Server, and a use case involving the entry of a Service Provider-specific URL via a web browser. Other potential use cases can alternately be pursued. Further discussion of this topic is provided in Clause 7.1.5.
- ***Use of Advance Priority*:** ATIS-1000065 [Ref 12] introduces two mechanisms for giving priority treatment (i.e., setting an ARP value corresponding to a higher priority) for NS/EP-subscribed UEs: Advance Priority-Subscription Profile Repository (SPR) and Advance Priority-Home Subscriber Server (HSS). The sub-flows illustrated in Clause 6.3.2 assume the use of Advance Priority-HSS. However, the choice of a particular mechanism is dependent on the option deployed by the Service Provider. Further detail concerning these options is provided in ATIS-1000065 [Ref 12] and ATIS-1000049 [Ref 11].
- ***Applicability of NS/EP Data Transport Service to particular PDN connection(s)*:** This TR assumes that the priority treatment, as applicable upon successful invocation of the NS/EP Data Transport Service, is applicable to traffic carried via a specific PDN connection associated with a Designated APN. The Designated APN is configured by the Service Provider as part of the NS/EP subscription. This TR assumes

that the DTS invocation request (and other messages used to support the UE communications with the DTS Server) are exchanged over that same PDN connection. Further discussion of this topic is provided in Clause 7.1.6.

NOTE: Whereas the NS/EP Data Transport Service impacts traffic sent via the Default Bearer of the Designated PDN Connection, the DTS invocation request (and subsequent signalling messages exchanged between the UE and the DTS Server) may be exchanged via a Dedicated Bearer within that PDN connection (established for priority signalling between these entities, as discussed above) rather than via the Default Bearer of that PDN connection.

- ***DTS Server determination of PCRF:*** This TR includes the optional use of a Diameter Routing Agent (DRA) to assist the DTS Server in determining the particular PCRF used to enable the PCC interactions for the NS/EP Data Transport Service. The Proxy mode of operation is assumed for the flows illustrated in this TR, as discussed in Clause 7.1 of TS 29.213 [Ref 6]. Clause 7.1.7 discusses the information used by the DTS Server to facilitate the routing of a Diameter message to the appropriate PCRF.

  NOTE: The inclusion of a DRA in the architecture, and the use of a DRA in either proxy or redirect mode, is dependent on the option deployed by the Service Provider. Whereas the use of DRA Proxy mode is illustrated as an example solution in this TR, other options are possible, some of which do not include a DRA.

- ***NS/EP Data Transport Service Revocation:*** Clause 6.3.6 of this TR illustrates procedures that enable the NS/EP Data Transport Service to be explicitly revoked by the Service User, patterned after similar procedures used for invocation of the NS/EP Data Transport Service. In addition, to prevent a UE from inadvertently enabling the NS/EP Data Transport Service for an extended period of time, the network may support revocation of the NS/EP Data Transport Service after a predetermined time. To support this capability, the DTS Server starts a DTS timer when the NS/EP Data Transport Service is successfully invoked. If the DTS timer expires before deactivation of the NS/EP Data Transport Service, the DTS Server sends a Diameter command to the PCRF in order to revoke the NS/EP Data Transport Service, as discussed in Clause 7.1.11.

This TR only considers the NS/EP Data Transport Service functionality for the EPS, based on the non-roaming architecture as described in Clause 5.2. Roaming solutions are not discussed in this TR. The DTS Server is assumed to be located in the managed IP network of the UE's Service Provider. It assumes Release 17 extensions to the Priority EPS Bearer Service functionality to support priority treatment for the transport of the Service User's data within the Service Provider's network, extending from the UE to the PDN Gateway (PDN-GW). Priority treatment is not considered beyond the PDN-GW, other than the setting of priority transport level indications, e.g., DiffServ Code Point (DSCP), on the outgoing SGi interface, and potential further priority treatment within the Service Provider network.

More detailed assumptions, as applicable to specific use cases, are provided in Clause 6.1.

4.3 Key Features and Characteristics

This clause discusses key features of the NS/EP Data Transport Service.

The use of HyperText Transfer Protocol (HTTP) and HyperText Transfer Protocol Secure (HTTPS) in this TR is illustrating two possible methods for Service Users to initiate invocation and revocation of NS/EP Data Transport Service. NS/EP Service Providers may implement other methods to initiate invocation or revocation of NS/EP Data Transport Service.

4.3.1 Invocation of the NS/EP Data Transport Service

To initiate NS/EP Data Transport Service, an HTTP or HTTPS invocation request is sent from the UE to a DTS Server via a Designated PDN Connection, with the intent to upgrade the QoS of the Default Bearer for that PDN connection, and to adjust PCC rules that are mapped to that Default Bearer. Details concerning these HTTP and HTTPS interactions are provided in Clause 6.3.4.

At the time the NS/EP Data Transport Service is invoked, the DTS Server sends a request to the PCRF, causing the PCRF to change the ARP and/or QCI of the Default Bearer within the Designated PDN Connection to

appropriate value(s) for the NS/EP Data Transport Service according to PCRF decision. The PCRF also modifies the PCC rules that have the same QCI/ARP as for the present Default Bearer, building upon specifications for the 3GPP Priority EPS Bearer Service. Details concerning this processing are provided in Clause 6.3.5.

4.3.2 Sustaining Performance of the NS/EP Data Transport Service

The NS/EP Data Transport Service achieves greater throughput by means of a higher-priority QCI, and/or by an NS/EP-specific ARP, which results in preferential scheduler treatment in the eNodeB for both downstream and upstream transmissions. This improved throughput is experienced by applications using the Default Bearer within the Designated PDN Connection and also for applications under control of PCC rules with the same QCI/ARP as that Default Bearer. In addition to the higher-priority QCI, the service is assigned an NS/EP ARP value that provides for higher admission capabilities and exemptions during congestion controls, including less likelihood of connection drop during handover. Details concerning this functionality are provided in ATIS-1000065 [Ref 12].

4.3.3 Revocation of the NS/EP Data Transport Service

When the need for priority communications ends, the Service User explicitly revokes the NS/EP Data Transport Service. If not explicitly revoked, the service is automatically revoked upon UE detachment/deregistration, e.g., power down. A timer may also be used to ensure that the NS/EP Data Transport Service does not remain enabled for an excessive period of time. Details concerning this processing are provided in Clause 6.3.6.

5 Architectural Reference Model

5.1 Overview

This clause provides the reference architectural model used in describing the use case scenarios.

The NS/EP functionality as described in this TR pertains to an Evolved UMTS (Universal Mobile Telecommunications System) Terrestrial Radio Access (E-UTRA) access network and the Evolved Packet Core (EPC). Hence this TR is applicable to both a legacy LTE system, as well as to a 5G system based on architectural option 3.

In support of NS/EP services, the EPC may interconnect to various PDNs, one of which is identified using a Designated APN. In the flows as illustrated in this TR, the DTS Server is assumed to identify the Designated PDN Connection based on UE IP address information together with an APN value that is preconfigured in the DTS Server, although other options are possible.

5.2 Reference Architecture for NS/EP Data Transport Service

Figure 5-1 illustrates the general non-roaming architecture as applicable for invocation of NS/EP Data Transport Service. Solid lines represent user plane interfaces, and dashed lines represent control plane interfaces.

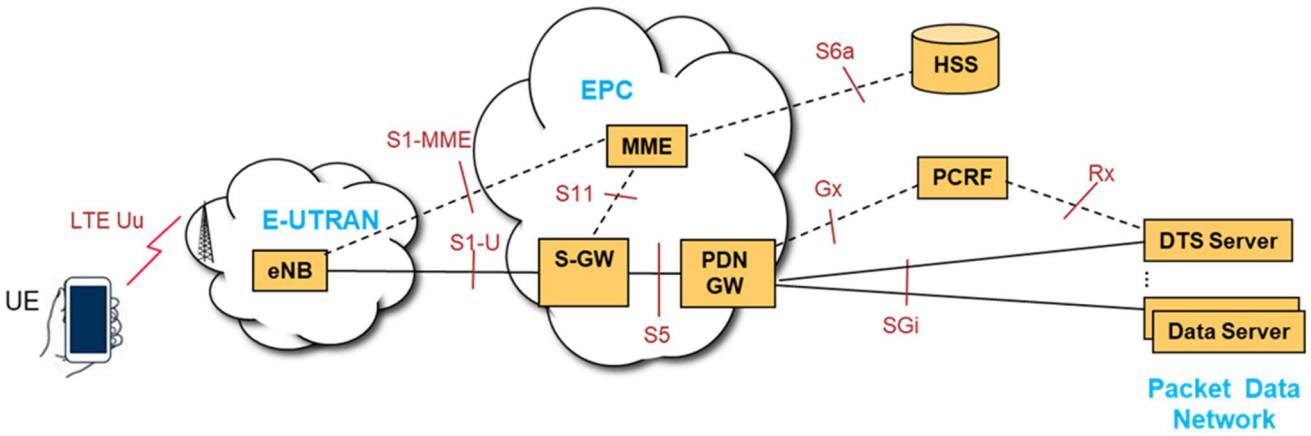

Figure 5-1: Non-roaming architecture for NS/EP Data Transport Service

This architecture is adapted from TS 23.401 [Ref 3] Figure 4.2.1-1 ("Non-roaming architecture for 3GPP accesses"). It is simplified to only illustrate E-UTRAN access, and is expanded to identify key elements that the UE is required to communicate with, in the context of the NS/EP Data Transport Service:

- The **DTS Server** exchanges (e.g., HTTP) signalling messages with the UE, as used to control the invocation / revocation of the NS/EP Data Transport Service. These signalling messages are transported transparently through the EPS as user plane packets between the UE and the PDN-GW, and are exchanged with the DTS Server via the SGi interface. The DTS Server uses the Rx interface to request the PCRF to invoke / revoke the NS/EP Data Transport Service, and the PCRF uses the Gx interface to transfer (QoS) policy and charging rules to the Policy and Charging Enforcement Function (PCEF) in the PDN-GW.
- The **Data Server(s)** illustrated in Figure 5-1 represent the server(s) that support various applications used by the UE (e.g., an HTTP Server hosting content that needs to be accessed by the UE).

In Figure 5-1, the DTS Server and the Data Server(s) are assumed to be accessed via the same Designated PDN Connection.

> NOTE: Further study is needed to determine how (or if) the DTS Server can upgrade a Default Bearer on other than the PDN used for UE-to-DTS Server communications. This requires the DTS Server to be aware of the IP address assigned to the UE in a different PDN. Such capabilities are not supported in 3GPP Release 17 and are not considered within this TR.

The NS/EP Data Transport Service allows a Service User to experience greater responsiveness and QoS when using data applications during network congestion. QoS and performance improvement is limited to priority treatment in the transport of the Service User's data within the Service Provider's network, and excludes any priority treatment for the corresponding data application processing in the far-end Data Server. The aggregate data performance will be affected by possible congestion in the Data Server, which is not mitigated by the priority of the NS/EP Data Transport Service.

The priority treatment supported by the NS/EP Data Transport Service is focused on the transport of the Service User's data within the Service Provider's network, extending from the UE to the PDN-GW. Priority transport may extend to the DTS Server (e.g., via use of special DSCP values for transport of priority packets within the Service Provider network), when the Data Server is accessed directly via the Service Provider's network. Beyond this, any additional priority treatment is not considered beyond the PDN-GW (neither within the external PDN nor for the corresponding data application processing in the far-end Data Server).

5.3 Use of EPS Bearers for the NS/EP Data Transport Service

The NS/EP Data Transport Service provides improved throughput during times of congestion for applications which use the Default EPS Bearer within the Designated PDN Connection, and applications which require the same

ARP/QCI as that Default EPS Bearer. The Default EPS Bearer is established when a PDN connection is established, and persists for the lifetime of the PDN connection. The Default EPS Bearer can transport traffic for multiple applications.

Figure 5-2 illustrates the intended use of EPS Bearers for the NS/EP Data Transport Service, superimposed on the reference architecture of Figure 5-1.

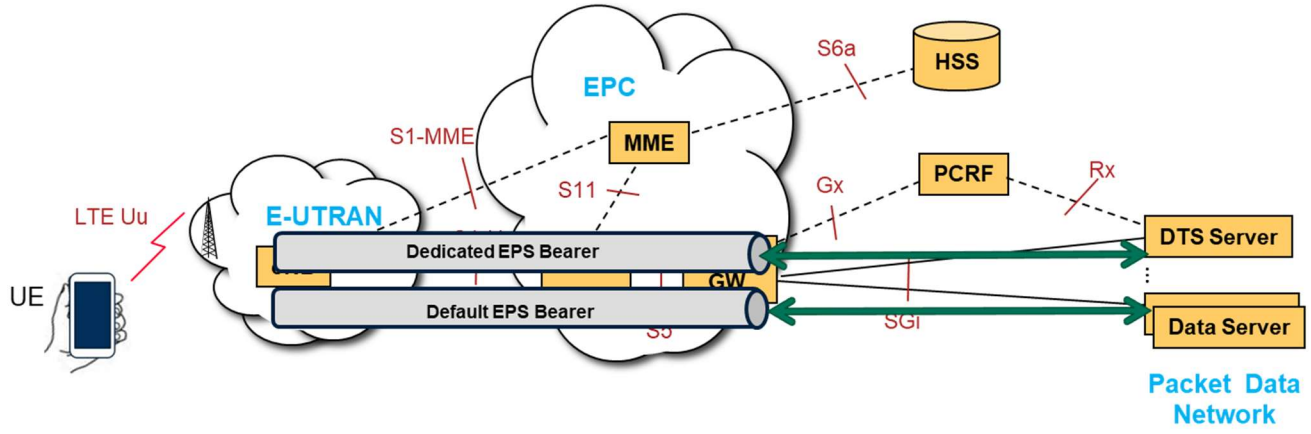

Figure 5-2: Use of EPS Bearers for the NS/EP Data Transport Service

As illustrated in Figure 5-2, the Default EPS Bearer associated with the Designated PDN Connection for the NS/EP Data Transport Service is used for the exchange of packets between the UE and the far-end Data Server(s), allowing for the priority transport of IP packets subsequent to the successful invocation of the NS/EP Data Transport Service. Details concerning the establishment of a Default EPS Bearer in conjunction with the establishment of a PDN Connection are provided in Clause 6.3.2.

Figure 5-2 also illustrates the use of an optional Dedicated EPS Bearer for priority signalling between the UE and the DTS Server. Details concerning the establishment of an AF Signalling Flow to transport priority signalling between the UE and the DTS Server are provided in Clauses 6.3.2.2 and 6.3.3.

6 Use Cases (Flow Descriptions)

This clause identifies several NS/EP Data Transport Service use cases, and illustrates various call/session flows for each use case.

- Clause 6.1 introduces the particular use cases that are considered in this TR, along with a set of assumptions that are used in the analysis of each use case.
- Clause 6.2 illustrates high-level flows for the NS/EP Data Transport Service use cases identified in Clause 6.1, each described as a particular sequence of sub-flows that may apply during particular stages of the lifecycle for the particular use case.
- Clause 6.3 provides detailed descriptions of the NS/EP Data Transport Service sub-flows as identified in the high-level flows of Clause 6.2. Given that many of the sub-flows are common to several use cases, this structure avoids the replication of such information for each use case.

The specific sequence of messages (plus the corresponding set of parameters) can vary, depending on the specific Service Provider decisions that are made for the deployment of the NS/EP Data Transport Service. Therefore, the flows depicted in the following subclauses were intended to be illustrative, and served as the basis for the identification and analysis of related standards gaps that were subsequently addressed in 3GPP Release 17.

6.1 Use Cases / Assumptions

The NS/EP Data Transport Service can be used to support a range of use cases, involving different types of UEs that may but need not be subscribed for NS/EP, and that may involve a variety of mechanisms to invoke the NS/EP Data Transport Service. Such mechanisms might use a normal browser to access the DTS Server or might make use of a special DTS application that is installed on the UE to facilitate the Service User's access to the DTS Server.

Various alternative mechanisms and associated options might be deployed and used to support the NS/EP Data Transport Service. Whereas the specific mechanisms and options for deployment of the NS/EP Data Transport Service will be determined by Service Providers in consultation with the designated government agency for the NS/EP Data Transport Service, the material in the following subclauses targets two primary use cases:

- The first use case pertains to UE invocation and revocation of NS/EP Data Transport Service via a **web browser**. This use case is applicable from either an NS/EP-subscribed UE or from a non-NS/EP subscribed UE.
- The second use case pertains to invocation and revocation of NS/EP Data Transport Service for an NS/EP-subscribed UE that is pre-configured with a **special DTS application**.

> NOTE: The special DTS application is assumed to be installed on the NS/EP-subscribed UE in advance, avoiding the need for the Service User to download that DTS application during the onset of congestion due to an NS/EP event.

The above use cases, in combination with the additional set of assumptions that are applied to each of these use cases, as summarized in Table 6-1, illustrate several of the different mechanisms and options that may need to be supported. These are not intended as service requirements, but are provided to illustrate how NS/EP Data Transport Service invocation can operate. They served as the basis for the identification and analysis of related standards gaps which were subsequently addressed in 3GPP Release 17. Such analysis focuses on PCC protocol-related aspects associated with the NS/EP Data Transport Service.

> NOTE: Aspects related to application-layer interactions between the UE and the DTS Server are subject to operator-specific implementation of the DTS Server, and how that DTS Server is designed to interact with the Service User (e.g., dependent on the use of specific HTML forms with browser-based invocation and/or dependent on the specific design of a particular UE DTS application). These aspects are beyond the scope of the analysis presented in this TR.

