**SA WG2 Meeting #143eS2-210**

**Feb 24th – March 9th, 2021 ; Elbonia (revision of S2-210)**

**Source: Ericsson**

**Title: KI#1, solution#12**

**Document for: Agreement (P-CR)**

**Agenda Item: 8.3**

**Work Item / Release: eEDGE\_5GC / Rel-17**

*Abstract of the contribution:*

# 1 Discussion

The following text is captured in clause 9.1.2 “Conclusions for Key Issue #1: Distributed Anchors” of TR 23.748:

*“The following aspects from Solution #12 are recommended for normative work:*

*- For SSC mode 2/3 PDU Session with central PSA UPF, when LDNSR receive DNS response from DNS server, it may trigger the SMF to release old PDU Session and establish new PDU Session using SSC mode 2/3 PSA change procedures.“*

This pCR updates TS 23.548 according to these conclusions.

# 2 Proposal

**It is proposed to update TS 23.548 as follows:**

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# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

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

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 23.501: "System architecture for the 5G System (5GS)".

[3] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[4] 3GPP TS 23.503: "Policy and Charging Control Framework for the 5G System".

[5] 3GPP TS 23.558: "Architecture for enabling Edge Applications (EA)".

[6] IETF RFC 7871: "Client Subnet in DNS Queries".

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# 5 Functional Description for Supporting Edge Computing

Editor’s Note: LDNSR is specified here: role, functionality and depolyment

Editor’s Note: This clause also brings clarity in the high-level relation between the solutions described in this TS and solutions built on SA6 Architecture for Enabling Edge Applications.

When LDNSR receives a DNS Query and takes action according to one of these options:

 **[Insert] Option A:** LDNSR receives an UL DNS query, inserts an ECS option, which includes an IP address/prefix obtained from SMF, into the DNS query and sends to C-DNS. The ECS option is related with the user location and possibly the requested FQDN.

 **[Forward]Option B:** LDNSR receives an UL DNS query, and forwards the UL DNS Query to a L-DNS. The L-DNS address is related with the user location and possibly requested FQDN.

 **[Analyse]Option C:** LDNSR receives UL DNS query and determines the L-DNS address but cannot send traffic to the L-DNS directly. The LDNSR requests the SMF to forward the DNS query to L-DNS.

SMF maps the user location into a DNAI/Local PSA for the Application Traffic, taking into consideration at least the following information:

- Information of the topology of UPFs and N6 accesses to the DNs;

- Application Layer information received via AF influence on routing API;

- PDU Session information, e.g. any PDU Session Local PSA.

 SMF provides to LDNSR either a L-DNS (options B&C) or an ECS (option A) related to the selected DNAI/Local PSA.

Editor’s Note: How the EC FQDNs are made available to the LDNSR and how the configuration is received from the SMF for the FQDN in the DNS query for the LDNSR to determine the forwarding par is FFS.

# 6 Procedures for Supporting Edge Computing

## 6.1 General

Editor’s Note: Any requirements on the applications and solution limitations are documented. For the detailed procedures for the management of the connectivity and run-time coordination with the application layer this clause refers to TS 23.502 and to TS 23.503 for the details on the Policy and Charging Control aspects.

## 6.2 EAS discovery and re-discovery

### 6.2.1 General

Editor’s Note: This clause describes general parts including e.g. privacy considerations, which DNS properties that are enabling DNS based Edge AS Discovery, recommendations/limitations for cases that OS/user overrides DNS setting.

In Edge Computing deployment, one application service may be served by multiple Edge Application Servers typically deployed in different sites. These multiple Edge Application Server instances that host same content or service may use a single IP address (anycast address) or different IP addresses. Before an application/UE starts to connect to the service, the application/UE is required to discover the IP address of a suitable Edge Application Server (e.g. the closest one), so that the traffic can be locally routed to the Edge Application Server, and service latency, traffic routing path and user service experience can be optimized.

EAS Discovery is the procedure by which a UE discovers the IP address of a suitable Edge Application Server for an application. EAS Rediscovery is the EAS Discovery procedure that takes place when the previously discovered Edge Application Server cannot be used or may have become non-optimal (e.g. at edge relocation to discover an Edge Application Server to replace the old one to serve the application/UE).

