Feasibility Study on supporting 5G delay sensitive services allowing satellite access

S1 Rel-18 Study Proposal
-Motivations, Use cases and Objectives

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Motivation (1/2)

- End to end delay is the key factor impacting user experience.
- Integration of Satellite Access Network in 5G (FS_5GSAT) has been well studied in R-16 with the assumption of 5GC on the ground.
  - TR 22.822 Table 2 in Chapter 6 gives one-Way Max propagation delays.
    - 3GPP has studied use cases with the delays including service link delay (UE to satellite delay) and feeder link delay (Satellite to GW delay).

Table 2: UE to satellite propagation delay

	UE to satellite Delay [ms]		One-Way Max propagation delay [ms]
	Min	Max	
LEO	3	15	30
MEO	27	43	90
GEO	120	140	280

  - Due to service link delay and feeder link delay, the UE to 5GC delay is much higher than that of terrestrial mobile access network.
  - When ISL link is considered, more delay is added to the UE to 5GC delay; what may significantly hurt user experience.
    - Feeder link, ISL link and service link all contribute to UE to 5GC delay.

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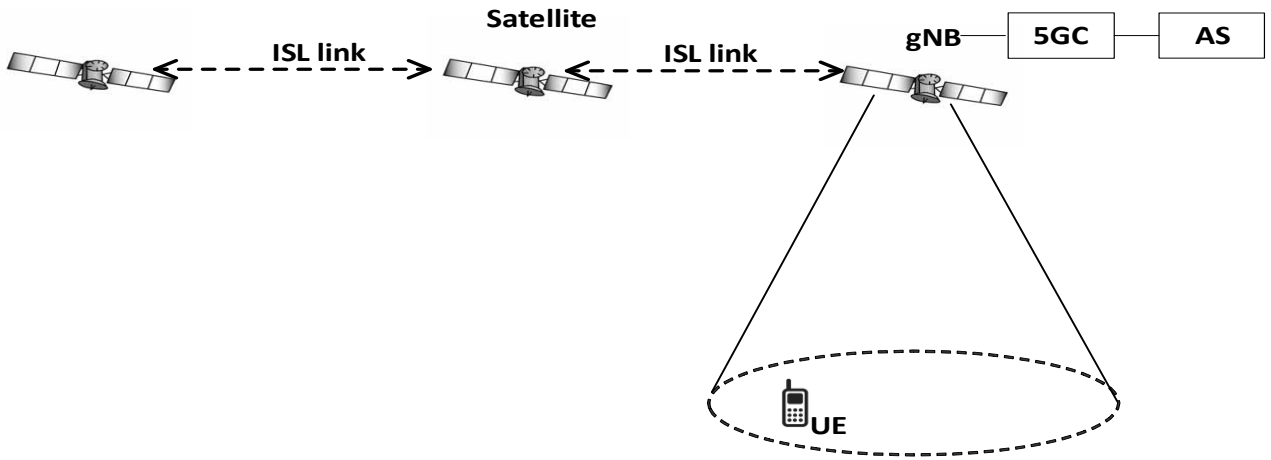
Motivation (2/2)

- In some use cases, components of application server dedicated for satellite access may be deployed on satellite.
- UE-5GC delay could be reduced significantly if moving gNB and 5GC components to Satellite.
  - Feeder link delay = 0
  - ISL link delay could be removed if 5GC components and gNB serving the UE are both deployed on the same satellite.



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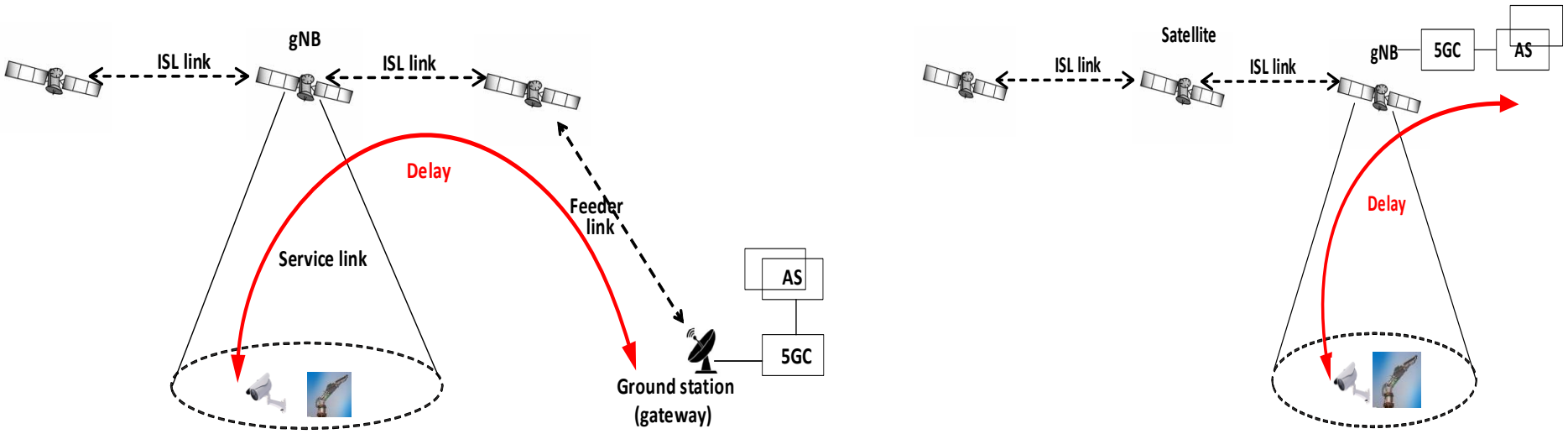
Example Use case 1-1: Mobile surveillance and analysis