Table 6-1: Use Case Assumptions: Invocation / Revocation of NS/EP Data Transport Service

Topic	Non-NS/EP-subscribed UE with Browser	NS/EP-Subscribed UE with Browser	NS/EP-Subscribed UE with DTS application
[01] Priority treatments prior to DTS invocation	No priority treatment prior to DTS invocation can be provided to non-NS/EP-subscribed UEs.	Priority treatment prior to DTS invocation can be provided to NS/EP-subscribed UEs via configuration of Universal Subscriber Identity Module (USIM) Access Class 14 / "HighPriorityAccess" Establishment cause	
		Advance Priority-HSS mechanism provides upgraded ARP	
[02] DTS invocation mechanism	On-demand via browser		On demand via a special DTS application that is installed on the UE
[03] User designation of a particular DTS Server	User enters Service Provider-specific URL for NS/EP Data Transport Service that identifies DTS Server. This TR assumes that the URL used from an NS/EP-subscribed-UE is the same as the URL used from a non-NS/EP-subscribed UE. As a consequence, the DTS Server must first check if the UE is an NS/EP-subscribed UE, and if not, proceed with procedures associated with a non-NS/EP-subscribed UE.		Special DTS application may be pre-configured with IP address(es) or URL of the target DTS Server(s).

Topic	Non-NS/EP-subscribed UE with Browser	NS/EP-Subscribed UE with Browser	NS/EP-Subscribed UE with DTS application
[04] Domain Name System (DNS) over HTTPS (DoH) impacts	No solution available to allow DTS Server access via a DNS Server external to the Service Provider when DoH is enabled, unless Service Provider advocates user entry of DTS Server's IP address (contrary to topology hiding practices) rather than URL.	User responsible for configuring / disabling DoH on their browser, as necessary to adhere to use of Service Provider's DNS Server.	DTS application can be configured to use DTS Server's IP address rather than use a URL that requires a DNS query. Same restrictions as for a browser apply otherwise.
[05] Support for priority signalling between UE and DTS Server	Not applicable for non-NS/EP-subscribed UEs. See further discussion in Clause 7.1.2.	DTS Server may optionally establish an AF Signalling Flow for IP traffic (carrying priority signalling) between the UE and the DTS Server, when the DTS invocation request is received. See further discussion in Clause 7.1.2.	The special DTS application can contact DTS Server when the user activates (opens) the DTS application, causing the DTS Server to establish an AF Signalling Flow for IP traffic (to carry priority signalling) between the UE and the DTS Server. Other options are described in Clause 7.1.2.
[06] Authorization for DTS	The Service User enters NS/EP credentials via HTML form that is sent to the DTS Server. The DTS Server verifies the entered credentials via the NS/EP database. See further discussion in Clause 7.1.4.	The Service User invokes the NS/EP Data Transport Service in a manner that requires no NS/EP credentials to be entered by the Service User. The PCRF performs the authorization by querying the Subscription Profile Repository (SPR). See further discussion in Clause 7.1.4.	
[07] Information obtained from the UE during interactions with the DTS Server (to support PCRF selection)	The DTS Server obtains the request type (invocation or revocation) during DTS invocation. The local UE IP address is provided by the UE to the DTS Server as part of the IP header. See further discussion in Clause 7.1.7.		The DTS application provides the necessary information to the DTS Server during the initial UE interactions with the DTS Server, i.e., when the Service User activates (opens) the DTS application and establishes an AF Signalling Flow for priority signalling. The request type (invocation or revocation) is indicated at the time of invocation / revocation of the NS/EP Data Transport Service.

6.2 NS/EP Data Transport Service - Flow Descriptions

This clause illustrates potential realizations of the NS/EP Data Transport Service, partitioned into a series of sub-flows. These flows illustrate invocation of the NS/EP Data Transport Service for the following cases, based on the applicable architecture in Clause 5.

- Clause 6.2.1 illustrates invocation of the NS/EP Data Transport Service using a browser. The method applies both for a UE that is subscribed to NS/EP services and for a UE that is not subscribed to NS/EP services.

- Clause 6.2.2 illustrates invocation of the NS/EP Data Transport Service for an NS/EP-subscribed UE, using a special DTS application.

6.2.1 NS/EP Data Transport Service - use of Browser

Figure 6-1 provides a high-level view of processing related to the NS/EP Data Transport Service using a web browser. As the same URL is assumed to be used from an NS/EP-subscribed UE and from a non-NS/EP-subscribed UE, the procedure differs in only a few aspects.

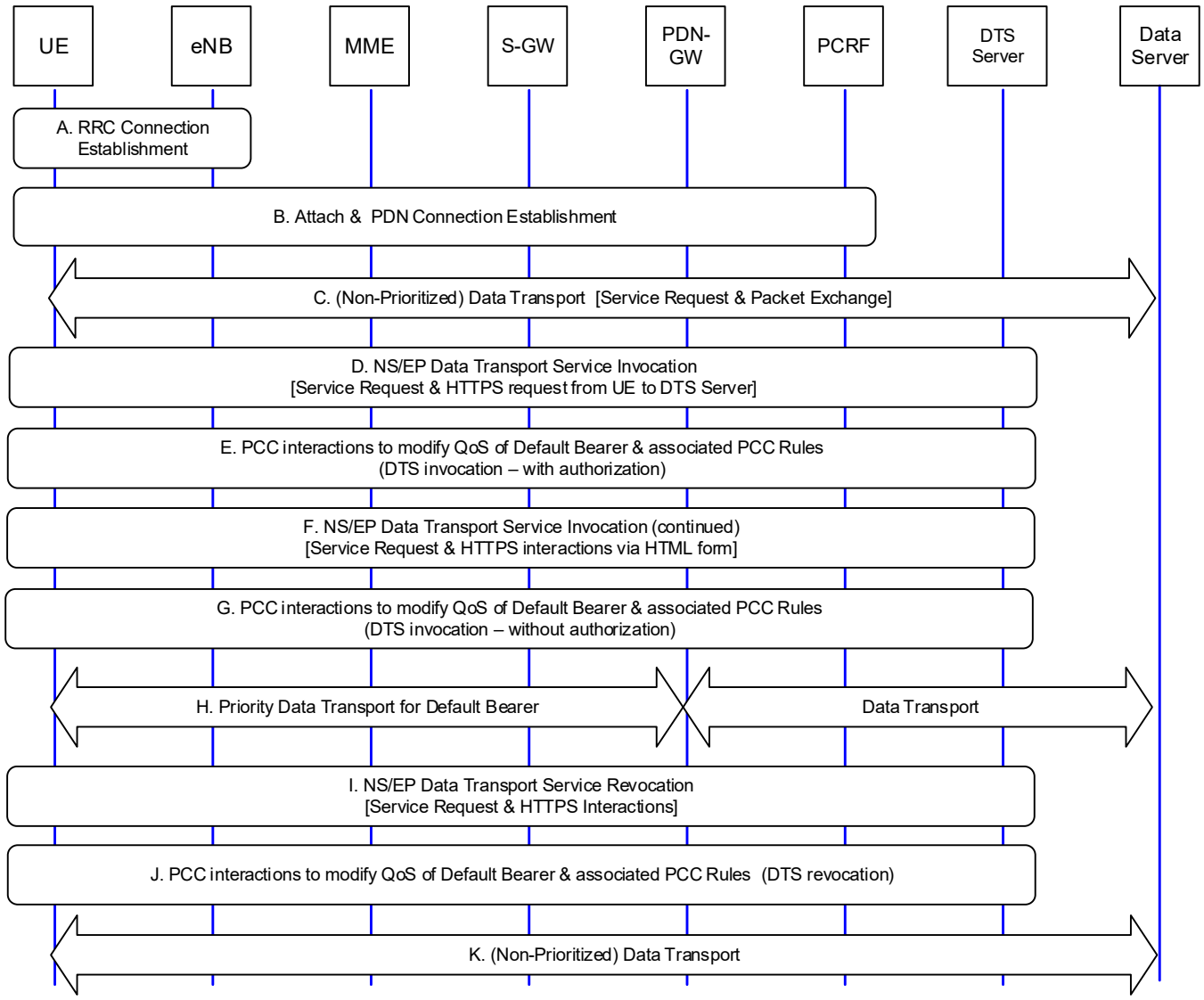

Figure 6-1: Overview of NS/EP Data Transport Service Flow - use of Browser

In Figure 6-1, the Service User initially makes use of normal procedures to access information provided by a Data Server.

The first three sub-flows (labeled as A, B, and C) illustrate this basic functionality, prior to invocation of the NS/EP Data Transport Service. Assuming the use of a non-NS/EP-subscribed UE, no special priority treatments are applied during this processing. Special treatments for an NS/EP-subscribed UE are provided in the step details when applicable.

A. The UE first invokes procedures to establish a Radio Resource Control (RRC) Connection with an eNodeB. These procedures are briefly described in Clause 6.3.1. An NS/EP-subscribed UE receives special priority treatments within the Access Class Barring test, as described in ATIS-1000065 [Ref 12].

B. The UE invokes procedures to attach to the EPC, and establishes a Default Bearer that is used to transport the Service User's HTTP (and other non-GBR) data traffic via the default PDN. These procedures are described in Clause 6.3.2. For the NS/EP-subscribed UE, Advance Priority is applied at the time of Attach/PDN Connection Establishment.

C. Triggered by Service User activity, the UE's browser sends an IP packet to the lower layers to be transmitted to the EPC[1]. When instructed to do so by the eNodeB, the IP packet is transmitted to the EPC and routed to the Data Server.

For this use case, the Service User experiences poor data performance during the above interactions (in sub-flow C of Figure 6-1), and therefore the Service User invokes the NS/EP Data Transport Service to improve performance.

D. For this use case, the Service User uses a browser to invoke the NS/EP Data Transport Service. The Service User enters the URL for the NS/EP Data Transport Service, the UE establishes a Transmission Control Protocol (TCP) connection to the DTS Server, and the Service User interacts with the DTS Server to invoke the NS/EP Data Transport Service. Clause 6.3.4 illustrates HTTPS-based interactions for the invocation of the NS/EP Data Transport Service.

> NOTE: The DTS Server does not know at this time if the UE is an NS/EP-subscribed UE or a non-NS/EP-subscribed UE, and 3GPP supports no means to make this determination before the DTS Server contacts the PCRF. Therefore, the DTS Server first attempts to invoke the NS/EP Data Transport Service assuming it is an NS/EP-subscribed UE. If this fails, the DTS Server then attempts to invoke the NS/EP Data Transport Service assuming it is a non-NS/EP-subscribed UE.

E. The DTS Server sends a PCC request to the PCRF, including an indication that the PCRF should verify that the UE is authorized for the NS/EP Data Transport Service, as described in Clause 6.3.5.

   If the NS/EP Data Transport Service invocation request is authorized, the PCRF invokes PCC procedures that trigger modification of the Default Bearer (i.e., assignment of a particular QCI value for the Default Bearer), plus updates to any PCC rules that map to the Default Bearer.

   Upon successful or failed invocation of the NS/EP Data Transport Service, the DTS Server is informed. In the case of success, the user is informed, and processing continues as described in step H.

F. In the case of failed invocation of the NS/EP Data Transport Service, the Service User is required to enter NS/EP credentials as part of the HTTP interactions (e.g., via entry of NS/EP credentials into an HTML form, along with an indication of the request type [invocation or revocation]). The DTS Server uses these credentials to authorize the user, and provides feedback to the user concerning the status of this authorization.

G. Assuming the NS/EP Data Transport Service invocation request is authorized (e.g., via an NS/EP database to validate the NS/EP credentials), the DTS Server initiates PCC procedures to facilitate subsequent transport of that UE's non-GBR data packets exchanged over the Default Bearer (i.e., upgrades to the QCI and ARP values) between the UE and the PDN-GW, as described in Clause 6.3.5. The DTS Server invokes PCC procedures that trigger these QoS upgrades of the Default Bearer, plus updates to any PCC rules that map to the Default Bearer, without requesting the PCRF to verify that the UE is authorized for the NS/EP Data Transport Service. Upon successful or failed invocation of the NS/EP Data Transport Service, the DTS Server is informed, and notifies the user of this event.

H. After the NS/EP Data Transport Service is successfully invoked, the corresponding priority treatment is applied to facilitate subsequent transport of that UE's non-GBR data packets over the Default Bearer between the UE and the PDN-GW. Priority transport can also be enabled within the Service Provider's

[1] If the UE is RRC-CONNECTED, the packet is immediately queued for transmission under control of the eNodeB scheduler. If on the other hand, the UE is RRC-IDLE, the UE invokes Service Request procedures to transition to RRC-CONNECTED. When instructed to do so by the eNodeB, the IP packet is transmitted to the EPC and routed to the Data Server. Note that this same clarification applies elsewhere in this clause, and in Clause 6.2.2.

network (e.g., via the use of a special DSCP marking).

I. When the need for priority communications ends, the Service User uses their browser to revoke the NS/EP Data Transport Service, in a manner similar to that described in step D. Clause 6.3.6 describes HTTPS-based interactions for revocation of the NS/EP Data Transport Service.

NOTE: Various methods (either explicit or implicit) could be used for revocation of the NS/EP Data Transport Service, as discussed in Clause 7.1.11.

J. When the DTS Server receives the NS/EP Data Transport Service revocation request from the UE, the DTS Server initiates PCC procedures to trigger any associated QoS downgrades of the Default Bearer, plus corresponding modifications as applied to any PCC rules that were mapped to the Default Bearer. Upon successful or failed revocation of the NS/EP Data Transport Service, the DTS Server is informed, and notifies the user of this event. These PCC interactions are described in Clause 6.3.6.

K. Upon revocation of the NS/EP Data Transport Service, the UE continues to interact with Data Server(s) via the Default Bearer, without the benefits of the NS/EP Data Transport Service priority treatment.

6.2.2 NS/EP Data Transport Service - use of special DTS Application by NS/EP-Subscribed UE

Figure 6-2 provides a high-level view of processing related to the NS/EP Data Transport Service, as applicable to an NS/EP subscriber. In this use case, the NS/EP subscriber is assumed to use a special DTS application that is installed on their UE.

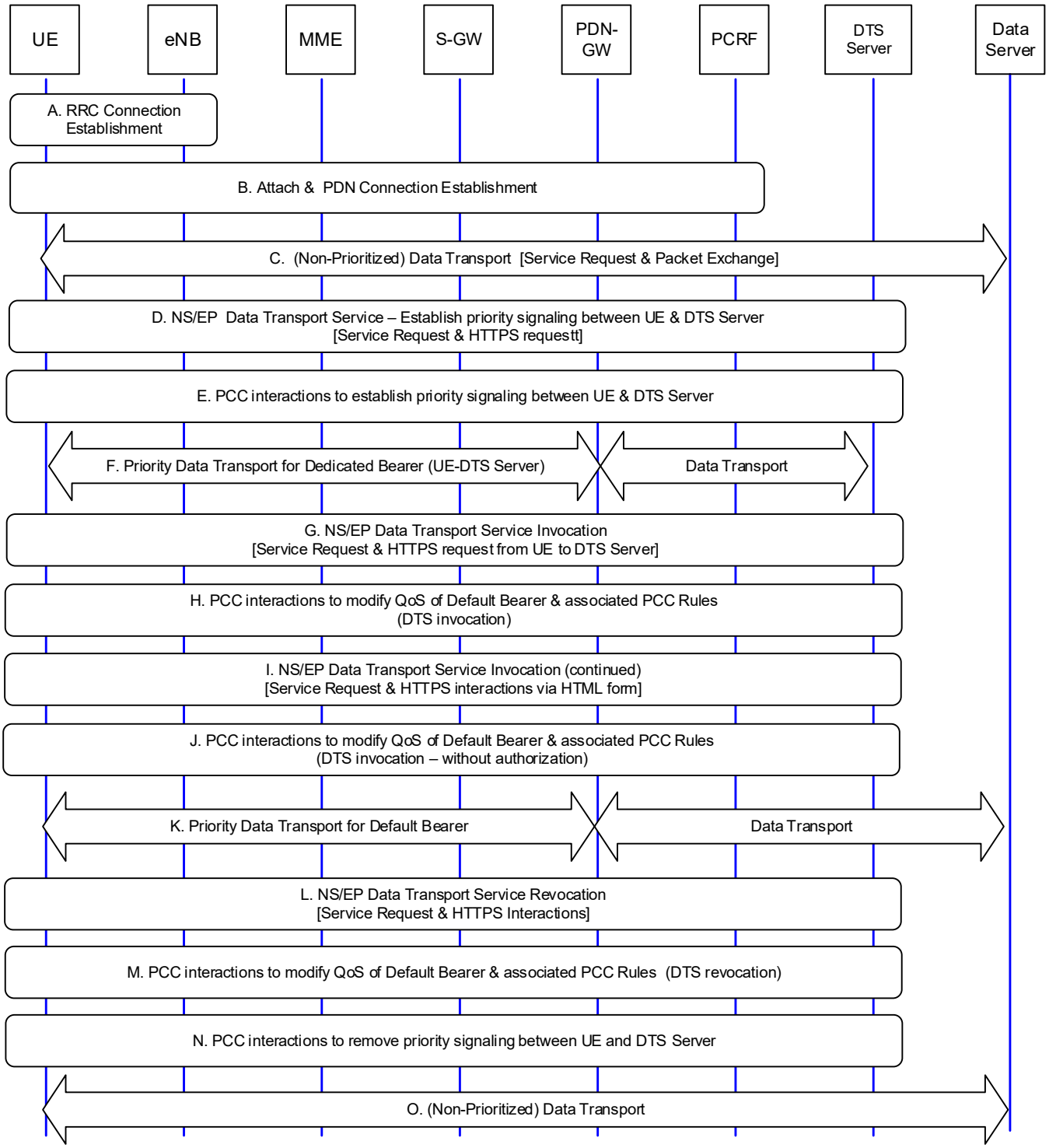

Figure 6-2: Overview of NS/EP Data Transport Service Flow - use of special DTS application by NS/EP-Subscribed UE

In Figure 6-2, the Service User initially makes use of normal procedures to access information provided by a Data Server. The first three sub-flows (labeled as A, B, and C) are identical to the steps described in Figure 6-1.

For this use case, the Service User experiences poor data performance during the above interactions (in sub-flow C of Figure 6-2) and therefore the Service User prepares to invoke the NS/EP Data Transport Service to improve performance. This use case assumes the Service User opens a special DTS application that has previously been installed on their NS/EP-subscribed UE to facilitate the invocation of the NS/EP Data Transport Service. This DTS

application functionality may include the ability to request the establishment of an AF Signalling Flow for priority signalling between the UE and the target DTS Server (e.g., at the time the DTS application is activated (opened) by the Service User, prior to the invocation of the NS/EP Data Transport Service), as discussed in steps D, E and F below.

