**3GPP TSG-SA5 Meeting #156 *S5-244207***

Maastricht, Netherlands, 19 Aug - 23 Aug 2024

**Source: Samsung**

**Title: S&F Solutions.**

**Document for: Approval**

**Agenda Item: 6.19.15**

# 1 Decision/action requested

***Discuss and Agree.***

# 2 References

None

# 3 Rationale

This provides the solution for existing use case of NTN.

# 4 Detailed proposal

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| **First Change** |

### 5.3.1 Use case #1: Store and Forward

#### 5.3.1.1 Description

The use case and requirements of store and forward functionality in defined in [5]. The Store and Forward Satellite (S&F) operation in a 5G system with satellite access is intended to provide some level of communication service for UEs under satellite coverage with intermittent/temporary satellite connectivity (e.g. when the satellite is not connected via a feeder link or via ISL to the ground network) for delay-tolerant communication service. The concept of “S&F” service is widely used in the fields of delay-tolerant networking and disruption-tolerant networking.

The management of the S&F functionality need to be defined. The limitations on the size/amount of data that can be sent from the UE to the AF (Application Function, e.g IoT devices) and vice versa need to be configured. Forwarding priority for the stored data to the ground station or to the UE and data retention period for the exchanged data should be configured. The acknowledgment can be provided for the received messages. The acknowledge policy may dictate that the acknowledgment should not be provided. Whether to acknowledgement of the received data by the satellite could be issued possibly with the additional information about the store and forward including (not limited to)estimated time to deliver the messages need to be configured.

The S&F functionality requires to store the messages, in case of MO (mobile originated message), until the satellite coverage is available and the UE is connected to the network. This is when the stored messages are sent to the UE. Same goes for MT (mobile terminated messages) messages where UE messages are stored until the connection is established with the ground network (gateway) and messages can be delivered to the appropriate AF. Since the stored messages have to be read by the network entity at run time the format and the composition, needed to enforce the S&F delivery policies, of the stored message need to be defined.

#### 5.3.1.2 Potential requirements

**REQ-SNF-REQ-01:** The 3GPP management system should enable an authorized MnS consumer to configure the limitations to the size/amount of data that can be sent from the UE to the ground station.

**REQ-SNF-REQ-02:** The 3GPP management system should enable an authorized MnS consumer to the size/amount of data that can be sent from the ground station to the UE.

NOTE: The above requirement is not for a specific UE but for all the connected UE to the satellite.

**REQ-SNF-REQ-03:** The 3GPP management system should enable an authorized MnS consumer to configure the forwarding priority for the stored data to the ground station.

**REQ-SNF-REQ-04:** The 3GPP management system should enable an authorized MnS consumer to configure the forwarding priority for the stored data to the UE.

NOTE: The above requirement is not for a specific UE but for all the connected UE to the satellite.

**REQ-SNF-REQ-05:** The 3GPP management system should enable an authorized MnS consumer to configure the data retention period.

**REQ-SNF-REQ-06:** The 3GPP management system should enable an authorized MnS consumer to configure the acknowledgement policy for both MO and MT messages.

**REQ-SNF-REQ-07:** The 3GPP management system should enable an authorized MnS consumer to configure the estimated time to deliver the messages to the UE.

NOTE: The above requirement is not for a specific UE but for all the connected UE to the satellite.

**REQ-SNF-REQ-08:** The 3GPP management system should enable an authorized MnS consumer to configure the estimated time to deliver the messages to the ground station.

**REQ-SNF-REQ-09:** The 3GPP management system should enable an authorized MnS consumer to configure the elements of network on the ground to support the S&F functionality of a satellite.