- A camera and multiple sensors are carried on board a vehicle in the desert, and the collected data is transmitted to the mobile surveillance server for processing. Once processed, data is further transmitted to another server for analysis and to derive immediate instructions to feedback to the camera and sensors on the vehicle.



Delay comparison: 5GC and AS on ground Vs 5GC and AS on satellite

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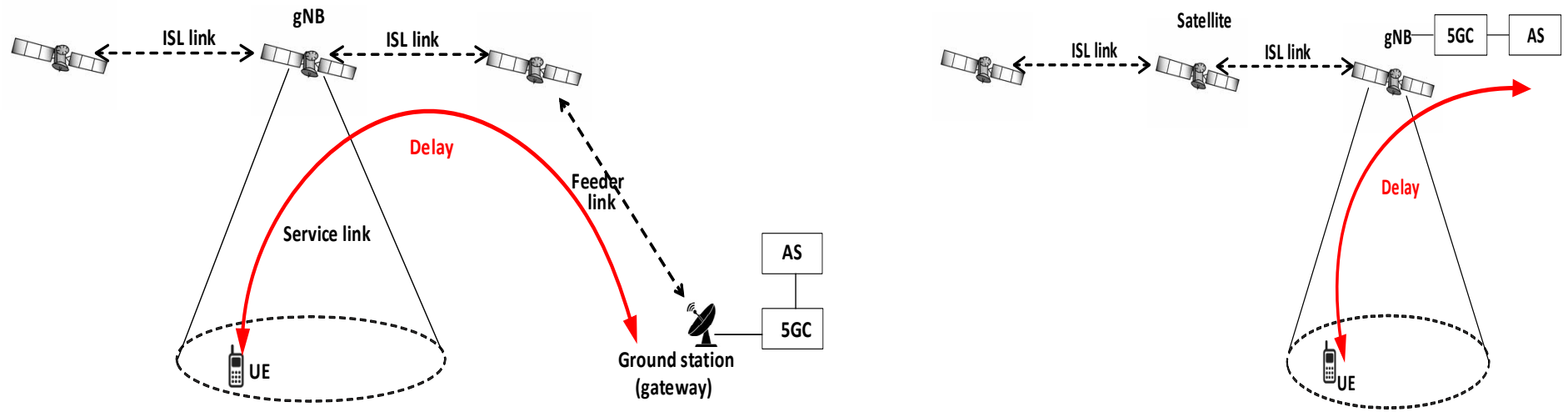
Example Use case 1-2: Gaming&Stocking trading

- Communication path between a 5G Satellite UE and the AS does not require going through the ground station, thus the UE to 5GC delay is largely reduced by removing feeder link delay and ISL link delay, what greatly benefits delay sensitive services such as:
    - Game playing, trading on stocks, auctions, etc.