NOTE: Various alternatives for establishing an AF Signalling Flow for this purpose are discussed further in Clause 7.1.2.

D. When the Service User activates the special DTS application (e.g., by clicking on the application's icon on their UE), the DTS application generates a signalling packet destined for the DTS Server, and sends that signalling packet to the lower layers to be transmitted via the EPC towards the DTS Server.

E. The DTS Server initiates PCC functionality, used to establish an AF Signalling Flow for the subsequent exchange of priority signalling between the UE and the DTS Server. The PCRF authorizes the request and establishes an AF Signalling Flow with appropriate QoS characteristics. The corresponding call flow is provided in Clause 6.3.3.

NOTE: The DTS Server needs to obtain sufficient information to allow it to initiate PCC interactions with the proper PCRF. Clause 7.1.7 discusses the mechanism used by the DTS Server to direct a PCC request towards the appropriate PCRF.

F. Assuming the AF Signalling Flow is established successfully, this may result in the establishment of a Dedicated Bearer for priority data transport between the UE and the PDN-GW, for the exchange of signalling messages between the UE and the DTS Server, as illustrated in sub-flow F of Figure 6-2.

G. When the Service User decides to invoke the NS/EP Data Transport Service (e.g., by clicking an invocation button on the DTS application), the DTS application generates an NS/EP Data Transport Service invocation request that is sent from the UE to the DTS Server via the Dedicated Bearer (as established in step E above) or alternatively via the Default Bearer as established in step B (if a Dedicated Bearer was not previously established). Clause 6.3.4 illustrates an example using HTTPS-based interactions for the invocation of the NS/EP Data Transport Service.

H. When the DTS Server receives the NS/EP Data Transport Service invocation request from the UE, the DTS Server sends a PCC request to the PCRF, including an indication of whether the PCRF should verify that the UE is authorized for NS/EP Data Transport Service.

NOTE: Various mechanisms can be used to determine whether the Service User is authorized as an NS/EP subscriber, as described in Clause 7.1.4. If the UE was previously authorized when an AF Signalling Flow was established (in step E above), then no further PCRF authorization is needed.

If the NS/EP Data Transport Service invocation request is authorized, the PCRF invokes PCC procedures that trigger modification of the Default Bearer (i.e., assignment of a particular QCI value for the Default Bearer), plus updates to any PCC rules that map to the Default Bearer.

Upon successful or failed invocation of the NS/EP Data Transport Service, the DTS Server is informed. In the case of success, the user is informed and processing continues as described in step K.

Steps I through M of Figure 6-2 are identical to the case of activation by a browser, as described by steps F through J of Figure 6-1.

N. When the Service User closes the special DTS application, the DTS application initiates actions to remove the AF Signalling Flow, as previously established in sub-flow E of Figure 6-2 for the exchange of priority signalling between the UE and the DTS Server. The DTS Server initiates PCC functionality, used to request the removal of the AF Signalling Flow. The corresponding call flow is illustrated in Clause 6.3.7.

O. Upon revocation of the NS/EP Data Transport Service, the UE continues to interact with Data Server(s) via the Default Bearer, without the benefits of the NS/EP Data Transport Service priority treatment.

6.3 Sub-Flow Descriptions

This clause provides detailed descriptions for the sub-flows as introduced in Clause 6.2 and identifies potential gaps or issues in the NS/EP processing, based on analysis of related standards. These aspects have been addressed in 3GPP Release 17.

- Clause 6.3.1 describes procedures to establish an RRC Connection with an eNodeB.
- Clause 6.3.2 describes procedures to attach to the EPC. It also describes the establishment of a PDN connection, including a Default Bearer and zero or more Dedicated Bearers.
- Clause 6.3.3 describes PCC procedures to establish priority treatment for transport of signalling packets between the UE and the DTS Server, in order to facilitate the necessary exchange of messages between the UE and the DTS Server.
- Clause 6.3.4 describes HTTPS-based procedures to invoke the NS/EP Data Transport Service.
- Clause 6.3.5 describes PCC procedures to establish priority treatment for transport of the IP packets, upon successful invocation of the NS/EP Data Transport Service.
- Clause 6.3.6 describes HTTPS-based procedures to revoke the NS/EP Data Transport Service.
- Clause 6.3.7 describes PCC procedures to remove the AF Signalling Flow that was previously established for priority signalling between the UE and the DTS Server.

6.3.1 RRC Connection Establishment

Prior to the transmission of Non-Access Stratum (NAS) messages in support of Mobility Management and Session Management, and the transmission of Application Layer data from the UE, or the delivery of Application Layer data to the UE, a UE must first establish an RRC Connection with an eNodeB.

The establishment of an RRC Connection requires Layer 1 and 2 procedures – involving the Physical, Medium Access Control (MAC), and RRC Layers of the Uu Interface. The eNodeB broadcasts information to selectively bar UEs from gaining access to the network (radio resources) during network congestion.

The RRC Connection Establishment mechanisms include the ability to prioritize RRC requests from an NS/EP-subscribed UE.

- Access Class Barring
  An eNodeB broadcasts information to support the Access Class Barring capability in SIB2 (System Information Block 2). NS/EP-subscribed UEs are statically provisioned with Access Class Value 14 (AC14) in the USIM. The Service Provider provides AC14 prioritized access to radio resources during times of network congestion.
- RRC Connection Establishment
  The RRC Connection Establishment prioritizes RRC requests from an NS/EP-subscribed UE. NS/EP-subscribed UEs mark their requests by setting the Establishment Cause to the “highPriorityAccess” value. This allows the eNodeB to apply priority in the decision to allocate signalling resources (specifically, an SRB1) for subsequent RRC and NAS messages. This also allows certain classes of traffic to be throttled by the eNodeB, thereby providing benefits for all UEs (for traffic not belonging to those targeted traffic classes). The Overload Control action is used by the Mobility Management Entity (MME) to signal the eNodeB to reject RRC Connection Requests that are for specific Establishment Causes.

Illustrative flows for these procedures are provided in Clause 6.3.1.1 of ATIS-1000049 [Ref 11].

6.3.2 Attach and PDN Connection Establishment

The Attach procedure allows a UE to register with the EPC to receive services that require registration. As part of the Attach procedure, prior to Release 13, the UE must establish IP connectivity to a PDN. Beginning in Release 13, the UE and MME may operate as EMM-Registered without PDN Connectivity, in which case an IP connection to a

PDN is not established at the time of Attach, but instead, when needed at a later time. PDN Connectivity includes an associated Default Bearer that remains established for the lifetime of the PDN connection.

> NOTE: The UE may establish PDN Connectivity with additional PDNs, e.g., to connect to the IMS Core Network. The UE is assigned a different IP address for each PDN connection. Each PDN connection will include an associated Default Bearer, and may involve the establishment of zero or more Dedicated Bearers. The establishment of multiple PDN connections is not pertinent to the NS/EP Data Transport Service functionality, as assumed in this TR, as the priority upgrade is only applied for the Default Bearer associated with an indicated IP address.

Advance Priority for an NS/EP-subscribed UE, as described in ATIS-1000065 [Ref 12], provides subscription-based QoS parameters for the Default Bearer within the EPS. Clause 5.2.4 of ATIS-1000065 [Ref 12] specifies E-UTRAN Attach procedures associated with the concepts of Advance Priority-SPR and Advance Priority-HSS. Both assume that a single PDN Connection is established with a Default Bearer to support Best Effort data traffic. Clause 6.3.2.1 illustrates the use of Advance Priority-HSS.

For a UE that is not subscribed to NS/EP, similar procedures apply, with the exception that Advance Priority is not provided.

Clause 6.3.2.2 extends the material in Clause 6.3.2.1 by also illustrating the establishment of a Dedicated Bearer at the time of Attach. This procedure can be applied to support the establishment of a priority Dedicated Bearer from an NS/EP-subscribed UE to the PDN-GW towards the DTS Server, to carry signalling traffic between the UE and the DTS Server for supporting the NS/EP Data Transport Service.

The following subclauses describe aspects of the Attach and PDN Connection Establishment call flows that are pertinent to NS/EP. More complete descriptions of these Attach and PDN Connection Establishment call flows are provided in Clause 6.3.1.2 of ATIS-1000049 [Ref 11].

6.3.2.1 Advance Priority-HSS at the time of Attach / PDN Connection Establishment

This clause describes the establishment of PDN Connectivity with the Default PDN at the time of Attach when only the Default Bearer is established. Advance Priority-HSS is assumed, as described in ATIS-1000065 [Ref 12] Clause 5.2.4.2.

Figure 6-3 illustrates the sequence of messages used to support the Attach and PDN Connection Establishment procedure, including the establishment of a Default Bearer.

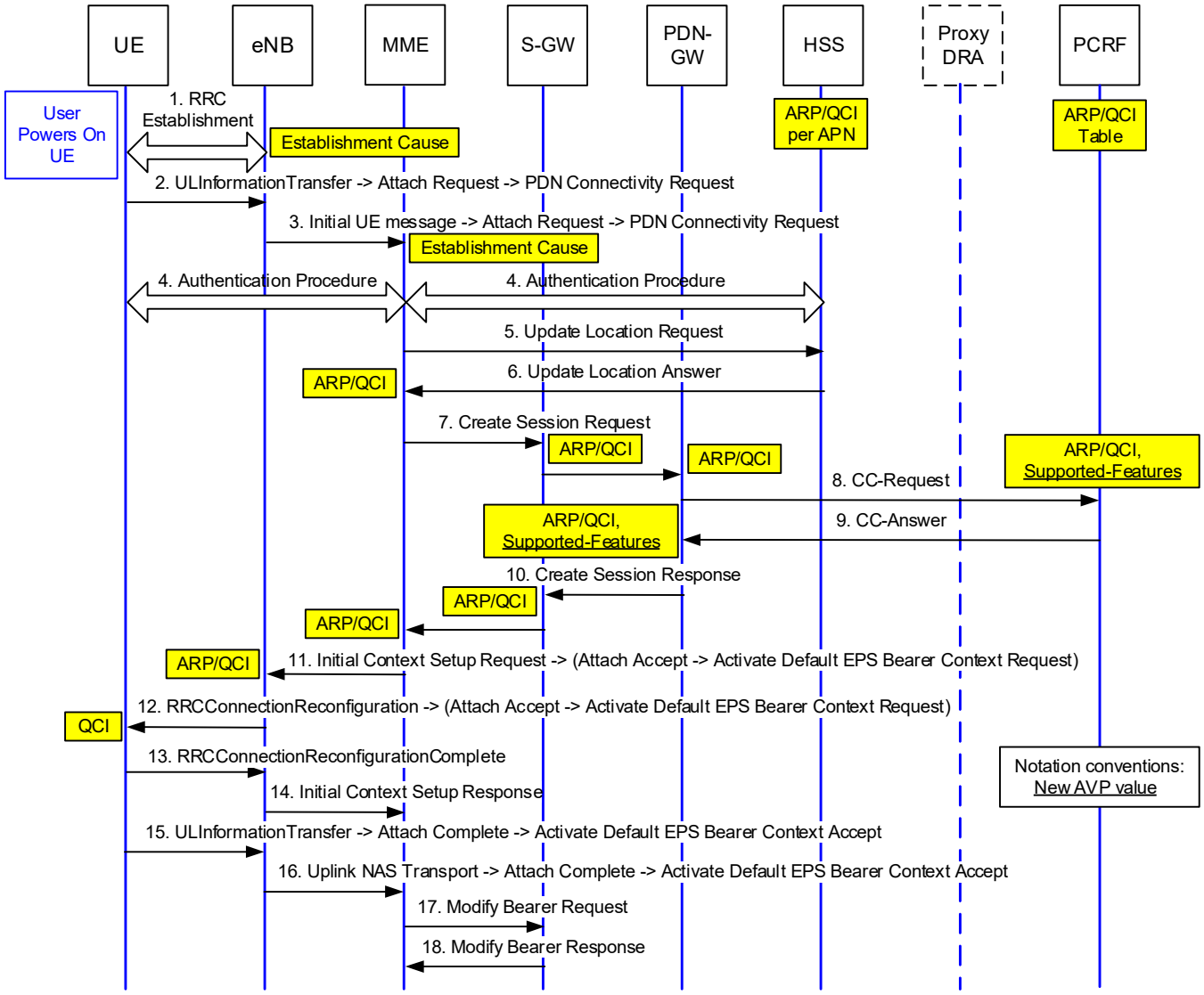

Figure 6-3: E-UTRAN Attach and PDN Connection Establishment Procedure (with GTP-based S5/S8) Illustrating Advance Priority-HSS

Following RRC Connection Establishment, the “highPriorityAccess” Establishment Cause is set by the UE and sent to the MME in the **Initial UE Message**, as illustrated in step 3 of Figure 6-3. This results in priority handling of the Attach procedures as described in ATIS-1000065 [Ref 12].

The **PDN Connectivity Request** message is sent by the UE to initiate establishment of a PDN connection. The APN for the PDN connection may be configured in the UE or may be stored in the Home Subscriber Server profile (as the UE’s Default APN). For the scenario illustrated in Figure 6-3, the APN is determined based on the UE’s Default APN, as stored in the HSS profile. The list of all APNs that the UE is permitted to access, an indication of which APN is the Default APN, and the EPS Subscribed QoS profile for each permitted APN are returned from the HSS to the MME in the **Update Location Answer** command in step 6. The EPS-Subscribed-QoS-Profile AVP, contained within each APN-Configuration AVP of the APN-Configuration-Profile AVP within the Subscription-Data AVP, contains the QCI and ARP information, as described in Clause 7.3.37 of TS 29.272 [Ref 8]. If Advance Priority-HSS is enabled, the ARP Priority Level of the Default Bearer for this PDN is set to the highest priority (lowest numerical value) Priority Level from the set allocated by the Service Provider for NS/EP use. The **Update Location Answer** command may also include the MPS-Priority AVP in the Subscription-Data AVP. The MPS-Priority AVP described in Clause 7.3.131 of TS 29.272 [Ref 8] contains an MPS-EPS-Priority bit that indicates whether the UE is subscribed to Multimedia Priority Service (MPS) in the EPS domain.

The MME sends a **Create Session Request** message to the S-GW, and the S-GW sends a **Create Session Request** message to the PDN-GW. These messages, as illustrated in step 7 of Figure 6-3 and described in Clause 7.2.1 of TS 29.274 [Ref 9], include the subscribed QoS and the APN information. The PDN-GW allocates an IP address to the UE (unless the UE has a static IP address that was stored in the HSS) and sends a Diameter **CC-Request** command towards the PCRF (in step 8).

NOTE: Figure 6-3 includes the DRA in a dashed box, plus a dashed line extending vertically below it. This notation is used to designate the optional use of a DRA, operating in Proxy mode, between the PDN-GW and the PCRF. Other configurations are possible. See further discussion in Clause 7.1.7.

The Diameter **CC-Request** command includes the Default-EPS-Bearer-QoS AVP which contains the subscribed QoS (as received by the PDN-GW in the **Create Session Request** message) and the Supported-Features AVP. The Supported-Features AVP informs the PCRF about the required and optional features that the PDN-GW supports, including the "MPSforDTS" feature number. The MPSforDTS feature on Gx permits the PDN-GW to report to the PCRF when resources for the NS/EP Data Transport Service invocation/revocation are successfully allocated, via use of the “SUCCESSFUL_QOS_UPDATE” Event-Trigger AVP value. The Diameter **CC-Request** command also includes the Subscription-Id, Framed-IP-Address or Framed-Ipv6-Prefix, and Called-Station-Id AVPs (as specified in Clauses 4.5.1 and 5.6.2 of TS 29.212 [Ref 5]) to facilitate the DRA's selection of a particular PCRF, and the use of that same PCRF when the NS/EP Data Transport Service is subsequently invoked by the DTS Server.

NOTE: The above information facilitates the DRA's selection of a particular PCRF when the NS/EP Data Transport Service is subsequently invoked. As specified in Clause 7.3.2 of TS 29.213 [Ref 6], the DRA finds the correct PCRF by matching one or more of the following optional parameters received in the subsequent Diameter **AA-Request** command with the corresponding information stored in the DRA: the user identity, IPv4 address or IPv6 address/prefix, and APN. See further discussion in Clause 7.1.7.

The Diameter **CC-Answer** command, sent by the PCRF to the PDN-GW in step 9 of Figure 6-3, contains the Supported-Features AVP, which indicates the set of features that the PCRF has in common with the PDN-GW, and that the PCRF supports within the Diameter session. If the PCRF determines that the QoS of the Default Bearer should be changed from that specified in the Diameter **CC-Request** command, the Diameter **CC-Answer** command includes the QoS description in the Default-EPS-Bearer-QoS AVP. The NS/EP ARP/QCI assigned to the Default Bearer of an NS/EP-subscribed UE is transferred from the PDN-GW to the S-GW, and then to the MME, in the **Create Session Response** message (step 10).

NOTE: In addition to an “upgraded ARP,” the PCRF could also provide an “upgraded QCI” for the Default Bearer. This can support an “always on” deployment of the NS/EP Data Transport Service.

The NS/EP ARP/QCI assigned to the Default Bearer of an NS/EP-subscribed UE is transferred from the MME to the eNodeB in the E-RAB Level QoS Parameters within the **Initial Context Setup Request** message over the S1 Interface (in step 11). The NS/EP QCI assigned to the Default Bearer of an NS/EP-subscribed UE is transferred from the MME to the UE (via the eNodeB) in the **Activate Default EPS Bearer Context Request** within the **Attach Accept** (within the **Initial Context Setup Request** message over the S1 Interface and within the **RRC Connection Reconfiguration** message over the Uu Interface).

6.3.2.2 Advance Priority with an Additional Dedicated Bearer

This clause extends the material in Clause 6.3.2.1 by also illustrating the establishment of a Dedicated Bearer at the time of Attach.

NOTE: The establishment of a Dedicated Bearer (within the same PDN connection as established at the time of Attach) can be used to support priority signalling between the UE and the DTS Server. Alternatively, priority signalling between the UE and the DTS Server can be established when the user activates (opens) a DTS application on their UE (as described in Clause 6.3.3), or when the user invokes NS/EP Data Transport Service (as described in Clause 6.3.4). These mechanisms are discussed further in Clause 7.1.2.