#### 5.3.1.3 Potential solutions

##### 5.3.1.3.1 Potential solution #1: Store and Forward configuration and storage

Define a new IOC (S&FConfigInfo) containing information related with generic S&F configuration for the satellite. This will include the following:

* Date retention period: duration for which the data should be stored before it gets discarded.
* Storage quota:
	+ Per UE (MO): This will define the total storage quota assigned to a single UE.
	+ Per AF (MT): This will define the total storage quota assigned to a single AF.
* Estimated delivery time:
	+ MO delivery time to AF
	+ MT delivery time to UE
* Acknowledgement available:
	+ MO acknowledgement: Yes/No – If the value is YES, Onboard-NF will provide acknowledgement to UE after receiving the MO message.
	+ MT acknowledgement: Yes/No - If the value is YES, Onboard-NF will provide acknowledgement to AF after receiving the MT message.
* Forwarding priorities (to UE and AF):
	+ First come first forwarded: This will imply that the messages received first will be delivered first to UE and AF in MT and MO respectively.
	+ AF (MO) based priority: Various AF can be provided with the priorities. This will imply that the messages received for a higher priority AF will be delivered first. This can be implemented with a list of AF’s FQDN in the chronological order of their priorities.
	+ UE (MT) based priority: Various UE can be provided with the priorities. This will imply that the messages received for a higher priority UE will be delivered first. This can be implemented with a list of UE identifier (IMSI, IMEI, Anonymous id e.g. C-RNTI, etc) in the chronological order of their priorities.

**Procedure flow (S&F Configuration)**



Figure 5.3.1.3.1-1 S&F Configuration

1. Operator decides for a Onboard-NF to support S&F mode of operation based on some local policies and service contracts.
2. Consumer send a createMOI request for SatelliteInfo IOC. The SatelliteInfo IOC will contain information related with ephemeris, S&F mode of operation.
3. The producer configures the information. Since the GNBCUCPFunciton has a direct association with NTNFunciton, it will have the information contained in all the child MOI i.e SatelliteInfo.
4. The producer send the response indicating the successful configuration

Define a new IOC (e.g S&FStorageInfo) containing information related with generic S&F storage management for the satellite. This will include the following:

* StoreMessages: Total number of stored messages.
* StoredMesssageRecord
	+ Message Name: Standardized message name as defined in 5GS.
	+ Provided parameters: Name (standardized parameters name as defined in S5S) value pair for each provided parameter.
	+ Originator: Destination for the stored message (UE or AF).
	+ Destination: Destination for the stored message (UE or AF).
	+ Received Time: Time stamp indication the time at which the message was received.
	+ Message Size: Total size of the message in bits.
* StoreAndForwardInfoRef: Reference to the S&F configuration that should apply to the delivery of this message.

**Procedure flow (S&F Storage Configuration)**



Figure 5.3.1.3.1-2 S&F Storage Configuration

1-4. The NTN configuration is done.

5. At some future point of time, UE successful gets connected to the Onboard-NF configured with the S&F mode of operation.

6. The UE send some messages destined for a particular AF.

7. The Onboard-NF will enforce all polices and restriction as per the S&FConfigInfo instantiated before.

8. As per the acknowledgement policy, Onboard-NF may provide acknowledgement for the received message.

9. As per the S&F mode of operation, all the messages received get stored in a S&D DB. The message will be stored according to the information created as part of S&FStorageInfo.

10. Satellite establishes connection with ground station

11. Based on the forwarding policies, Onboard-NF forward messages to the appropriate AF.

Alternate to MO message handling (step 5-11), for MT message handling the following steps are taken

12. At some future point of time, AF successful gets connected to the Onboard-NF configured with the S&F mode of operation.

13. The AF send some messages destined for a particular UE.

14. The Onboard-NF will enforce all polices and restriction as per the S&FConfigInfo instantiated before.

15. As per the acknowledgement policy, Onboard-NF may provide acknowledgement for the received message.

16. As per the S&F mode of operation, all the messages received get stored in a S&F DB. The message will be stored according to the information created as part of S&FStorageInfo.

17. Satellite establishes connection with UE

18. Based on the forwarding policies, Onboard-NF forward messages to the appropriate UE.

Note: Although the solution proposes Onboard-NF to store the the messages, the actual entity storing the SnF messages need to be further confirmed as per the discussions in other working groups.

5.3.1.4 Evaluation of potential solutions

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| **Last Change** |