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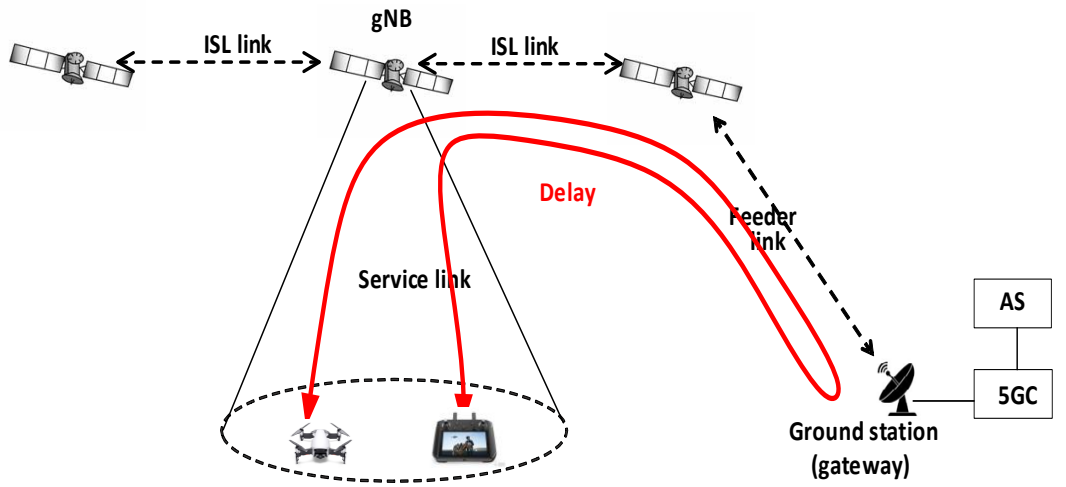
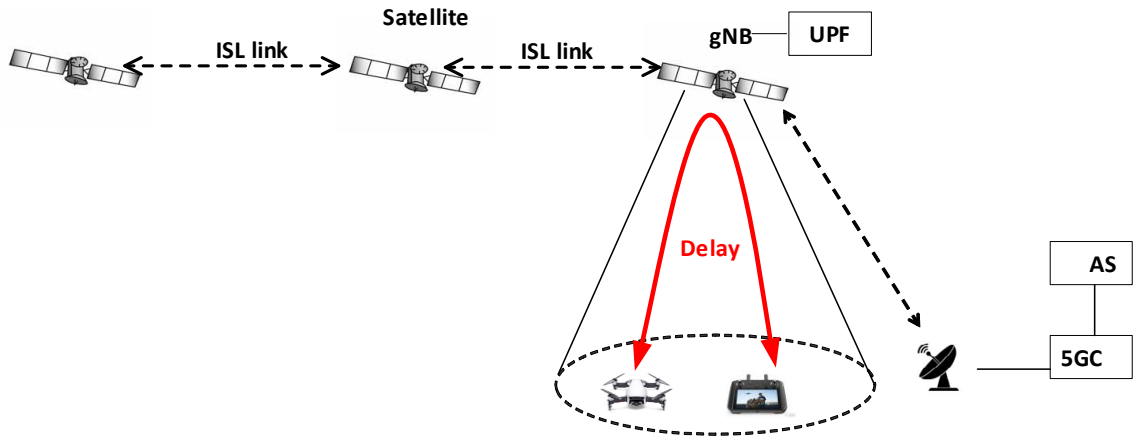
Example Use case 2-1: UAV C2 control

- A person working on a ship in the ocean controls a UAV beyond its visual line carrying on a task, the C2 communication is via UPF on the satellite.





Delay comparison: 5GC and AS on ground Vs 5GC and AS on satellite

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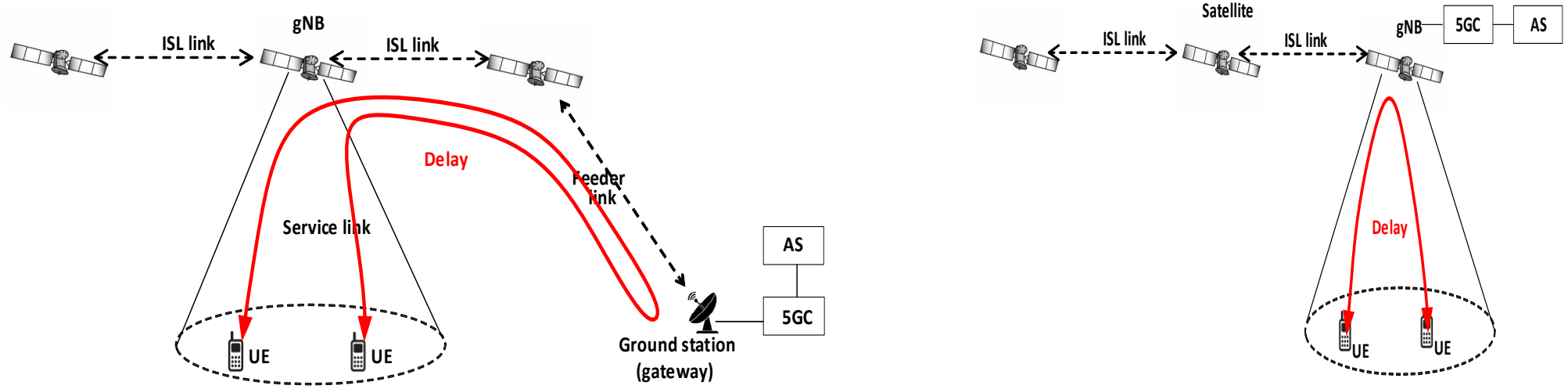
Example Use case 2-2: Call between UEs