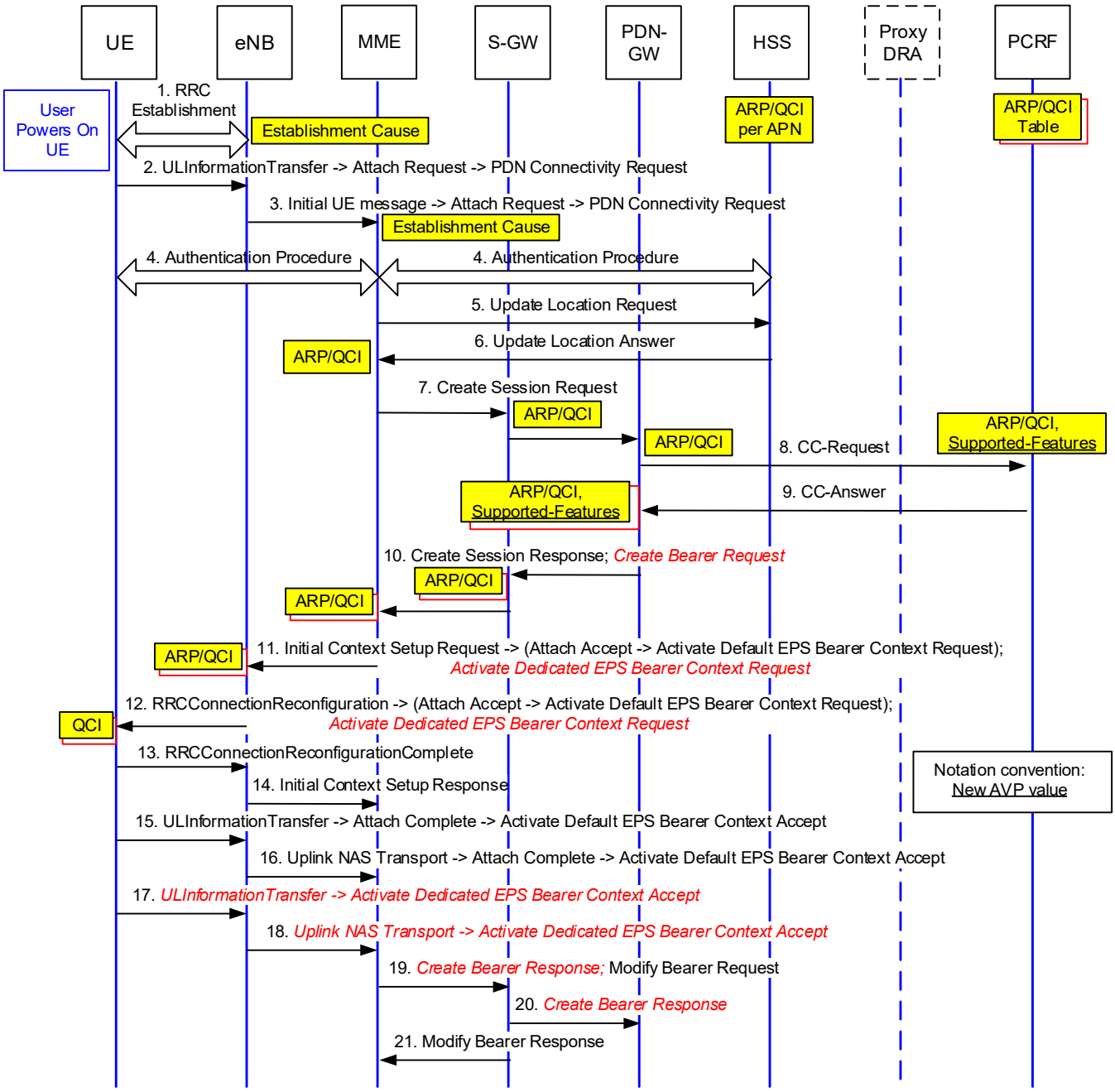

Figure 6-4: E-UTRAN Attach and PDN Connection Establishment Procedure (with GTP-based S5/S8) Illustrating Advance Priority-HSS, including Dedicated Bearer

Figure 6-4 illustrates the sequence of messages (differentiated from those depicted in Figure 6-3 via red italics font) used to establish a Dedicated Bearer (with appropriate ARP and QCI values) at the time of Attach / PDN Connection Establishment, in addition to the Default Bearer (assigned an appropriate ARP value).

NOTE: While Figure 6-4 assumes Advance Priority-HSS, a similar solution can also apply to Advance Priority-SPR.

One manifestation of this processing involves the establishment of a priority Dedicated Bearer from an NS/EP-subscribed UE to the PDN-GW towards the DTS Server, to carry signalling traffic between the UE and the DTS Server for supporting the NS/EP Data Transport Service. The Dedicated Bearer between the UE and the PDN-GW towards the DTS Server is associated with the same PDN connection as the Default Bearer portrayed in this figure.

NOTE: Since the EPS Subscribed QoS profile received in the Diameter **Update-Location-Answer** command from the HSS (in step 6 of Figure 6-4) does not include any information concerning the QCI and ARP for the Dedicated Bearer(s), the QCI and ARP for the Dedicated Bearer(s) must be derived in some other manner. This requires extensions as discussed in Clause 7.1.2.

For cases where the PCRF determines the need to establish an AF signalling flow between the UE and the DTS Server, the PCRF installs the corresponding dynamic PCC rules by sending a Diameter **CC-Answer** command to the PDN-GW, as illustrated in step 9 of Figure 6-4. The PCRF includes the Charging-Rule-Install AVP including the Charging-Rule-Definition AVP. Applying procedures based on Clause 4.4.12 of TS 29.214 [Ref 7], the Charging-Rule-Definition AVP identifies the signalling flow between the UE and the DTS Server in the Flow-Information AVP, and includes the QoS-Information AVP that defines the authorized QoS information, containing the Allocation-Retention-Priority and the QoS-Class-Identifier AVPs. The AF-Signalling-Protocol AVP in the Charging-Rule-Definition AVP is omitted or set to “NO_INFORMATION” to indicate that signalling with the DTS Server is not based on SIP.

NOTE: To populate the Flow-Information AVP within the Charging-Rule-Definition AVP, the PCRF requires the IP addresses of the UE and the DTS Server, to identify the signalling flow between the UE and the DTS Server. Given that communications have not yet been established between the DTS Server and the PCRF at the time of Attach / PDN Connection Establishment, the PCRF must determine the IP address of the DTS Server. See Clause 7.1.2.

To establish a Dedicated Bearer at the time of Attach, the PDN-GW sends a **Create Bearer Request** to the S-GW in step 10 of Figure 6-4. The PDN-GW marks the **Create Session Response** with the “P” flag set to “1” to indicate that a second GTPv2 message (i.e., the **Create Bearer Request** message, as defined in Clause 7.2.3 of TS 29.274 [Ref 9]) will follow in the same User Datagram Protocol (UDP) message. The ARP/QCI assigned to the Dedicated Bearer is transferred from the PDN-GW to the S-GW, and then to the MME, in the **Create Bearer Request** message over the S5/S8 and S11 Interfaces respectively. The NS/EP ARP/QCI assigned to the Dedicated Bearer is transferred from the MME to the eNodeB in the E-RAB Level QoS Parameters in the **Initial Context Setup Request** message over the S1 Interface in step 11. The MME also includes the **Activate Dedicated EPS Bearer Context Request**, as defined in Clause 8.3.3 of TS 24.301 [Ref 4], in the S1-AP **Initial Context Setup Request** message. The **Activate Dedicated EPS Bearer Context Request** message initiates the Dedicated EPS Bearer Activation procedure defined in Clause 6.4.2 of TS 24.301 [Ref 4]. The **Activate Dedicated EPS Bearer Context Request** includes the EPS QoS parameter, defined in Clause 9.9.4.3 of TS 24.301 [Ref 4], which contains the QoS parameters for each Dedicated Bearer. The **Activate Dedicated EPS Bearer Context Request** is also transported over the Uu Interface in the RRC **RRCConnectionReconfiguration** message in step 12 of Figure 6-4, as specified in Clauses 5.3.5.3 and 6.2.2 of TS 36.331 [Ref 10].

NOTE: Clause 7.1.12 discusses the assignment of QCI value(s) for NS/EP Data Transport Service.

6.3.3 Establishment of AF Signalling Flow between UE and DTS Server

This clause illustrates the establishment of an AF Signalling Flow for priority signalling between the UE and the DTS Server prior to the subsequent invocation of the NS/EP Data Transport Service. If the NS/EP-subscribed UE is configured with a special DTS application to facilitate the invocation of the NS/EP Data Transport Service, this flow can be initiated when the user opens that DTS application (e.g., by clicking on that special application’s icon on their UE), allowing the UE's DTS application to initiate HTTP signalling with the DTS Server, in order to allow the DTS Server to initiate the establishment of an AF Signalling Flow for priority signalling between the UE and the DTS Server. This is only one possible deployment scenario. Alternatively, an AF Signalling Flow for priority signalling between the UE and the DTS Server could be established at a later time when the UE invokes the NS/EP Data Transport Service. This procedure is based on Clause 4.4.12 of TS 29.214 [Ref 7].

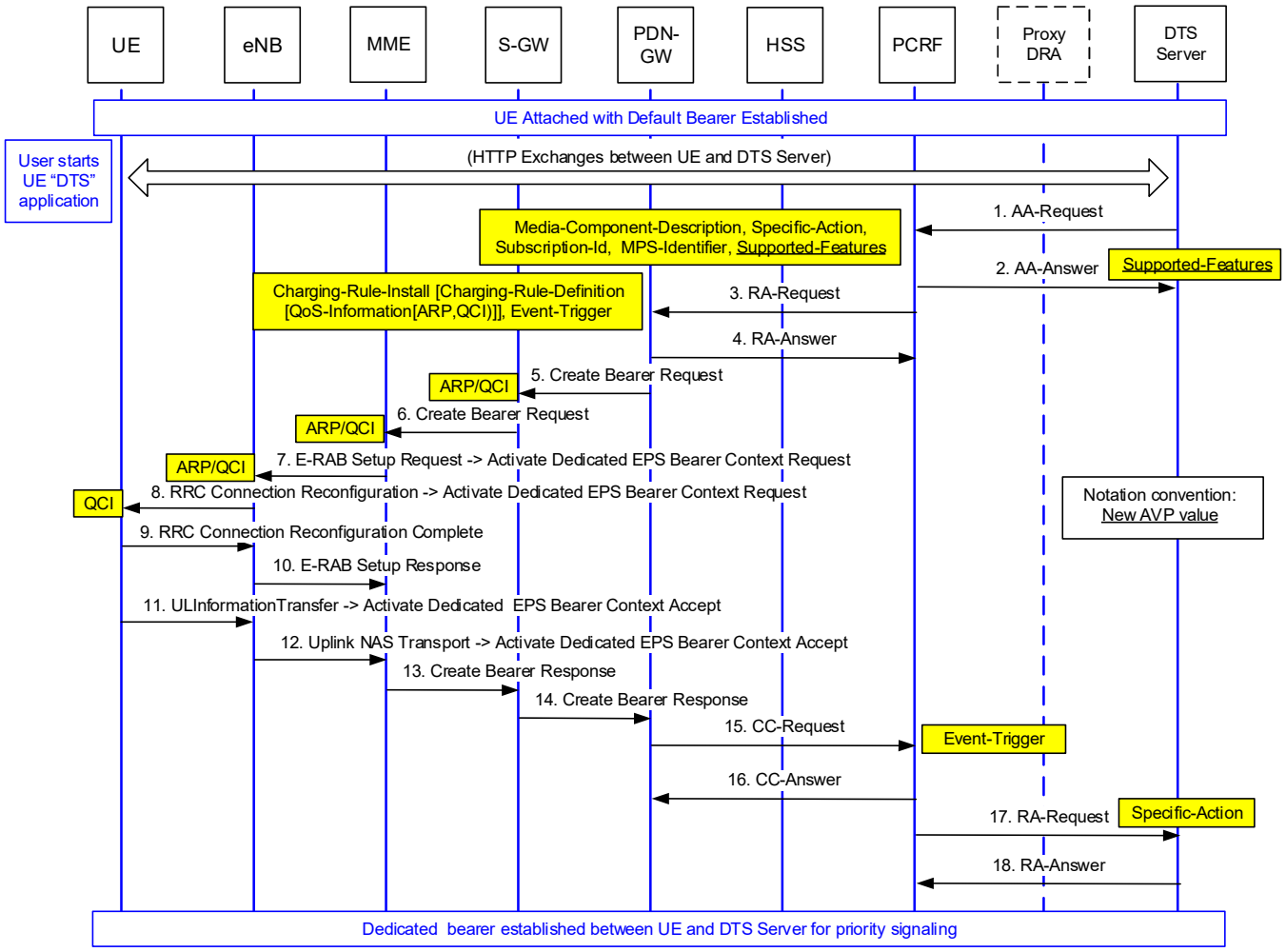

Figure 6-5: Establishment of AF Signalling Flow for UE to DTS Server Communications

Figure 6-5 illustrates the establishment of an AF Signalling Flow (with appropriate ARP and QCI values) for priority signalling between the UE and the DTS Server, at the time the DTS Server is initially contacted by the UE, but prior to the invocation of NS/EP Data Transport Service (e.g., triggered by Service User activation of a special DTS application on an NS/EP-subscribed UE). Information concerning the target DTS Server (e.g., a Service Provider-specific URL or specific IP address(es)) is configured for the special DTS application, allowing the UE to establish a connection to an appropriate DTS Server. The DTS application establishes communications with the DTS Server (e.g., via messages exchanged via the Default Bearer, as illustrated in Figure 6-6). For establishing communications with the DTS Server in a non-roaming scenario, this TR assumes that a valid UE IP address is received by the DTS Server in the source IP address of the initial message that it receives from the UE.

The DTS Server generates a Diameter **AA-Request** command to establish an AF Signalling Flow for priority signalling between the UE and the DTS Server. To accomplish this, the DTS Server sends the local UE IP address and the Designated APN towards the PCRF (via an intermediate DRA) in the Framed-IP-Address or Framed-Ipv6-Prefix and Called-Station-Id AVPs of the Diameter **AA-Request** command, in order to facilitate the DRA's identification of the correct PCRF. The Media-Component-Description AVP includes the Media-Sub-Component AVP representing the AF signalling IP flow. The Media-Sub-Component AVP representing the AF signalling IP flow contains the Flow-Description AVP set to the IP flow of the AF signalling. Additionally, the Media-Sub-Component AVP includes the Flow-Usage AVP set to the value "AF_SIGNALLING", the Flow-Status AVP is set to "ENABLED" and the AF-Signalling-Protocol AVP is omitted or set to “NO_INFORMATION”. The Supported-Features AVP informs the PCRF about the required and optional features that the DTS Server supports, including the "MPSforDTS" feature number. The MPS-Identifier AVP is included to indicate a request to apply priority treatment for the AF signalling between the UE and the DTS Server for the NS/EP Data Transport Service.

NOTE: The above procedures are discussed further in Clause 7.1.2.

Beginning in 3GPP Release 18, the DTS Server also includes the MPS-Action AVP in the Diameter **AA-Request** command, set to the value "AUTHORIZE_AND_ENABLE_MPS_FOR_AF_SIGNALLING". The DTS Server and PCRF indicate support for this new MPS-Action value via the inclusion of the "AuthorizationForMpsSignalling" feature number in the Supported-Features AVP.

NOTE: The new "AUTHORIZE_AND_ENABLE_MPS_FOR_AF_SIGNALLING" value is added to the MPS-Action AVP, as specified in TS 29.214 [Ref 7a] (Release 18). This value enhances the prior 3GPP Release 17 mechanism used to trigger the appropriate PCRF behavior as specified for the NS/EP Data Transport Service, by providing an explicit indication that the PCRF should authorize the UE for the NS/EP Data Transport Service prior to establishment of the AF Signalling Flow.

The Diameter **AA-Request** command can also request the subsequent reporting of successful processing, as illustrated in steps 15 through 18.

When the PCRF receives the **AA-Request** command, the PCRF retrieves the subscriber's MPS EPS Priority information from the SPR, as specified in TS 23.203 [Ref 2], to determine whether the subscription supports MPS. Assuming the UE is authorized for the NS/EP Data Transport Service, the PCRF responds to the DTS Server with a Diameter **AA-Answer** command. Assuming support for the "MPSforDTS" feature, the Supported-Features AVP includes the corresponding "MPSforDTS" feature number to indicate this feature is commonly supported by both the PCRF and the DTS Server. Receipt of the **AA-Answer** command by the DTS Server indicates the request in the associated **AA-Request** command was received and understood by the PCRF, but does not imply that all the requested actions were completed successfully.

NOTE: If the request is not authorized, the PCRF indicates in the **AA-Answer** command the cause for the rejection with the Experimental-Result-Code AVP set to the value "REQUESTED_SERVICE_NOT_AUTHORIZED".

When the PCRF receives the Diameter **AA-Request** command to establish an AF signalling flow between the UE and the DTS Server, the PCRF installs the corresponding dynamic PCC rules by sending a Diameter **RA-Request** command to the PDN-GW, as illustrated in step 3 of Figure 6-5. The PCRF includes the Charging-Rule-Install AVP including the Charging-Rule-Definition AVP. The Charging-Rule-Definition AVP identifies the signalling flow between the UE and the DTS Server in the Flow-Information AVP, and includes the QoS-Information AVP that defines the authorized QoS information, containing the Allocation-Retention-Priority and the QoS-Class-Identifier AVPs. The AF-Signalling-Protocol AVP in the Charging-Rule-Definition AVP is omitted or set to “NO_INFORMATION”.

NOTE: Clause 7.1.12 discusses the assignment of QCI value(s) for NS/EP Data Transport Service.

The PDN-GW responds to the PCRF with a Diameter **RA-Answer** command, which confirms the PDN-GW received and understood the associated **RA-Request** command. It does not imply that all requested actions were completed successfully by the EPC and the Radio Access Network (RAN).