NOTE: This specification describes the discovery procedure based on 5GS NFs. However, this does not exclude any upper layer solution to be adopted by operator or service provider. See annex B.

EAS (re)discovery relies on DNS and has no impact on the Application itself that is kept agnostic of the operator connectivity model chosen. The mechanism enables the UE to be unaware of the application deployment (at edge or at central DN) and application ownership (e.g. the EAS is owned by the MNO or by a third party).

EAS (re)discovery relies on DNS mechanism where many Authoritative (DNS) Name servers return different responses based on the perceived topological location of the user, either using the source IP address of the DNS query or ECS when received according to RFC 7871 [7].

For an optimal EAS (re)discovery the following is required:

- The corresponding Authoritative DNS needs to support geographical resolution.

- The operator DNS settings provided for the PDU Session need to be applied. If the OS, user or applications override the operator-provided DNS settings, the DNS resolvers or servers in the third party may take the source IP address of the DNS request as the location information of UE, which may correspond to the local/remote PSA UPF or other entities (e.g. a NAT server) on the N6 interface.

UE IP address may be subject to privacy restrictions and shall not be sent to Authoritative DNS / DNS Resolvers outside the network operator; neither within ECS nor as Source IP address of the DNS Query. UE source IP address may be protected by using NAT mechanism of the DNS request.

In case the UE DNS Queries are addressing a DNS Resolver other than the one provided by the operator (e.g. depends on the UE Application client, Browser and/or OS configuration) see Annex A.

### 6.2.2 EAS (re-)discovery over Distributed Anchor connectivity model

#### 6.2.2.1 General

With Distributed Anchor connectivity model the PDU Session anchor is moved far out in the network. The PSA is the same for all the user PDU session traffic and according to subscription policies.

The DNS gets addressing information related to the UE topological location in one of two ways:

1. In the source IP address of the DNS query by providing a DNS Resolver for the PDU Session that is near the PSA. The 5GC(SMF) may provide a DNS that is closest to the PSA or it may provide an Anycast DNS address.

2. In an ECS header, by including in the DNS Query an ECS that is representative of the UE location /N6 interface, that DNS can use for resolution. In this case the 5GC(SMF) provides for the PDU Session, a DNS Resolver that supports RFC 7871 [7]. This name server adds an ECS that is representative of the UE location /N6 interface, e.g. based on the user IP address after (an optional) NAT.

For dynamic PSA distribution described in clause 6.2.2.2.1, only 2. is used. DNS gets addressing information related to a candidate UE topological location instead of the actual UE topological location, which is a central PSA.

#### 6.2.2.2 EAS discovery procedure

Editor’s Note: This clause describes the procedure for Edge AS Discovery over Distributed Anchor connectivity model according to the recommendations in the conclusions in the TR clause 9.1.2 (selected parts from Sol 2/4/5/10).

#### 6.2.2.2.1 General EAS Discovery procedure

#### 6.2.2.2.2 Procedure for EAS Discovery with dynamic PSA Distribution

5GC supports an EAS Discovery procedure that allows that at PDU session establishment the SMF selects a central PSA, regardless whether a local PSA is available to the SMF. The EAS Discovery triggers a PDU Session re-anchoring that is used to transition to the "Distributed Anchor Point" model. This is applicable to PDU Sessions type SSC#2 and SSC#3.

This procedure relies on LDNSR capability to influence the DNS Query of an Edge Application so that the EAS Discovery considers a candidate UE topological location of a PSA further out in the network than current PSA. The PDU Session re-anchoring to the edge is performed as part of the DNS resolution.

This procedure requires that the DNS settings provided to the UE for the PDU Session are respected.

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Figure 6.2.2.2.2-1 Application Server Discovery with Dynamic PSA distribution using LDNSR

The EAS Discovery procedure with Dynamic PSA distribution using LDNSR is described in Figure 6.2.2.2.2.-1

The AF may provide, at any time, EAS deployment information to UDR via Nnef\_TrafficInfluence service (see clause 5.2.6. in TS 23.502 [3]).

The PDU session establishment is performed as specified in TS 23.502 [3] clause 4.3.2. The PDU session is established with UPF1 (central PSA).

