**SA WG2 Meeting #162 S2-2404872r01**

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**Source: NOVAMINT, Sateliot**

**Title: KI#2 - Initial principles for S&F Satellite operation for solution evaluation**

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**Agenda Item: 19.1**

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*Abstract of the contribution: This paper proposes some principles for solution evaluation for the FS\_5GSAT\_Ph3\_ARCH / TR 23.700-29.*

# 1 Introduction

The TR 23.700-29 proposes several solutions to address the listed 3 Key Issues as per listed in chap.6:

Table 6.0-1: Mapping of Solutions to Key Issues

|  |  |
| --- | --- |
|  | Key Issues |
| Solutions | 1 | 2 | 3 |  |
| 1 | X |  |  |  |
| 2 | X |  |  |  |
| 3 | X |  |  |  |
| 4 | X |  |  |  |
| 5 | X |  |  |  |
| 6 | X |  |  |  |
| 7 | X |  |  |  |
| 8 | X |  |  |  |
| 9 | X |  |  |  |
| 10 | X |  |  |  |
| 11 |  | X |  |  |
| 12 |  | X |  |  |
| 13 |  | X |  |  |
| 14 |  | X |  |  |
| 15 |  | X |  |  |
| 16 |  | X |  |  |
| 17 |  | X |  |  |
| 18 |  | X |  |  |
| 19 |  | X |  |  |
| 20 |  | X |  |  |
| 21 |  | X |  |  |
| 22 |  | X |  |  |
| 23 |  | X |  |  |
| 24 |  | X |  |  |
| 25 |  | X |  |  |
| 26 |  | X |  |  |
| 27 |  | X |  |  |
| 28 |  |  | X |  |
| 29 |  |  | X |  |
| 30 |  |  | X |  |
| 31 |  |  | X |  |
| 32 |  |  | X |  |
| 33 |  |  | X |  |
| 34 | X |  |  |  |
| 35 | X |  |  |  |
| 36 | X |  |  |  |
| 37 |  | X |  |  |
| 38 |  | X |  |  |
| 39 |  | X |  |  |
| 40 |  |  | X |  |
| 41 |  |  | X |  |
| 42 | X |  | X |  |

This paper proposes key principles which should be considered for the evaluation and conclusion of the key issue#2 based on the analysys conducted below.

# 2 Analysis of key principles for KI#2

The following section is providing analysis of key principles which should be considered for the evaluation and conclusion of the key issue#2 as following:

* The solution supports multi-satellites
* Roaming is supported
* The information indicating whether/when a satellite cell is operating in S&F Satellite operation mode or normal/default mode should be provided to the UE

Multi Satellites

Store and Forward Satellite operation is used in the case of NGSO (Non-Geostationary Satellite Orbit) constellation for delay tolerant communications for areas where there is intermittently/temporarily unavailability of the feeder link between the serving satellite and the ground network (e.g. at sea, very remote areas lack of ground-station infrastructures). Due to the nature of a NGSO constellation, the serving satellite is always changing. This is even reinforced for a moving UE.

Therefore, one of the key principles for KI#2 is that the solution shall support multi satellites.

Roaming Scenario

It is assumed that roaming scenario is a fundamental use case for delay tolerant services such as IoT NTN as it will be used as coverage extension to MNOs..

Therefore, another key principles for KI#2 is that the solution shall support roaming scenario.

Informing UE whether S&F Satellite operation is applied.

One of the service requirements from SA1 regarding Store & Forward Satellite operation ([1], clause 6.46.8.2) is the following:

*A 5G system with satellite access shall be able to inform a UE whether S&F Satellite operation is applied.*

The rationale for this requirement was based on the fact that a given satellite cell could be alternating between S&F and normal operation mode during an orbit. For instance, considering the case of an Earth-moving satellite cell in a NGSO constellation such as the one depicted in Figure 1. Such a satellite cell will have to be operated necessarily in S&F satellite operation mode when flying over service areas in which the satellite is or cannot be connected to the ground network. But the same satellite cell may be operated in normal/default mode in other service areas if a feeder link is available.



Figure 1. Illustration of a Earth-moving satellite cell operating switching operation between “normal/default” and “S&F” operation modes.

This situation could even change over time for a same service area. For example, a ground station could be installed to provide a feeder link in the service area where there was not previously or the feeder link could be unavailable for other reasons and the serving satellites could then operate in S&F Satellite operation mode for a brief time.

Given that a UE could be supporting different services and applications and as S&F has an impact on the services and use cases, awareness of S&F on the UE side allows for optimization of the UE operation.

For instance, with this knowledge, a UE working for real-time application can autonomously skip a cell operating in S&F mode during the cell selection or cell reselection. In a similar way, a UE working for delay-tolerant application can select and get connected via the cell in S&F and adjust data transfer to the constraints imposed by the S&F operation. Since only UE can be aware of the application layer information, this sort of decisions could be left to UE implementation based on the S&F assistance information delivered by the network.

This should apply also for SMS which can be used by different types of UE including IoT devices and there should be a consistent and similar solution for SMS or other services.

Therefore, the another key principles for KI#2 is that the information indicating whether/when a satellite cell is operating in S&F Satellite operation mode or normal/default mode should be provided to the UE.

**References:**

[1] 3GPP TS 22.261: "Service requirements for the 5G system; Stage 1".

# 3 Proposal

It is proposed to include the following changes in TR 23.700-29 V0.4.0.

 **\* \* \* \* Start of Changes – All New Text \* \* \* \***

## 7.X Key Issue #2 Principles for evaluation

The solution evaluation and conclusion for key issue#2 should be performed following the principles and criteria below:

* The solution supports multi-satellites
* Roaming is supported (the definition of roaming should be clarified?)
* The information indicating whether/when a satellite cell is operating in S&F Satellite operation mode or normal/default mode should be provided to the UE
* Support of SMS service, CIoT CP at least
* Delay for a UE to complete the attach procedure and for a registered UE to access service
* 3GPP procedures which would require change or new definition
* Proprietary NFs needed to support S&F
* Compute and storage requirements on satellite considering limitation of satellite payload, which can be estimated based on NFs deployed on the satellite.
* UE location verification
* Support of MT data transmission (to be clarified)
* Security consideration

**\* \* \* \* End of Changes \* \* \* \***