The corresponding Bearer Establishment procedures, used to install appropriate PCC rules and to update the policy decision for the new Dedicated Bearer (i.e., steps 5 – 14 in Figure 6-5) are described in ATIS-1000065 [Ref 12] and are illustrated in Clause 6.3.1.6 of ATIS-1000049 [Ref 11]. The NS/EP ARP/QCI for the dedicated bearer are delivered to the eNodeB, and the NS/EP QCI for the dedicated bearer is delivered to the UE.

Steps 15 through 18 pertain to the potential notification event to the DTS Server, based on success or failure of the attempted establishment of the signalling bearer between the UE and the DTS Server. To trigger these procedures, the Diameter **AA-Request** command in step 1 may optionally include the Specific-Action AVP, with the value "INDICATION_OF_SUCCESSFUL_RESOURCES_ALLOCATION" to request notification when the PCRF has successfully acted upon the request. If this Specific-Action AVP value is received in the Diameter **AA-Request** command, the PCRF includes the Event-Trigger AVP with the value "SUCCESSFUL_RESOURCE_ALLOCATION" in the Diameter **RA-Request** command in step 3.

NOTE: As indicated in Clause 4.4.5 of TS 29.214 [Ref 7], the DTS Server may also subscribe to notifications of the status of the AF Signalling transmission path by including the Specific-Action AVP in the Diameter **AA-Request** command to request the subscription to "INDICATION_OF_LOSS_OF_BEARER" and/or "INDICATION_OF_RELEASE_OF_BEARER".

The PDN-GW includes the Event-Trigger AVP with the value "SUCCESSFUL_RESOURCE_ALLOCATION" in the Diameter **CC-Request** command in step 15 of Figure 6-5, to notify the PCRF of the successful completion of the requested actions, as previously requested by the Diameter **RA-Request** command as illustrated in step 3. The reception of this Event-Trigger AVP value in the Diameter **CC-Request** command triggers the PCRF (in step 17) to send the Diameter **RA-Request** command to the DTS Server, including the Specific-Action AVP with the "INDICATION_OF_SUCCESSFUL_RESOURCES_ALLOCATION" value.

6.3.4 HTTPS-based Invocation of the NS/EP Data Transport Service

This clause describes HTTPS-based invocation of the NS/EP Data Transport Service.

It is assumed that the UE is RRC-CONNECTED; if instead, the UE is RRC-IDLE, a Service Request procedure as described in ATIS-1000065 [Ref 12] and illustrated in Clause 6.3.1.4 of ATIS-1000049 [Ref 11] must first be completed to transition the UE from RRC-IDLE to RRC-CONNECTED and to reestablish EPS Bearers and IP connectivity with the EPC.

Figure 6-6 illustrates the sequence of messages used to support the HTTPS-based method of invocation for the NS/EP Data Transport Service. This figure illustrates the exchange of DNS, TCP, Secure Sockets Layer (SSL) / Transport Layer Security (TLS), Diameter, and HTTPS packets that are used to support HTTPS interactions between a UE and the DTS Server.

- When the Service User uses the UE's browser to enter the URL to invoke the NS/EP Data Transport Service, Figure 6-6 (step A) illustrates the exchange of a Domain Name System (DNS) query and response between the UE and a DNS Server (to translate the URL to the IP address of the DTS Server). See Clause 6.3.4.1.
- Using the IP address of the DTS Server, Figure 6-6 (step B) illustrates the establishment of a TCP connection between the UE and the DTS Server (see Clause 6.3.4.2) and (step C) the subsequent SSL/TLS handshake used to establish a secured connection between these entities (see Clause 6.3.4.3).
- Figure 6-6 (steps D1 through D3) also illustrates the optional establishment of an AF Signalling Flow for priority signalling between the UE and the DTS Server, as described in Clause 6.3.3. Clause 7.1.2 provides further analysis of this topic.
- Figure 6-6 (steps E1 through E6) illustrates the exchange of HTTPS messages between the UE and the DTS Server via the secured connection, as discussed in Clauses 6.3.4.4 and 6.3.4.5 for the cases with and without entry of NS/EP Credentials respectively.

NOTE: Figure 6-6 illustrates three potential points at which NS/EP authorization can be performed, depending upon the particular use case: [a] as an integrated function during the establishment of the AF Signalling Flow, as discussed in Clause 6.3.3; [b] as an integrated function during the invocation of NS/EP Data Transport Service, as discussed in Clause 6.3.5, or [c] using NS/EP credentials collected from a non-NS/EP-subscribed UE by the DTS Server, as discussed in Clause 6.3.4.5. These options are discussed further in Clause 7.1.4.

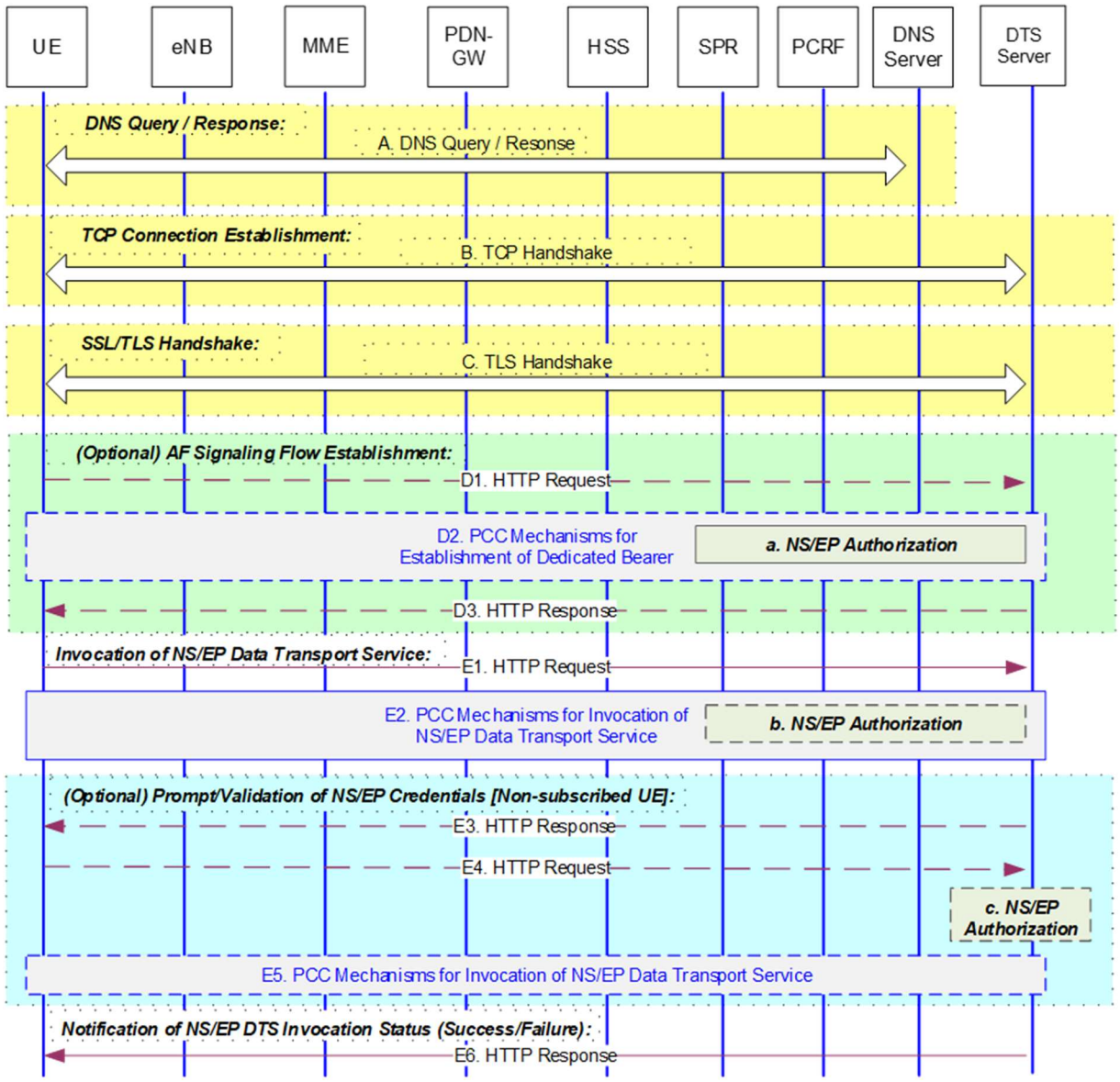

Figure 6-6: Illustrative Service Request Flow (for HTTPS-based Service Invocation)

6.3.4.1 DNS Query and Response

For the scenario illustrated in Figure 6-6, the Service User enters a Service Provider-specific URL to invoke the NS/EP Data Transport Service via the Service Provider's DTS Server. Before the UE establishes a TCP connection with the DTS Server, and subsequently exchanges HTTPS requests and responses with the DTS Server, the UE must determine the DTS Server's IP address. In this example, the UE generates a query to a DNS Server, to translate the URL to an IP address of the Service Provider's DTS Server. These steps can be eliminated, if the IP address of the DTS Server is entered directly in the URL bar of the web browser, or is provided by an NS/EP Application on an NS/EP-subscribed UE.

NOTE: Figure 6-6 assumes that the DNS query and response are transported via UDP. If TCP is instead used, a TCP connection is established between the UE and the DNS Server prior to exchanging the DNS query and response (between the UE and a DNS Server).

The increasing adoption of DNS over HTTPS (DoH) deployments (i.e., via modern web browsers) could potentially complicate the implementation of the NS/EP Data Transport Service. This TR assumes that the Service User is responsible for configuring / disabling DoH, as necessary to adhere to use of the Service Provider's designated DNS Server.

6.3.4.2 TCP Connection Establishment

Before a UE attempts to connect with the DTS Server, the UE establishes a TCP connection to the DTS Server, by initiating a handshake as illustrated in Figure 6-6. Upon completion of this handshake, both the UE and DTS Server have received an acknowledgment of the TCP connection, thus enabling full-duplex communication.

6.3.4.3 SSL/TLS Handshake

The TLS protocol provides privacy and data integrity between the UE and the DTS Server, in order to prevent eavesdropping and tampering. A SSL/TLS handshake is used to establish a secured connection for an HTTPS exchange between the UE and the DTS Server [Ref 14]. TLS uses symmetric cryptography to encrypt the data transmitted between the UE and the DTS Server, to ensure the connection is private (secure). The keys for this symmetric encryption are generated based on a shared secret that is negotiated via a TLS handshake in a secure and reliable manner. The UE and the DTS Server negotiate the details of which encryption algorithm and cryptographic keys to use prior to initiating the secure data transmission.

Applications can communicate either with or without TLS (or SSL). For the example use case as illustrated in Figure 6-6, the UE indicates the setup of a TLS connection to the DTS Server (e.g., via the use of port 443). The UE and the DTS Server then use the handshaking procedure to agree on various parameters used to establish the connection's security. The specific messages exchanged between the UE and the DTS Server during the TLS handshake vary based on the key exchange algorithm that is used and the supported cipher suites. The protocols use a handshake with an asymmetric cipher to establish not only cipher settings but also a session-specific shared key that enables encryption of further communication using a symmetric cipher. Upon completion of the SSL/TLS handshake, the secured connection begins. The UE and the DTS Server use the session keys to encrypt and decrypt the data they exchange and to validate the integrity of the data.

Upon completion of the SSL/TLS handshake, the UE and the DTS Server are able to exchange HTTPS messages using the secured connection, as discussed in the following clauses.

6.3.4.4 HTTP Message Exchange – without Subsequent Entry of NS/EP Credentials

The following material describes an example of DTS invocation without entry of NS/EP credentials. First, an optional AF Signalling Flow is established to support priority signalling between an NS/EP-subscribed UE and the DTS Server (depicted in steps D1 through D3), followed by a single HTTP request / response pair that supports the required interactions between the UE and the DTS Server:

E1. For the scenario illustrated in Figure 6-6, the **HTTP request** is sent from the UE to the DTS Server to request the invocation of the NS/EP Data Transport Service.

E2. The DTS Server initiates PCC interactions with the PCRF to invoke the NS/EP Data Transport Service. The DTS Server generates an Rx interface message to initiate the required actions, as described in Clause 6.3.5. In the PCC request, the DTS Server instructs the PCRF whether to verify that the UE is authorized for the NS/EP Data Transport Service.

> NOTE: The optional establishment of an AF Signalling Flow includes an NS/EP subscription check by the PCRF to authorize the UE (depicted as NS/EP Authorization option "a" in Figure 6-6). If this authorization was already completed (in step D2) prior to invocation of the NS/EP Data Transport Service, the DTS Server instructs the PCRF to invoke the NS/EP Data Transport Service without requesting further authorization of the UE in step E2. Otherwise, the DTS Server instructs the PCRF to authorize the UE as an integral part of the NS/EP Data Transport Service invocation procedures.

Assuming an appropriate event notification is reported from the PCRF to the DTS Server after successful invocation of the NS/EP Data Transport Service (as illustrated in step 15 of Figure 6-7), processing continues as indicated in step E6.

> NOTE: If the DTS Server is notified (in step E2) that the UE is not authorized for the NS/EP Data Transport Service, the DTS Server may optionally prompt the user to enter NS/EP credentials in order to treat the request in the same manner as applicable to a non-NS/EP-subscribed UE. This involves processing as illustrated in steps E3 through E5 of Figure 6-6, including authorization of the UE as depicted for NS/EP Authorization option "c". These procedures are described in Clause 6.3.4.5.

E6. Assuming successful invocation of the NS/EP Data Transport Service, the DTS Server notifies the Service User that the requested service has been invoked successfully.

6.3.4.5 HTTP Message Exchange – with Subsequent Entry of NS/EP Credentials

The Service User may use a browser to interact with the DTS Server. If the UE is not subscribed to NS/EP service and does not have access to a special DTS application, multiple HTTP request / response pairs can be used to accomplish the required UE interactions to enable the DTS Server to collect NS/EP credentials and other required information from the Service User, as described below.

E1. The UE's browser sends an **HTTP request**, containing the URL associated with the DTS Server, to request the invocation of the NS/EP Data Transport Service.

E2. The DTS Server may generate a PCC request for invocation of the NS/EP Data Transport Service, as described in Clause 6.3.4.4.

> NOTE: If the DTS Server needs to provide differentiated treatment for NS/EP-subscribed UEs vs non-NS/EP-subscribed UEs based on a common HTTP request, the DTS Server may generate a PCC request (as described in step E2). If the UE is authorized (as applicable for an NS/EP-subscribed UE), this results in the successful invocation of the NS/EP Data Transport Service, as described in Clause 6.3.4.4. If the DTS Server is instead notified that the UE is not authorized, the DTS Server assumes that the UE is not subscribed to NS/EP, and proceeds as described in step E3, below.

E3. The DTS Server sends an **HTTP response**, containing a message body that provides an HTML document used to prompt the Service User for NS/EP credentials (plus other information as described below in step E4). This HTML document provides a form, to present the Service User with a page that displays a number of user interface widgets, such as text fields and pulldown menus, along with a submit button.

E4. The Service User interacts with the widgets in some manner, e.g., by selecting whether DTS invocation or DTS revocation is desired, filling in any required NS/EP credentials, and then clicking the submit button. At this point, the UE's browser takes the current values of all the widgets, builds a string that carries their values, and constructs an **HTTP request** to the DTS Server.

The DTS Server accesses an NS/EP database to validate the NS/EP credentials received from the Service User, as depicted for NS/EP Authorization option "c" in Figure 6-6.

E5. Assuming the request is authorized, the DTS Server generates an Rx interface message to initiate the required PCC actions, as described in Clause 6.3.5.

E6. Assuming an appropriate event notification is reported from the PCRF to the DTS Server after successful invocation of the NS/EP Data Transport Service (as illustrated in step 15 of Figure 6-7), the DTS Server then sends an **HTTP response**, containing a message body that provides an HTML document that can be rendered and displayed to the Service User (to indicate that the requested service has been invoked successfully).

6.3.5 PCC Mechanisms for Invocation of the NS/EP Data Transport Service

This clause illustrates PCC procedures (triggered by the DTS Server) and associated bearer modification procedures associated with invocation of the NS/EP Data Transport Service. Figure 6-7 illustrates PCC procedures used to enable priority treatment for the transport of non-GBR data traffic via the Default Bearer, in conjunction with the successful invocation of the NS/EP Data Transport Service. This TR assumes that the HTTP invocation request, as described in Clauses 6.3.4.4 and 6.3.4.5, is sent from the UE to a DTS Server via the Designated PDN Connection, with the intent to upgrade the QoS of the Default Bearer for that same PDN connection, and to adjust PCC rules that are mapped to that Default Bearer. This is discussed further in Clause 7.1.6.

Steps 1 through 4 of Figure 6-7 illustrate the messages exchanged over the Rx interface [Ref 7] (between the DTS Server and the PCRF) and over the Gx interface [Ref 5] (between the PCRF and the PDN-GW).

Steps 5 through 12 of Figure 6-7 illustrate the invocation of EPS Bearer Modification procedures, used to enable priority treatment for the subsequent transport of non-GBR data traffic over the Default Bearer.

Steps 13 through 16 pertain to the notification event from the PDN-GW to the PCRF, and on to the DTS Server, based on success of the attempted invocation of the NS/EP Data Transport Service.