- Call between 5G Satellite UEs under the same gNB coverage.
- Communication path between the two 5G Satellite UEs does not require going through the ground station, thus the UE to 5GC delay is largely reduced by removing feeder link delay and ISL link delay.



Delay comparison: 5GC and AS on ground Vs 5GC and AS on satellite

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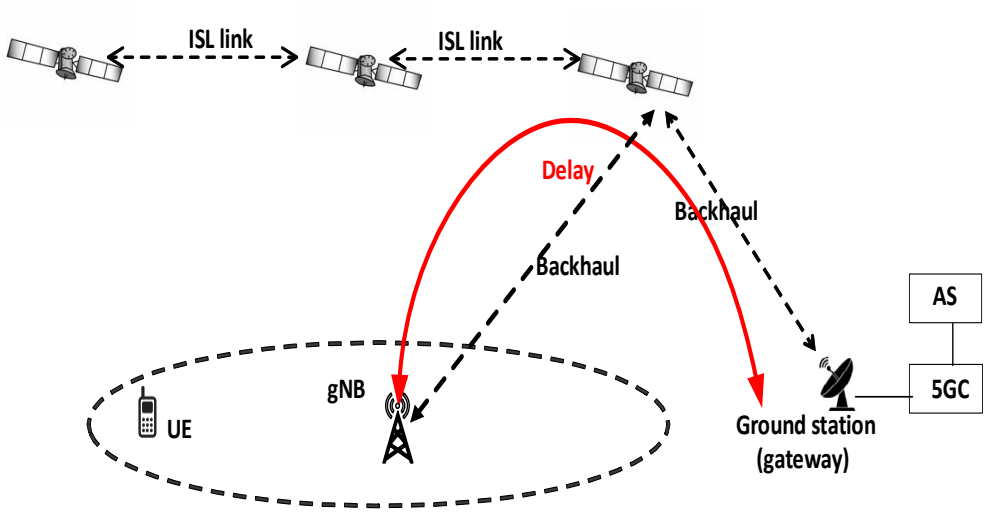
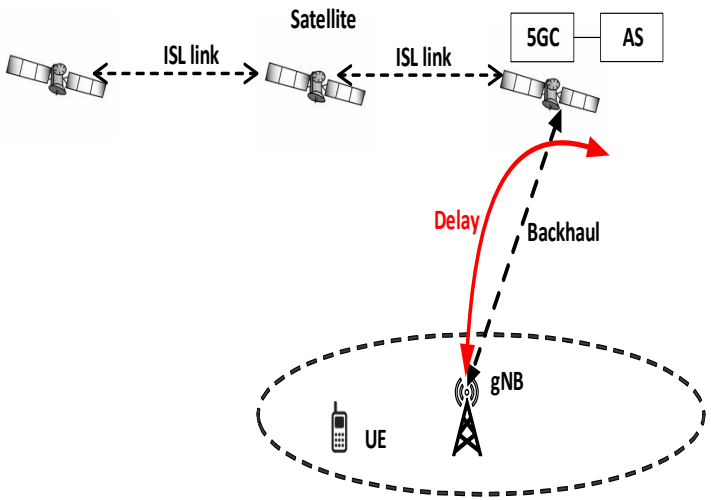
Example Use case 3: Service access from isolated island

- Terrestrial Access network is deployed in an isolated island to serve people living on the island, satellite backhaul is used to connect access network to 5GC and AS.





Delay comparison: 5GC and AS on ground Vs 5GC and AS on satellite

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SA1 Rel-18 Study Proposal - Objectives

- This SID will study the use cases for supporting 5G delay sensitive services allowing Satellite access, including:
  - Use cases for gNB on the satellite, and components of 5GC and AS on satellite
  - Use cases for gNB on the ground, and components of 5GC and AS on satellite
- Identify potential requirements of above use cases, including but not limited to
    - KPIs for specific applications/media etc., e.g. latency
    - Requirements for enforcement of the specific applications/media etc.
    - Security aspects
    - Charging aspects
    - Regulatory aspects, if any, for the use cases above
- Evaluate the gap between the identified potential requirements and the existing requirements.

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