If Dynamic PSA distribution applies to the PDU Session, as part of PDU session establishment, the SMF selects a LDNSR based on SMF local configuration or using NF selection mechanism provided by NRF. The UE is provided the LDNSR address as the DNS name server for the PDU session.

Editor’s note: a session context for the PDU Session is created in LDNSR. Details of the session context contents and creation procedure and how that relates to PDU Session Establishment are FFS. Details will be available in clause 5.

The EAS Discovery procedure consists of the following steps:

1. The application in the UE does a DNS discovery request to discover the EAS. The DNS request is handled via central PSA (UPF1) by the LDNSR.

2. The LDNSR checks whether the FQDN in the DNS Query is an FQDN for which it needs to provide a specific handling. LDNSR proceeds with DNS resolution using one of the options described in clause 5 to convey UE IP location information for a selected DNAI/Edge PSA to the authoritative DNS server.

Editor’s note: how LDNSR gets the information of FQDNs for which the procedure applies, the option to apply and corresponding forwarding parameters is FFS. That will be detailed in clause 5.

3. The LDNSR checks the DNS response against the matching conditions that trigger interaction with SMF.

4. LDNSR interacts with SMF and provides it with the FQDN and the IP address of the EAS selected.

Editor’s note: the mechanism used for SMF-LDNSR interaction is FFS and should be detailed in clause 5.

5. The LDNSR request triggers SMF to consider selecting a new UPF. Selection Criteria is according to clause 6.3.3 of TS 23.501 [2]. The information provided by LDNSR is also considered. SMF determines that the serving UPF needs to be changed to an Edge UPF.

6. One of the following procedures is triggered by SMF in order to change the PDU Session Anchor serving the PDU Session:

- SSC mode 3 with IPv6 Multi-homed PDU Session (clause 4.3.5.3 of TS 23.502 [3]).

- SSC mode 3 with multiple PDU Sessions (clause 4.3.5.2 of TS 23.502 [3]).

- SSC mode 2, clause 4.3.5.1 of TS 23.502 [3].

Editor’s note: the following modifications are needed for SSC mode 2 and SSC mode 3 with SMF reallocation:

- SMF sends a "use DNAI for next PDU session" indication to the AMF by invoking the Nsmf\_PDUSession\_SMContextStatusNotify message. The indication contains the actual DNAI to be used for SMF selection by AMF for the next PDU Session from the UE on the same (DNN, S-NSSAI).

- This indication is then stored and used by AMF and conveyed to new SMF.

As part of the procedure to change the PDU session anchor, the UE is provided with new DNS settings including a DNS name server address for the PDU session.

Editor’s note: the session context for the PDU Session created in LDNSR is updated accordingly. How that relates to applicable PDU Session management procedure is FFS.

NOTE 2: Dynamic re-anchoring to an edge PSA implies that the UE IP address is changed from a UE IP address corresponding to the old (central) PSA to a UE IP address corresponding to the new (edge) PSA for all applications on the PDU session. If SSC#3, former PSA and IP will still be available for some time.

NOTE 3: Further re-anchoring (to a central UPF) may be triggered by the activity monitoring e.g. if EC application traffic ceases. In that case, LDNSR is provided again in the DNS settings for the PDU Session and a new EAS Discovery follows steps 1-11.

7. Once the PDU Session Anchor serving the PDU Session has been changed, SMF interacts with LDNSR, in order for LDNSR to know how to proceed with the DNS Response (only applicable to SSC#3 mode sessions, which still keep a session context in LDNSR).

 Editor’s note: the mechanism used for SMF-LDNSR interaction is FFS and should be detailed in clause 5.

8. The DNS response is forwarded to the UE.

9. The application may start sending traffic may start over UPF1 (Central PSA) to the selected EAS until an EAS rediscovery takes place (the application in the UE may as well be aware of the new connection and be designed to skip this step).

10. A new discovery (see clause 6.2.2.2.1) or a rediscovery procedure (see clause 6.2.2.3) is triggered.

11. Application traffic starts via the PDU Session Edge PSA to the discovered EAS.

#### 6.2.2.3 EAS re-discovery procedure at Edge relocation

Editor’s Note: This clause also describes rediscovery (UE based), and aspects and assumptions based on applicable clause 9.2.2 in the TR

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