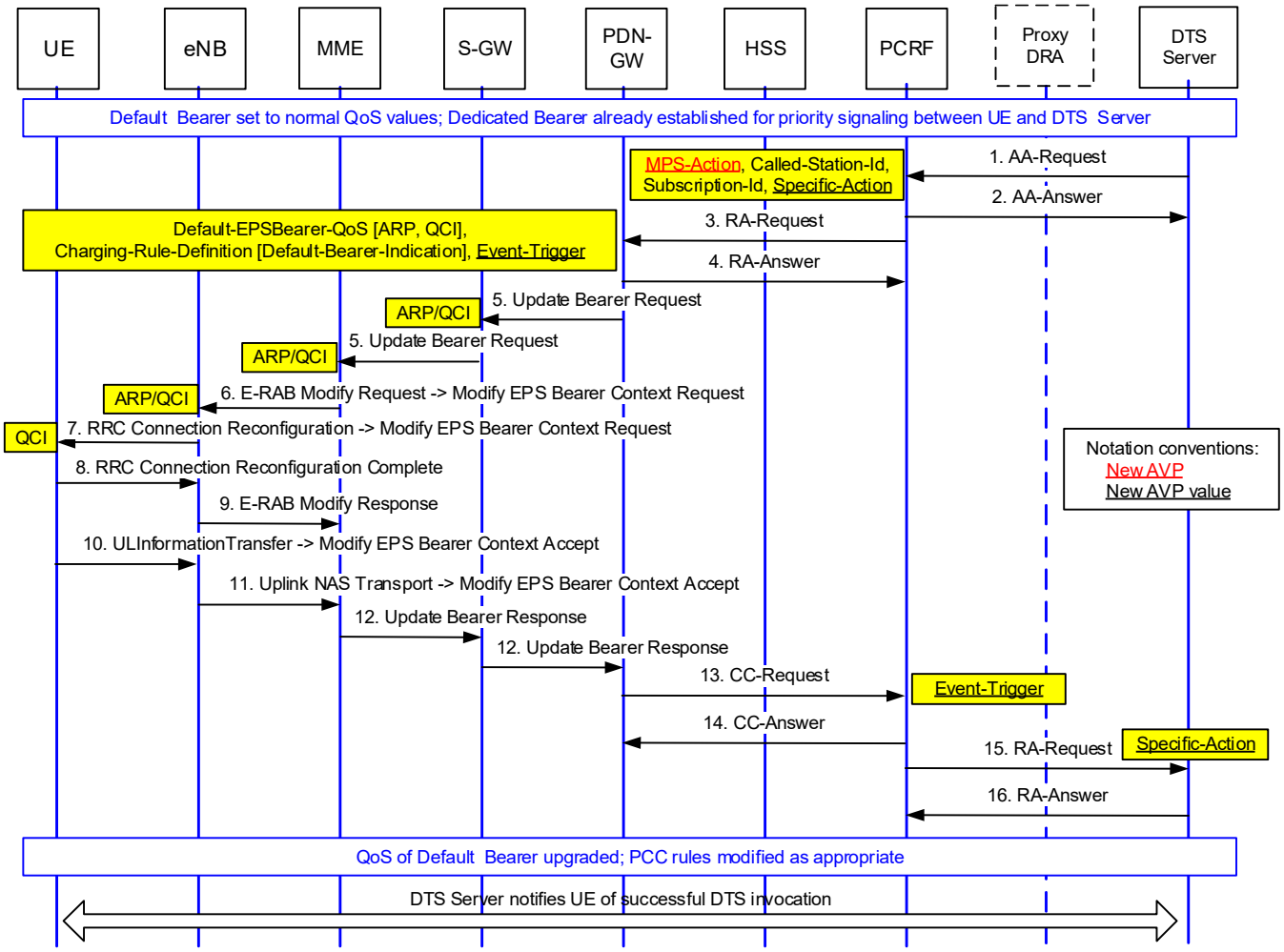

Figure 6-7: NS/EP Data Transport Service Invocation - PCC Interactions

This procedure assumes that an Rx session was established previously, to establish an AF Signalling Flow for priority signalling between the UE and the DTS Server, as described in Clause 6.3.3. In this case, the NS/EP Data Transport Service authorization was already performed by the PCRF at step 2 of Figure 6-5. Alternate procedures for authorizing the NS/EP Data Transport Service, as applicable to other use cases, are described in Clause 7.1.4.

NOTE: If the Rx session is instead established at the time that the NS/EP Data Transport Service is invoked, the Diameter **AA-Request** command in step 1 of Figure 6-7 would include the Supported-Features AVP, including the corresponding "MPSforDTS" feature number to indicate this feature is supported by the DTS Server, and would include the Framed-IP-Address or Framed-Ipv6-Prefix and Called-Station-Id AVPs (to identify the local UE IP address and the Designated APN) in order to facilitate the DRA's identification of the correct PCRF.

The DTS Server includes the MPS-Action AVP in the Diameter **AA-Request** command in step 1 of Figure 6-7 to invoke the NS/EP Data Transport Service. Assuming the Service User has already been authorized, the DTS Server sets the MPS-Action AVP value to "ENABLE_MPS_FOR_DTS," to trigger the PCRF to upgrade the QoS of the Default Bearer associated with the PDN Connection to the Designated APN, without further authorization by the PCRF.

NOTE: The DTS Server sets the MPS-Action AVP value to "AUTHORIZE_AND_ENABLE_MPS_FOR_DTS" to indicate that the PCRF should verify that the UE is authorized for the NS/EP Data Transport Service prior to upgrading the QoS of the Default Bearer and associated PCC rules.

The DTS Server also includes the Specific-Action AVP in the Diameter **AA-Request** command, populated with values "SUCCESSFUL_QOS_UPDATE" and "FAILED_QOS_UPDATE" to request notification when the request has been successfully acted upon or has failed, i.e., when the QoS of the Default Bearer has been successfully updated or not. The Media-Component-Description AVP is not included.

When the PCRF receives the Diameter **AA-Request** command, the PCRF recognizes that the request is associated with an NS/EP Data Transport Service invocation, based on the inclusion of the MPS-Action AVP set to the value "ENABLE_MPS_FOR_DTS" or "AUTHORIZE_AND_ENABLE_MPS_FOR_DTS".

NOTE: When the MPS-Action AVP value "AUTHORIZE_AND_ENABLE_MPS_FOR_DTS" is received by the PCRF, the PCRF retrieves the subscriber's subscription related information from the SPR, as specified in TS 23.203 [Ref 2]. The SPR provides the MPS EPS Priority to indicate whether the subscription supports MPS and the MPS Priority Level to provide the user priority. The PCRF uses the MPS EPS Priority to determine whether the UE is authorized for NS/EP Data Transport Service. If the request is not authorized, the PCRF indicates in the **AA-Answer** command the cause for the rejection with the Experimental-Result-Code AVP set to the value "REQUESTED_SERVICE_NOT_AUTHORIZED".

The PCRF derives the QoS values of the Default Bearer as appropriate for the NS/EP Data Transport Service and sends a Diameter **RA-Request** command to the PDN-GW, including the Allocation-Retention-Priority AVP and the QoS-Class-Identifier AVP in the Default-EPS-Bearer-QoS AVP, to indicate the appropriate priority treatment that should be applied for the Default Bearer.

The PCRF also modifies the dynamic PCC rules that have the same QCI/ARP as were previously assigned to the Default Bearer. If the Rule-Bound-to-Default-Bearer feature is supported by both the PDN-GW and PCRF (as described in Clause 5.4.1 of TS 29.212 [Ref 5]), for each of the PCC rules that have the same QCI/ARP as the Default Bearer, the PCRF sets the Default-Bearer-Indication AVP within the Charging-Rule-Definition AVP to the value "BIND_TO_DEF_BEARER" to accomplish a binding of the corresponding PCC rules to the Default Bearer.

NOTE: Step 3 of Figure 6-7 assumes that the Default-Bearer-Indication AVP is included in the **AA-Request** command, based on support of the Rule-Bound-to-Default-Bearer feature by both the PDN-GW and PCRF. Alternatively, the PCRF may explicitly change the QCI and ARP values of these PCC rules to match the new QCI and ARP values assigned to the Default Bearer by setting the QoS-Class-Identifier AVP and Allocation-Retention-Priority AVP within the QoS-Information AVP, as discussed in Clause 7.1.9.

NOTE: Clause 7.1.12 discusses the assignment of QCI value(s) for the NS/EP Data Transport Service.

Based on inclusion of the "SUCCESSFUL_QOS_UPDATE" value in the Specific-Action AVP of the Diameter **AA-Request** command from the DTS Server (in step 1), the PCRF also requests the PDN-GW to confirm that the resources associated to the Default Bearer and PCC rules mapped to the Default Bearer are successfully updated, by setting the Event-Trigger AVP to the "SUCCESSFUL_QOS_UPDATE" value.

The PCRF responds to the DTS Server with a Diameter **AA-Answer** command which indicates the request in the associated **AA-Request** command was received and understood by the PCRF, but does not imply that the requested actions were taken.

When the PDN-GW receives the Diameter **RA-Request** command, it invokes Bearer Modification procedures to modify the QoS characteristics of the Default Bearer, based on the Default-EPS-Bearer-QoS AVP value received from the PCRF. Subsequent processing (i.e., steps 5 – 12 in Figure 6-7) is described in ATIS-1000065 [Ref 12] and Clause 6.3.1.7 of ATIS-1000049 [Ref 11]. The PDN-GW also uses the received Default-Bearer-Indication AVP value "BIND_TO_DEF_BEARER" to trigger binding of the designated PCC rules to the Default Bearer, or the QoS-Class-Identifier AVP and Allocation-Retention-Priority AVP within the QoS-Information AVP to update these QoS values of the PCC rules.

The PDN-GW responds to the PCRF with a Diameter **RA-Answer** command which indicates the request in the associated **RA-Request** command was received and understood by the PDN-GW, but does not imply that the requested actions were taken in the EPC and RAN.

Assuming that the desired actions as requested by the MPS-Action AVP (i.e., QoS updates of the Default Bearer plus PCC rules that are mapped to the Default Bearer) are successfully completed, the PDN-GW sends a Diameter **CC-Request** command to the PCRF, including the Event-Trigger AVP with value "SUCCESSFUL_QOS_UPDATE." Based on this event notification, the PCRF informs the DTS Server by sending a Diameter **RA-Request** command

with the Specific-Action AVP set to the value "SUCCESSFUL_QOS_UPDATE." When the DTS Server receives this notification from the PCRF, it initiates procedures to notify the UE that the NS/EP Data Transport Service has been successfully invoked.

NOTE: If the QoS of the Default Bearer fails to be updated successfully, this is reported by the PDN-GW to the PCRF via the Event-Trigger AVP value "DEFAULT-EPS-BEARER-QOS_MODIFICATION_FAILURE" in accordance with Clause 4.5.5.10 of TS 29.212 [Ref 5]. If the DTS Server included the Specific-Action AVP set to "FAILED_QOS_UPDATE" in the Diameter **AA-Request** command (in step 1), the PCRF informs the DTS Server by sending a Diameter **RA-Request** command with the Specific-Action AVP set to the value "FAILED_QOS_UPDATE". The DTS Server notifies the UE accordingly.

6.3.6 HTTPS-based Revocation of the NS/EP Data Transport Service

This clause describes HTTPS-based interactions to support the revocation of the NS/EP Data Transport Service.

Sub-flow I of Figure 6-1 and sub-flow L of Figure 6-2 suggest HTTPS interactions between the UE and the DTS Server to support revocation of the NS/EP Data Transport Service. This processing is similar to the HTTPS-based service invocation procedures as described in Clauses 6.3.4.4 and 6.3.4.5, with differences in the particular HTTPS message contents that are exchanged, and in the population of the Diameter commands that are used to modify the Default Bearer and related PCC rules upon successful revocation of the NS/EP Data Transport Service.

The HTTPS interactions between the UE and DTS Server, as described in Clauses 6.3.4.4 and 6.3.4.5, are modified to allow the Service User to interact with the widgets in the DTS Application or included in the HTML form when using a web browser, to choose “revocation of the NS/EP Data Transport Service” as the desired NS/EP service.

NOTE: The need for Service User authorization may differ for DTS invocation and DTS revocation. See Clause 7.2.

The PCC interactions as illustrated in Figure 6-8 are used to disable priority treatment for the transport of non-GBR data traffic, in conjunction with the successful revocation of the NS/EP Data Transport Service.

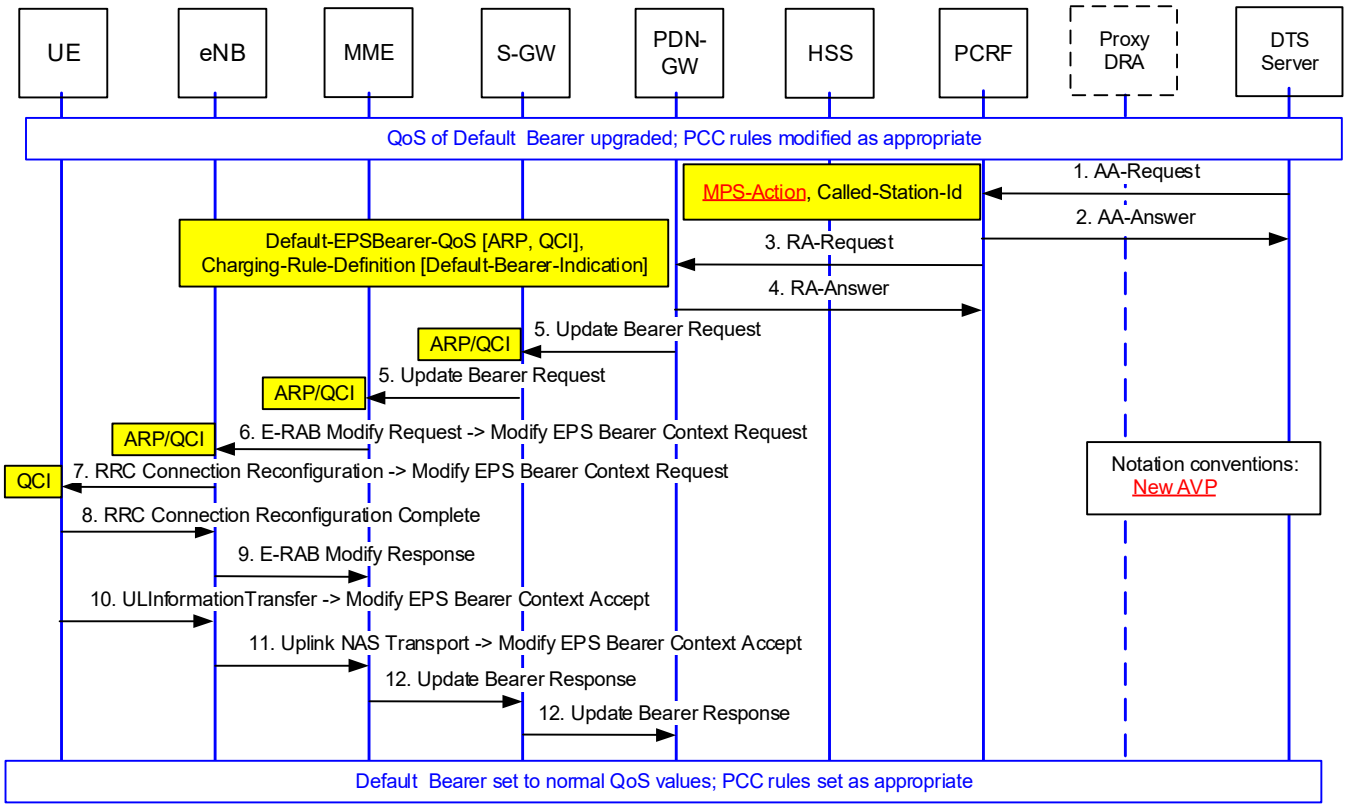

Figure 6-8. NS/EP Data Transport Service Revocation - PCC Interactions

Figure 6-8 contains the same sequence of messages as illustrated in Figure 6-7, but excludes the (optional) event notification.

Steps 1 through 4 of Figure 6-8 illustrate the messages exchanged over the Rx interface (between the DTS Server and the PCRF) and over the Gx interface (between the PCRF and the PDN-GW). The DTS Server includes the MPS-Action AVP in the Diameter **AA-Request** command in step 1 of Figure 6-8 to revoke NS/EP Data Transport Service. The MPS-Action AVP value "DISABLE_MPS_FOR_DTS" triggers the PCRF to downgrade the QoS of the Default Bearer associated with the Designated PDN Connection.

When the PCRF receives the Diameter **AA-Request** command and recognizes that the request is associated with an NS/EP Data Transport Service revocation, the PCRF indicates the appropriate priority treatment that should be applied for the Default Bearer by restoring appropriate values for the Allocation-Retention-Priority AVP and the QoS-Class-Identifier AVP, as included in the Default-EPS-Bearer-QoS AVP.

> NOTE: This may require more complex logic on the part of the PCRF, beyond simply restoring the prior ARP and QCI values as set prior to invocation of the NS/EP Data Transport Service, if these values and/or the Default-Bearer-Indication AVP value were modified by another service during the time that the NS/EP Data Transport Service was enabled. Similarly, the PCRF may require more complex logic, beyond simply restoring the PCC rules as set prior to invocation of the NS/EP Data Transport Service. The corresponding logic is dependent on the identification of particular services that may be deployed, and the desired interactions between the NS/EP Data Transport Service and any such services. These aspects are not considered in this TR.

The PCRF also modifies the ARP and QCI values for the dynamic PCC rules that were previously modified during invocation of the NS/EP Data Transport Service (based on having the same QCI/ARP as the Default Bearer, as discussed in Clause 6.3.5), by setting the Default-Bearer-Indication AVP value to "BIND_TO_APPLICABLE_BEARER" to remove the previous binding to the Default Bearer for the corresponding PCC rules, and by setting the QoS-Class-Identifier AVP and Allocation-Retention-Priority AVP within the QoS-Information AVP of the Charging-Rule-Definition AVP to restore the appropriate PCC rules, as discussed in Clause 7.1.9.

The PCRF sends a Diameter **RA-Request** command to the PDN-GW, to indicate the appropriate treatment that should be applied for the Default Bearer and for the dynamic PCC rules, as described above. The PDN-GW responds to the PCRF with a Diameter **RA-Answer** command.

Steps 5 through 12 of Figure 6-8 illustrate EPS Bearer Modification procedures that are used when the PDN-GW receives the Diameter **RA-Request** command and determines that the Default Bearer should be modified based on the QoS information received from the PCRF. This processing is described in ATIS-1000065 [Ref 12] and Clause 6.3.1.7 of ATIS-1000049 [Ref 11]. When the PDN-GW receives the Diameter **RA-Request** command, it invokes Bearer Modification procedures to modify the QoS characteristics of the Default Bearer, based on the Default-EPS-Bearer-QoS AVP value received from the PCRF. To restore other flows that were bound or mapped to the Default Bearer when the NS/EP Data Transport Service was invoked, the PDN-GW uses the received Default-Bearer-Indication AVP value "BIND_TO_APPLICABLE_BEARER" plus the QCI and ARP values as set in the QoS-Class-Identifier AVP and Allocation-Retention-Priority AVP within the QoS-Information AVP of the Charging-Rule-Definition AVP, to trigger appropriate modifications to the designated PCC rules (and removal of binding of these rules to the Default Bearer).

6.3.6.1 TCP Connection Release

When their communication is complete, the UE and DTS Server release the TCP connection, to free the resources for other uses.

6.3.7 Removal of AF Signalling Flow Previously Established for Priority Signalling between UE and DTS Server

Various mechanisms can be used to trigger the removal of the AF Signalling Flow between the UE and the DTS Server. Symmetrical procedures are recommended for the establishment and removal of the AF Signalling Flow.

For example, assuming that the AF Signalling Flow was established when the Service User activated (opened) the special DTS application on their UE, that AF Signalling Flow may persist until the user closes that DTS application. For this use case, when the DTS application is closed, the DTS Server is notified that no further NS/EP Data Transport Service actions are needed. When the DTS Server receives this notification from the UE, the DTS Server closes the Rx session by sending a Diameter **Session-Termination-Request** (STR) command to the PCRF, which is acknowledged with a **Session-Termination-Answer** (STA) command, as described in Clause 4.3.1.2.3 of [Ref 6].

NOTE: If the DTS Server decides to remove the AF Signalling Flow between the UE and the DTS Server but decides to retain the Rx session, the DTS Server removes the IP flow within the Media-Sub-Component AVP by sending an **AA-Request** command that contains the Flow-Status AVP set to the value "REMOVED". The corresponding Bearer Release procedures, used to remove the Dedicated Bearer that was used to support the AF Signalling IP flow, are specified in Clause 5.4.4.1 of TS 23.401 [Ref 3].

7 Analysis and Recommendations

7.1 Analysis

The following subclauses provide further analysis pertaining to key topics for the NS/EP Data Transport Service. All the needed functionality has been included in 3GPP Release 17 at the time of completion of this TR.

7.1.1 Relationship to 3GPP Priority EPS Bearer Service

The NS/EP Data Transport Service builds upon functionality as specified in TS 29.212 Clause 4.5.19.1.2 [Ref 5] for the Priority EPS Bearer Service. This functionality applies appropriate updates to the ARP and QCI values assigned to the Default Bearer within the Designated PDN Connection, and also modifies the settings for particular PCC rules (with the same QCI/ARP as the Default Bearer), by binding those PCC rules to the Default Bearer or by setting the ARP and QCI of those particular PCC rules to the updated ARP and QCI values. This TR proposes the following extensions and clarifications, and specific usage of Priority EPS Bearer Service capabilities, as applicable for the NS/EP Data Transport Service:

- It introduces the 3GPP Diameter MPS-Action AVP to explicitly support the dynamic on demand invocation and revocation of NS/EP Data Transport Service in a 3GPP-specified manner, as described further in Clause 7.1.8.
- It assumes that when the DTS Server sends a Diameter **AA-Request** command for invocation of the NS/EP Data Transport Service, the DTS Server optionally requests the PCRF to check whether the originating UE is authorized as an NS/EP-subscribed UE. The DTS Server selects an appropriate authorization mechanism for the NS/EP Data Transport Service, as discussed in Clause 7.1.4.
- It extends the PCC event notification capabilities, to enable the DTS Server to receive a success or failure indication pertaining to invocation/revocation of the NS/EP Data Transport Service, which the DTS Server uses to notify the originating Service User of this event. These extensions are described in Clause 7.1.10.
- It enables the establishment of an AF Signalling Flow to support priority signalling between the UE and the DTS Server, as described in Clause 7.1.2.
- It extends the Supported-Features AVP, to support the "MPSforDTS" feature.

7.1.2 Priority Signalling between the UE and the DTS Server

A DTS Server interacts with the UE to control the dynamic invocation and revocation of the NS/EP Data Transport Service. The messages exchanged between the UE and the DTS Server would normally be transported via the Default Bearer. However, the exchange of these messages over the Default Bearer may be hampered during congestion, since the QoS of the Default Bearer is not upgraded until the NS/EP Data Transport Service is successfully invoked, i.e., after the HTTPS request(s) in Figure 6-6 are processed and corresponding PCC procedures as illustrated in Figure 6-7 of Clause 6.3.5 are successfully completed.

In order to support communications between the UE and the DTS Server when network congestion is experienced, an AF Signalling Flow is established to support priority signalling between the UE and the DTS Server. This AF

Signalling Flow may result in the establishment of a new Dedicated Bearer, as illustrated in Clause 5.3. This capability may be useful for selected use cases as described in Clause 6.1. Clause 6.3 includes sub-flows that illustrate the establishment of an AF Signalling Flow for this priority signalling prior to the invocation of the NS/EP Data Transport Service, as may be applicable to particular use case scenarios.

Priority signalling between the UE and the DTS Server can be established:

[a] at the time a PDN connection is established;

[b] when the user activates (opens) a DTS application on their UE; or

[c] when the user invokes NS/EP Data Transport Service.

NOTE: This capability is only applicable for NS/EP subscribed UEs, since it relies on PCRF retrieval of the subscriber's subscription related information (i.e., the MPS Priority information) from the SPR to trigger the AF Signalling Flow establishment procedures with option [a], or to authorize the AF Signalling Flow establishment request with options [b] and [c].

Option [a] is described in Clause 6.3.2.2. Options [b] and [c] make use of procedures based on Clause 4.4.12 of TS 29.214 [Ref 7], as described in Clause 6.3.3.

NOTE: The DTS Server needs to include the MPS-Identifier AVP for either option [b] or [c].

NOTE: The Reservation-Priority AVP may be used to indicate the Service User's priority level. However, no PCRF distinctions based on Service User priority level have been identified, so this AVP is not required based on the analysis in this TR.

Option [a]: Establishment of priority signalling between the UE and the DTS Server at the time a PDN connection is established

Clause 6.3.2.2 describes the potential establishment of a Service Data Flow from the UE towards the DTS Server at the time of Attach, to carry priority AF signalling traffic between the UE and the DTS Server for supporting the NS/EP Data Transport Service. To accomplish these actions, an appropriate Dedicated Bearer (with appropriate QCI and ARP values) may be established to provide priority access to a DTS Server. This requires PCRF configurations to support the following functionality:

- The PCRF must be configured with appropriate NS/EP ARP and QCI values for the PCC rule(s) that are used for establishing the Dedicated Bearer for DTS signalling on the Designated PDN Connection.

  NOTE: This functionality is in addition to Advance Priority procedures used to set an upgraded ARP for the Default Bearer of the Designated PDN Connection, as discussed in Clause 6.3.2.1.

- The PCRF must be able to trigger the Dedicated Bearer establishment procedures. This can be triggered by PCRF access to the subscriber's subscription related information (i.e., the MPS Priority information).

- The PCRF needs the IP addresses of the UE and the DTS Server to identify the signalling flow between the UE and the DTS Server.

  NOTE: The PCRF uses this information to populate the Flow-Information AVP within the Charging-Rule-Definition AVP in the Diameter CC-Answer command as illustrated in step 9 of Figure 6-4.

  Since communications have not yet been established between the DTS Server and the PCRF at the time of Attach, the PCRF must determine the IP address of the DTS Server. A fixed IP address of the DTS Server can be pre-configured in the PCRF for this purpose. Alternatively, the PCRF may generate a query to a DNS Server, to translate a URL to an IP address of the DTS Server.

NOTE: Option [a] is only applicable to NS/EP-subscribed UEs.

Option [b]: Establishment of priority signalling between the UE and the DTS Server when the user activates a DTS application on their UE

Option [b] is illustrated in sub-flows D and E of Clause 6.2.2. In sub-flow D, the Service User activates (opens) the special DTS application, which causes a UE request to establish priority AF signalling with the DTS Server. This request triggers the DTS Server to initiate the corresponding PCC interactions, as illustrated in sub-flow E. For the PCC interactions as described in Clause 6.3.3, an AF Signalling Flow is established for priority signalling between the UE and the DTS Server. This procedure is specified in Clause 4.4.12 of TS 29.214 [Ref 7]. The DTS Server includes the MPS-Identifier AVP in the Rx Diameter **AA-Request** command that it sends to the PCRF, as illustrated in step 1 of Figure 6-5.

NOTE: Option [b] is only applicable to UEs with the associated DTS application.

Option [c]: Establishment of priority signalling between the UE and the DTS Server when the user invokes NS/EP Data Transport Service

For option [c], the DTS Server initiates PCC procedures to establish an AF Signalling Flow for subsequent priority signalling after it receives a request to invoke the NS/EP Data Transport Service. This provides more limited benefits than options [a] or [b], since it does not help with the establishment of the TCP connection and SSL/TLS handshake procedure (as illustrated in steps B and C of Figure 6-6), but only helps for HTTP transfers after the HTTP connection has been established.

- For a UE that invokes the NS/EP Data Transport Service via a browser as illustrated in Clause 6.2.1, the DTS Server may initiate PCC procedures to establish an AF Signalling Flow for subsequent priority signalling after it receives the invocation request (in step E1 of Figure 6-6). This would result in priority treatment only for subsequent HTTP message(s) as illustrated in Figure 6-6.
- For a UE that uses a special DTS application as illustrated in Clause 6.2.2, only a single HTTP request is required within the HTTP interactions, as described in Clause 6.3.4.4. Thus, establishing the AF Signalling Flow upon receipt of the initial HTTP request would provide no value.

The specific option(s) need to be chosen by the Service Provider, consistent with the specific use case(s) that are deployed.

7.1.3 Mechanism used for UE interactions with DTS Server

A variety of mechanisms can be used to invoke and revoke NS/EP Data Transport Service. Whereas the specific mechanisms and details concerning particular interactions are considered to be implementation and deployment choices, this TR considers two general types of mechanisms that can be used: use of a UE browser to access the DTS Server and use of a special DTS application that is installed on the UE to facilitate the Service User's access to the DTS Server.

Further assumptions and considerations, as applicable to each of these mechanisms, are described in Clause 6.1.

7.1.4 Authorization Mechanism(s) for the NS/EP Data Transport Service

The NS/EP Data Transport Service must support authentication of the originating Service User (or the NS/EP-subscribed UE) and the ability to verify that the originator is authorized to invoke the NS/EP Data Transport Service. The specific mechanism(s) used to support this functionality should be chosen based on detailed security assessments that consider the specific security objectives established by particular Service Providers in consultation with the designated government agency for the NS/EP Data Transport Service. This clause describes mechanisms that may apply for the use cases as described in Clauses 6.2.1 and 6.2.2.

Authorization for NS/EP-Subscribed UE

For authorization of NS/EP-subscribed UEs in a non-roaming scenario, this TR assumes that the source IP address, as received by the DTS Server in the IP header of the initial AF Signalling establishment request or DTS invocation

request can be used to verify the UE's authorization for the NS/EP Data Transport Service. To support this assumption, there should be no Network Address Translation (NAT) of the UE's IP address between the PDN-GW and the DTS Server. If the packets went through any HTTP proxies between the PDN-GW and DTS Server, the "forwarded" field should be included in the HTTP header, as specified in RFC 7239 [Ref 16], to enable the DTS Server to retrieve the original UE IP address.

The use case as described in Clause 6.2.2 assumes that the PCRF is used to authorize the NS/EP-subscribed UE for the NS/EP Data Transport Service. When the DTS Server requests the PCRF to establish an AF Signalling Flow, authorization of the NS/EP-subscribed UE is an integral part of the PCRF's processing of the Diameter **AA-Request** command, as illustrated in step 1 of Figure 6-5. When the DTS Server requests the PCRF to invoke the NS/EP Data Transport Service, the DTS Server indicates whether the PCRF should first authorize the DTS invocation request, as an integral part of the PCRF's processing of the Diameter **AA-Request** command, as illustrated in step 1 of Figure 6-7.

Authorization for Non-NS/EP-Subscribed UE

For the browser-based mechanism as discussed in Clauses 6.2.1 and 6.3.4.5, the Service User enters NS/EP-specific user credentials into an HTML form that is sent to the DTS Server. These credentials are maintained in a logical NS/EP credentials database, which can be collocated with the DTS Server or accessed remotely. The DTS Server must be able to reliably access the NS/EP credentials data in an appropriate manner, which may be tailored for the specific use cases and deployment options that are chosen by the Service Provider. The specific architecture used to support this functionality is not specified in this TR.

When the DTS Server requests the PCRF to invoke or revoke the NS/EP Data Transport Service after having already authorized the non-NS/EP subscribed UE (as discussed above), the DTS Server requests the PCRF to process the Diameter **AA-Request** command (as illustrated in step 1 of Figure 6-7) without any further authorization of the DTS invocation request.

Composite Procedures for UE Authorization

Assuming the use of a common URL (or IP address) to access the DTS Server for both NS/EP subscribed UEs and non-NS/EP subscribed UEs, the DTS Server may perform UE authorization as follows: The DTS Server first applies the procedure as described above for an NS/EP-subscribed UE. If successful, the UE is determined to be an authorized NS/EP subscribed UE. However, if the PCRF notifies the DTS Server that the UE is not authorized, the DTS Server then applies the corresponding procedure as applicable for a non-NS/EP subscribed UE. This two-step process is shown in Clause 6.2.1.

7.1.5 Access to DTS Server

The selection of a particular DTS Server by the UE (and routing of messages to that DTS Server) can be based on [a] configuration of specific IP address(es) for the DTS Server, or [b] assignment of unique URL for the DTS Server.

Clause 6.1 considers option [a] in the context of a use case involving a UE that is configured with a special DTS application, and option [b] in the context of a use case involving the invocation of the NS/EP Data Transport Service via a web browser. Other potential use cases can be pursued.

> NOTE: For option [a] (where the DTS Server's IP address is stored in the DTS application), if the DTS application is unable to successfully access the DTS Server via its IP address, it may subsequently attempt to access the DTS Server via a URL.

To facilitate the ability of the DTS Server to authorize a DTS request received from a UE, and to support subsequent PCC interactions with a PCRF serving that UE, the use of a Service Provider-specific URL is recommended, to enable the DTS invocation request to be routed to a DTS Server for the Service Provider to which the UE is subscribed. To support such functionality, the UE should be configured to use a DNS server that is designated by the UE's subscribed Service Provider and can map the Service Provider-specific URL to the IP address assigned to the DTS Server.

A DTS Server supports functionality to authorize DTS requests (via access to information used to validate NS/EP credentials for non-NS/EP-subscribed UEs) and to initiate appropriate Rx signalling towards a PCRF. Whereas the DTS Server that receives the DTS invocation request is assumed to support the required authorization functionality, it is recognized that every DTS Server is not expected to provide access to every PCRF. Thus, upon receiving a DTS invocation request from a UE, if that DTS Server is not capable of accessing the required PCRF within the Service Provider network, a mechanism may be needed to identify a DTS Server that does have access to the required PCRF, and to convey an appropriate request between the DTS Servers. This may entail proprietary signalling between DTS Servers. Alternatively, URL redirection (as described in RFC 7231 [Ref 15]) may be considered to support such functionality. The specific mechanism needs to be chosen by the Service Provider, consistent with the specific use case(s) that are deployed.

7.1.6 Applicability of NS/EP Data Transport Service to particular PDN connection(s)

This TR assumes that the priority treatment, as applicable upon successful invocation of the NS/EP Data Transport Service, is applicable to traffic carried via the same PDN connection as used to communicate with the DTS Server. The DTS invocation request (and other messages used to support the UE communications with the DTS Server) are assumed to be exchanged over that same Designated PDN Connection, as illustrated in Clause 5.2. The priority treatment is associated with that single PDN connection. The DTS Server is assumed to be configured with an APN value that is used as the Designated APN for the NS/EP Data Transport Service.

> NOTE: Whereas the NS/EP Data Transport Service impacts traffic sent via the Default Bearer of the Designated PDN Connection, the DTS invocation request (and subsequent signalling messages exchanged between the UE and the DTS Server) may be exchanged via a Dedicated Bearer within that PDN connection (established for priority signalling between these entities, as discussed in Clause 7.1.2) rather than via the Default Bearer of that PDN connection.

7.1.7 DTS Server / DRA determination of PCRF

A DRA may be optionally used to assist the DTS Server in determining the particular PCRF used to enable the PCC interactions for the NS/EP Data Transport Service. A DRA supports the selection of an appropriate PCRF in case an administrative domain has more than one PCRF. The Proxy mode of operation, as discussed in Clause 7.1 of TS 29.213 [Ref 6], is assumed for the flows illustrated in this TR.

> NOTE: The inclusion of a DRA in the architecture, and the use of a DRA in either proxy or redirect mode, is dependent on the option deployed by the Service Provider. Whereas the use of DRA Proxy mode is illustrated as an example solution in this TR, other options are possible, some of which do not include a DRA.

Based on Clause 7.3.2 of TS 29.213 [Ref 6], the DRA maintains information about the user identity, the UE Ipv4 address and/or Ipv6 prefix, the APN (if available), the PDN-GW identity (if available) and the selected PCRF identity for a certain IP-CAN session. The DRA gathers this information during the establishment of a PDN connection (i.e., based on the corresponding AVPs in the Diameter **CC-Request** command sent by the PDN-GW, as illustrated in step 8 of Clause 6.3.2.1).

Based on Clause 7.3.2 of TS 29.213 [Ref 6], the DRA finds the correct PCRF by matching information received in the Diameter **AA-Request** command from the DTS Server (in step 1 of Clause 6.3.3, or in step 1 of Clause 6.3.5) with the corresponding information stored in the DRA. For the NS/EP Data Transport Service, the DTS Server provides the UE's IP address in the Framed-IP-Address or Framed-Ipv6-Prefix AVP and the Designated APN in the Called-Station-Id AVP.

7.1.8 Addition of New Diameter MPS-Action AVP

This TR illustrates the use of the Diameter MPS-Action AVP (introduced in 3GPP Release 17), with values "ENABLE_MPS_FOR_DTS", "AUTHORIZE_AND_ENABLE_MPS_FOR_DTS", and "DISABLE_MPS_FOR_DTS" for invocation and revocation of the NS/EP Data Transport Service. The DTS Server uses MPS-Action AVP value "ENABLE_MPS_FOR_DTS" or "AUTHORIZE_AND_ENABLE_MPS_FOR_DTS" to request invocation of the NS/EP Data Transport Service. If the PCRF receives the "AUTHORIZE_AND_ENABLE_MPS_FOR_DTS" value, the PCRF will confirm that the UE is an authorized NS/EP subscriber before initiating the requested actions. Use of these values is described further in Clause 6.3.5.

The addition of this new AVP is recommended as a preferred 3GPP-based approach (e.g., rather than the specification of unique values for the MPS-Identifier AVP).

NOTE: The Supported-Features AVP is used during establishment of the Diameter session to indicate support for the NS/EP Data Transport Service functionality, via inclusion of the "MPSforDTS" feature number.

The existing 3GPP MPS-Identifier AVP is optional, and is left for specification in particular national standards. 3GPP does not specify values for the MPS-Identifier AVP, nor the specific treatment to be applied for related functionality. Thus, if the MPS-Identifier AVP was used to invoke and revoke the NS/EP Data Transport Service, the details concerning such functionality would be left to national standardization, and would not achieve the benefits of international standardization.

This TR also describes a new ("AUTHORIZE_AND_ENABLE_MPS_FOR_AF_SIGNALLING") value of the MPS-Action AVP, introduced in 3GPP Release 18, which allows the DTS Server to explicitly signal that authorization for the NS/EP Data Transport Service is required for priority AF signalling.

NOTE: Inclusion of the "AuthorizationForMpsSignalling" feature number in the Supported-Features AVP is used to indicate support for the new "AUTHORIZE_AND_ENABLE_MPS_FOR_AF_SIGNALLING" value of the MPS-Action AVP.

7.1.9 PCC Mechanism used for Modification of PCC Rules

Two mechanisms have been defined, either of which can be used to adjust the PCC rules that are mapped to the Default Bearer, in order to ensure that the QCI and ARP values for those service data flows continue to match the corresponding QoS values as assigned to the Default Bearer when the NS/EP Data Transport Service is invoked:

- The PCRF can explicitly change the QCI/ARP values of the PCC rules to match the new QCI/ARP values assigned to the Default Bearer by explicitly setting the QoS-Class-Identifier AVP and Allocation-Retention-Priority AVP within the QoS-Information AVP.
- The PCRF can set the Default-Bearer-Indication AVP, to accomplish a binding of the corresponding PCC rules to the Default Bearer (without the need to explicitly modify the QCI/ARP values of those PCC rules).

Either PCRF mechanism could be pursued for invocation of the NS/EP Data Transport Service, based on corresponding specifications as described in Clause 5.4.1 of TS 29.212 [Ref 5].

7.1.10 Extensions to PCC Event Notification Capabilities

This TR illustrates the use of PCC event notification capabilities (as introduced in 3GPP Release 17), to enable an indication to be delivered to the DTS Server, upon successful or failed invocation/revocation of the NS/EP Data Transport Service. The Event-Trigger AVP is extended to include a new "SUCCESSFUL_QOS_UPDATE" value on the Gx interface (to report a successful update of the QoS of the Default Bearer within the Designated PDN Connection, plus PCC rules that are mapped to that Default Bearer) and the Specific-Action AVP is extended to include a corresponding "SUCCESSFUL_QOS_UPDATE" value on the Rx interface. The Specific-Action AVP is also extended to include a "FAILED_QOS_UPDATE" value on the Rx interface (to report a failed update of the QoS of the Default Bearer).

This functionality supports the ability to report the successful or failed completion of the QoS upgrade (due to invocation of the NS/EP Data Transport Service) to the DTS Server, to enable the DTS Server to subsequently inform the originating user of this event. This functionality is intended to discourage subsequent NS/EP Data Transport Service invocation re-attempts by the user, if the QoS performance is not improved noticeably after the NS/EP Data Transport Service is invoked (e.g., if the perceived quality problems are due to problems experienced by the far end Data Server, rather than due to difficulties triggered by network congestion).

7.1.11 NS/EP Data Transport Service Revocation

Clause 6.3.6 illustrates procedures that enable the NS/EP Data Transport Service to be explicitly revoked by the Service User, patterned after similar procedures used for invocation of the NS/EP Data Transport Service. Other mechanisms can be used to trigger the revocation of the NS/EP Data Transport Service, e.g., when the user closes the special DTS application on their UE. The NS/EP Data Transport Service is automatically revoked upon UE detachment/deregistration (e.g., power down).

In addition, to prevent a UE from inadvertently enabling the NS/EP Data Transport Service for an extended period of time, the network may support revocation of the NS/EP Data Transport Service after a predetermined time. To support this capability, the DTS Server starts a DTS timer when the NS/EP Data Transport Service is successfully invoked. If the DTS timer expires before deactivation of the NS/EP Data Transport Service, the DTS Server sends a Diameter **AA-Request** command to the PCRF (as discussed in Clause 6.3.6), in order to revoke the NS/EP Data Transport Service. The DTS Server may close the Rx Diameter session by sending a **Session-Termination-Request** (STR) command to the PCRF, which is acknowledged with a **Session-Termination-Answer** (STA) command.

When the NS/EP Data Transport Service is revoked, the PCRF restores appropriate QoS values for the Default Bearer within the Designated PDN Connection, and updates PCC rules that were previously mapped or bound to that Default Bearer when the NS/EP Data Transport Service was previously invoked. Clause 6.3.6 describes the PCRF procedures, as needed to restore the prior QoS settings that were applicable prior to invocation of the NS/EP Data Transport Service. It also discusses the need for more complex PCRF logic, to accommodate potential updates to the QoS of the Default Bearer and/or to the related PCC rules by other services during the time that the NS/EP Data Transport Service was enabled, rather than simply restoring the previous QoS settings. The corresponding logic is dependent on the identification of particular services that may be deployed, and the desired interactions between the NS/EP Data Transport Service and any such services. These aspects are not considered in this TR.

7.1.12 Configuration of QoS Values for NS/EP Data Transport Service

The NS/EP Data Transport Service relies on the setting of appropriate QCI values when an AF Signalling Flow is established to support priority signalling between the UE and the DTS Server, and when the NS/EP Data Transport Service is invoked.

As described in step E of Clause 6.2.1, invocation of the NS/EP Data Transport Service entails the assignment of a special QCI value to support priority treatment of packets that are transported via the Default Bearer of the Designated PDN Connection. The specific QCI value is configured in the PCRF for this purpose. The one with the highest priority for a non-GBR Bearer (other than used for signalling) is recommended for the NS/EP Data Transport Service.

> NOTE: QCI value "6" or "70" as specified in Table 6.1.7-A of TS 23.203 [Ref 2] could be used for this purpose. QCI value "5", as used for signalling, cannot be used. Table 6.1.7-A of TS 23.203 [Ref 2] specifies a recommended priority level of 5.5 for QCI value "70", which is numerically lower than the recommended priority level (6) as specified for QCI value "6". Therefore, QCI value "70" is recommended over QCI value "6" for the NS/EP Data Transport Service. Table 6.1.7-A of TS 23.203 [Ref 2] indicates a Packet Delay Budget value of 200 msec for QCI value "70" versus 300 msec for QCI value "6".
>
> NOTE: Objective [287] in ATIS-1000065 [Ref 12] recommended the assignment of QCI value "6" for the corresponding "QCI_NGNGETS_NONGBR" variable, based on 3GPP Release 10. However, QCI value "70" was introduced in 3GPP Release 12, subsequent to the publication of ATIS-1000065 [Ref 12], to support services such as Mission Critical Data.

As illustrated in step 3 of Figure 6-5, a special QCI value is assigned to support priority treatment of signalling packets that are exchanged between the UE and the DTS Server. The specific value is configured in the PCRF for this purpose. A QCI with the highest priority as allowed by local policy is recommended for the NS/EP Data Transport Service.

> NOTE: Table 6.1.7-A of TS 23.203 [Ref 2] indicates that QCI values "5" and "69" have the highest priority level assignments, and therefore may be considered for the corresponding PCRF variable.

The NS/EP Data Transport Service relies on the prioritized transport of IP packets when the NS/EP Data Transport Service is invoked (e.g., via setting of appropriate DSCP values). Appropriate values are to be determined by Service Providers to facilitate priority transport of NS/EP data packets within the NS/EP Service Provider's network, as well as values to be used across network boundaries. See ATIS-1000079 [Ref 13].

7.2 Recommendations

This clause describes various recommendations pertaining to the NS/EP Data Transport Service. Many of these items pertain to mechanisms and options for deployment of the NS/EP Data Transport Service that will need to be chosen by Service Providers in consultation with the designated government agency for the NS/EP Data Transport Service.

Information sent to DRA in the Diameter AA-Request command

Clause 7.1.7 discusses information that is sent to the DRA in the Diameter **CC-Request** command from the PDN-GW, as illustrated in step 8 of Figure 6-3 in Clause 6.3.2.1, in order to enable the DRA to subsequently direct a Diameter **AA-Request** command (received from the DTS Server in step 1 of Figure 6-5) towards the appropriate PCRF. For the NS/EP Data Transport Service, the DTS Server should include the local UE IP address and the Designated APN in the Framed-IP-Address or Framed-Ipv6-Prefix, and Called-Station-Id AVPs of the Diameter **AA-Request** command that is sent to the PCRF (via an intermediate DRA).

Preservation of local UE IP address

For use cases that rely on the local UE IP address to be provided by the UE to the DTS Server as part of the IP header, there should be no NAT of the UE's IP address between the PDN-GW and the DTS Server. In addition, the “forwarded” field should be included in the HTTP header, as specified in RFC 7239 [Ref 16], to enable the DTS Server to retrieve the original UE IP address if the packets went through any HTTP proxies between the PDN-GW and DTS Server.

Configuring / disabling DoH

To avoid complications in the implementation of the NS/EP Data Transport Service based on adoption of third-party DoH deployments as discussed in Clause 6.3.4.1, this TR assumes that the Service User is responsible for configuring / disabling DoH, as necessary to adhere to use of the Service Provider's designated DNS Server.

This TR recommends that guidance be provided to the Service User such that:

- DoH, if supported by the web browser selected by the user to invoke the NS/EP Data Transport Service, is able to be manually disabled or overridden by the Service User, and
- Prior to activation of the NS/EP Data Transport Service, the third-party DoH has been disabled (e.g., by the Service User in the web browser selected by the user to invoke the NS/EP Data Transport Service).

Security considerations

The NS/EP Data Transport Service must support security mechanisms to ensure that the UE is able to securely and effectively communicate with the DTS Server. These security capabilities include message integrity mechanisms and the ability to verify that the originator is authorized to invoke the NS/EP Data Transport Service. The specific security objectives will be established by particular Service Providers in consultation with the designated government agency for the NS/EP Data Transport Service. A detailed security assessment is recommended, including the choice of appropriate authentication mechanisms for the NS/EP Data Transport Service, based on the specific use case(s) that are deployed.

The use case as presented in Clause 6.2.1 assumes that the Service User uses a browser to invoke the NS/EP Data Transport Service. When using a non-NS/EP-subscribed UE, the Service User enters NS/EP credentials via an HTML form that is sent to the DTS Server. The DTS Server verifies these entered credentials via an NS/EP database. When using an NS/EP-subscribed UE, no NS/EP credentials need to be entered by the Service User.

The use case as presented in Clause 6.2.2 assumes that the Service User uses an NS/EP subscribed UE, and no entry of NS/EP credentials is required.

The DTS Server requests the PCRF to perform UE authorization for the NS/EP Data Transport Service. The DTS Server sends to the PCRF the "trusted" UE IP address received from the UE in the IP header of the AF Signalling Flow establishment request or DTS invocation request. The PCRF retrieves NS/EP subscription information from the SPR using this trusted UE IP address (and its associated APN) received from the DTS Server to check whether this UE is authorized or not for the NS/EP Data Transport Service. Further discussion of these procedures is provided in Clause 7.1.4.

Extended PCRF procedures to establish priority AF signalling

Clauses 6.3.2.2 and 6.3.3 describe the potential establishment of an AF Signalling Flow from the UE towards the DTS Server, to carry priority signalling traffic between the UE and the DTS Server for supporting the NS/EP Data Transport Service. To accomplish these actions, the PCRF establishes an appropriate AF Signalling Flow (with appropriate QCI and ARP values) to provide priority access to a DTS Server.

Clause 6.3.2.2 describes the possible establishment of a priority Dedicated Bearer from an NS/EP-subscribed UE towards the DTS Server when the user activates (opens) a DTS application on their UE (option [b]) or when the user invokes NS/EP Data Transport Service (option [c]).

Options [b] and [c] require the inclusion of the MPS-Identifier AVP by the DTS Server in the Diameter **AA-Request** command, used to establish the priority AF Signalling Flow from the UE towards the DTS Server, as described in Clause 6.3.3. Inclusion of MPS-Action AVP value "AUTHORIZE_AND_ENABLE_MPS_FOR_AF_SIGNALLING" is recommended for NS/EP Data Transport Service deployments beginning with 3GPP Release 18, to allow the DTS Server to explicitly signal that authorization for the NS/EP Data Transport Service is required for priority AF signalling.

Clause 6.3.2.2 describes an alternative (option [a]) that would involve the establishment of an AF Signalling Flow from the UE towards the DTS Server (with appropriate QCI and ARP values) at the time when a PDN connection is established. This would require extensions to the PCRF configuration, as discussed in Clause 7.1.2 (option [a]).

Based on the additional PCRF functionality required for option [a] and the limited utility of option [c] as described in Clause 7.1.2, option [b] is recommended. Clause 7.1.2 provides additional material concerning these procedures.

Trigger for removal of AF Signalling Flow between the UE and the DTS Server

The specific mechanism used to trigger the removal of the AF Signalling Flow between the UE and the DTS Server can vary, based on the particular use case. Symmetrical procedures are recommended for the establishment and removal of the AF Signalling Flow used for priority signalling between the UE and the DTS Server.

If the NS/EP-subscribed UE is configured with a special DTS application to facilitate the invocation of the NS/EP Data Transport Service, and that DTS application is designed to establish the AF Signalling Flow upon activation (as described in Clause 6.3.3), then the removal of that AF Signalling Flow may be triggered in a symmetrical manner (i.e., that DTS application can initiate HTTP signalling with the DTS Server prior to terminating, in order to first remove the AF Signalling Flow). Corresponding procedures are described in Clause 6.3.7.

> NOTE: Adoption of non-symmetrical procedures could complicate the DTS Server logic that is applied when the NS/EP Data Transport Service is invoked. For example, if an AF Signalling Flow was established for priority signalling when the Service User activated (opened) the DTS application, yet if that AF Signalling Flow is removed when the NS/EP Data Transport Service is revoked (rather than when the DTS application is closed), the DTS Server logic may need to first determine whether or not an AF Signalling Flow is already established before it invokes the PCC procedures for NS/EP Data Transport Service invocation.

If the AF Signalling Flow is established when the NS/EP Data Transport Service is invoked (as discussed in Clause 6.3.5), the subsequent revocation of the NS/EP Data Transport Service (as discussed in Clause 6.3.6) can be designed to trigger the removal of the AF Signalling Flow.

Authorization of NS/EP Data Transport Service revocation requests

The set of credentials required to authorize an NS/EP Data Transport Service revocation request can vary, depending on the particular use case. The added burden of having to manually enter NS/EP credentials to authorize service revocation requests may be deemed unnecessary, when considering that the NS/EP Data Transport Service is automatically revoked upon UE detachment/deregistration (e.g., power down). To authorize an NS/EP Data Transport Service revocation request from a UE that is not subscribed to NS/EP, authorization may be performed in an implementation-specific manner (e.g., via information used to correlate the NS/EP Data Transport Service revocation request with a previously-authorized NS/EP Data Transport Service invocation request). Eliminating the need to enter NS/EP credentials to authorize service revocation requests provides a simplified procedure, facilitating the Service User's ability to quickly revoke the service before returning a borrowed UE to its owner.

Annex A
(Informative)

A NS/EP Data Transport Service - 3GPP Release 17 Extensions

The NS/EP Data Transport Service functionality for EPS as described in this TR includes several extensions that have been added in the 3GPP Release 17 specifications, as discussed below.

Use of MPS-Identifier AVP to request priority treatment for AF signalling

The procedure illustrated in Clause 6.3.3 to establish an AF Signalling Flow for priority signalling between the UE and the DTS Server is based on Clause 4.4.12 of TS 29.214 [Ref 7], including the MPS-Identifier AVP within the Rx Diameter **AA-Request** command, sent from the DTS Server to the PCRF in step 1 of Figure 6-5.

NOTE: A specific value of the MPS-Identifier AVP is not required for this purpose.

New Supported-Features AVP value for "MPSforDTS" feature

The Diameter **AA-Request** command, sent by the DTS Server to the PCRF in step 1 of Figure 6-5, includes the Supported-Features AVP, which informs the PCRF about the required and optional features that the DTS Server supports. The Diameter **AA-Answer** command also includes the Supported-Features AVP, to enable the PCRF to respond with an indication of the set of features that it has in common with the DTS Server, and that the PCRF supports within the Diameter session. The Supported-Features AVP is extended to support the "MPSforDTS" feature number for the NS/EP Data Transport Service.

The Supported-Features AVP, as exchanged between the PCRF and the PDN-GW within an Gx session, is similarly extended to support the "MPSforDTS" feature number for the NS/EP Data Transport Service.

Addition of new Diameter MPS-Action AVP

3GPP Release 17 extends the PCC capabilities, by introducing the 3GPP Diameter MPS-Action AVP to explicitly support the dynamic on demand invocation and revocation of the NS/EP Data Transport Service and request for PCRF authorization during invocation of the NS/EP Data Transport Service in a 3GPP-specified manner. These extensions are discussed further in Clause 7.1.8.

Extensions to PCC event notification capabilities

3GPP Release 17 extends the PCC event notification capabilities, to enable the DTS Server to be notified of the disposition of processing pertaining to the invocation/revocation of the NS/EP Data Transport Service. The Specific-Action AVP is extended to include new "SUCCESSFUL_QOS_UPDATE" and "FAILED_QOS_UPDATE" values on the Rx interface, and the Event-Trigger AVP is extended to include a new "SUCCESSFUL_QOS_UPDATE" value on the Gx interface. These extensions are discussed further in Clause 7.1.10.