



WE LOOK AFTER THE EARTH BEAT

# CEA workshop 5G electronics, 3rd July 2018

## “Enablers for Satellite integration in 5G system”

Nicolas Chuberre, Cyril Michel, Fabrice Arnal, JM Houssin,  
Thales Alenia Space

02/07/2018

Ref.:

THALES ALENIA SPACE INTERNAL

ThalesAlenia  
A Thales / Finmeccanica Company  
Space

83230353-DOC-TAS-EN-003

- ✈ Rational for satellite in 5G ?
- ✈ Integration scenarios of satellite in 5G system
- ✈ NR via satellite
- ✈ Satellite roadmap in 3GPP



WE LOOK AFTER THE EARTH BEAT

# Rational for satellite in 5G

02/07/2018

THALES ALENIA SPACE INTERNAL



83230353-DOC-TAS-EN-003

- ✈️ Telcos to address two main challenges
  - ✈️ Capacity in dense urban areas
    - Sustain the increasing average bandwidth per user fuelled by HD video
  - ✈️ Coverage in rural areas
    - Coverage is a key QoS performance for verticals but also for consumers

5G: a way to address capacity/coverage challenges.  
It shall not be restricted to townfolks

# Role of Non-Terrestrial networks in 5G

Towards COOPERATION with fixed, cellular and wireless technologies to address specific challenges

## Service continuity

### Moving platforms

*Transportation (High speed rail, Aircraft, vessels, buses),  
connected cars, Fleet management,*

5G  
satellite

## Service ubiquity

### Unserved and underserved areas

*Fixed Wireless Access, Emergency networks, Remote  
medical, Internet of things (agriculture, oil & gas,  
critical infrastructure surveillance..)*

## Service scalability

### Sustain massive audience

*Leverage broadcast to convey  
popular content in various format including 3D  
video, Ultra High Definition Video*


**Transport**  
(maritime, logistics, railways, aeronautics)  
**Public Safety**  
**Mission Critical**  
**Communication**  
**Media &**  
**Content Delivery**  
**Agriculture**  
**Manufacturing**  
**Finance**  
**Energy**

Non-Terrestrial networks are key to support vertical market requirements and mitigate the digital divide

THALES ALENIA SPACE INTERNAL

This document is not to be reproduced, modified, adapted, published, translated in any material form in whole or in part nor disclosed to any third party without the prior written permission of Thales Alenia Space - © 2014, Thales Alenia Space

ThalesAlenia  
Space  
A Thales / Finmeccanica Company



WE LOOK AFTER THE EARTH BEAT

# Integration scenarios of satellite in 5G system

02/07/2018

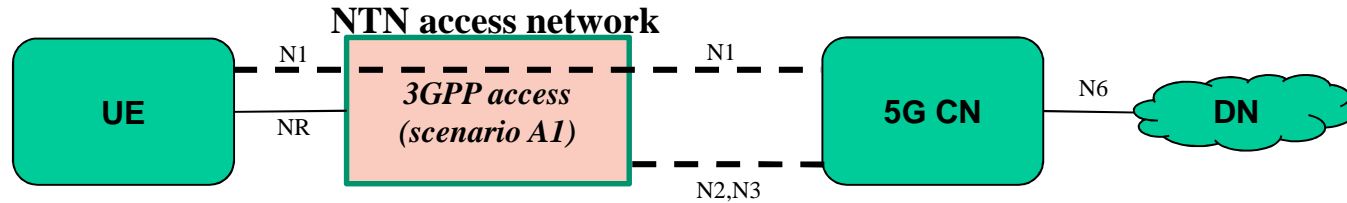
Ref.:

THALES ALENIA SPACE INTERNAL

ThalesAlenia  
A Thales / Finmeccanica Company *Space*

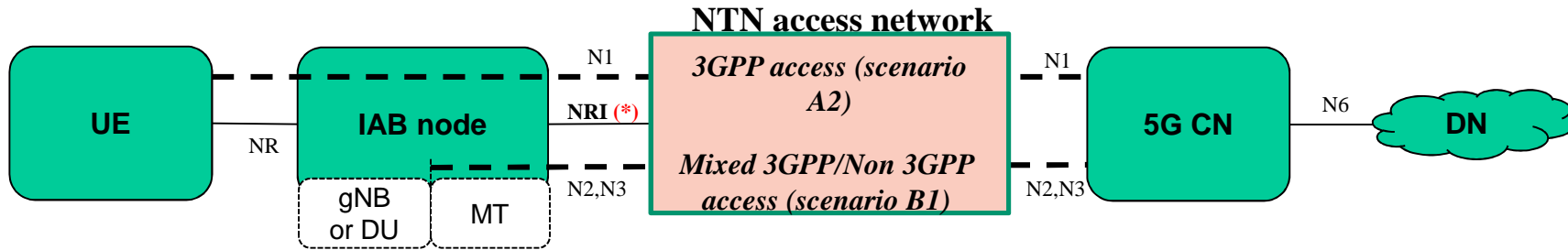
# Integration scenarios of Non-Terrestrial networks in 5G system

*A1 scenario: Direct access with 3GPP defined NTN access network*



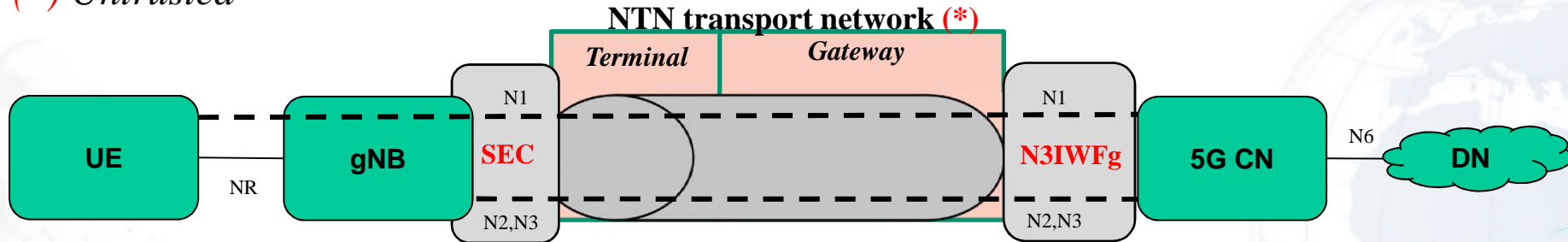
*A2/B1 scenarios: Indirect access with 3GPP or non 3GPP defined NTN access network.*

*The NTN Radio Interface (NRI) = 3GPP NR or (\*) mixing NR higher layers with proprietary L2, L1 layers*



*B2/B3 scenarios: Non-terrestrial transport network which may be trusted or*

*(\*) Untrusted*



# Expected cost reduction for each scenarios

Scenarios	CAPEX/OP EX reduction	Rational
A1	High impact	Access to global economy of scale of cellular market thanks to technology commonalities including UE chipset and hardware platforms.
A2	High impact	Same as above. Leveraging integrated access and backhaul feature to allow Telcos can control the radio resources of the SatCom
B1	Medium impact	Reduce development cost through reuse of 5G core network functions. Adaptation layers needed to map 3GPP protocols onto the Satellite radio interface. Telcos could also control the SatCom radio resources.
B2	Low impact.	Only network management system can be common between the cellular and the satellite systems
B3	Low impact	Same as above





WE LOOK AFTER THE EARTH BEAT

# NR via satellite

02/07/2018

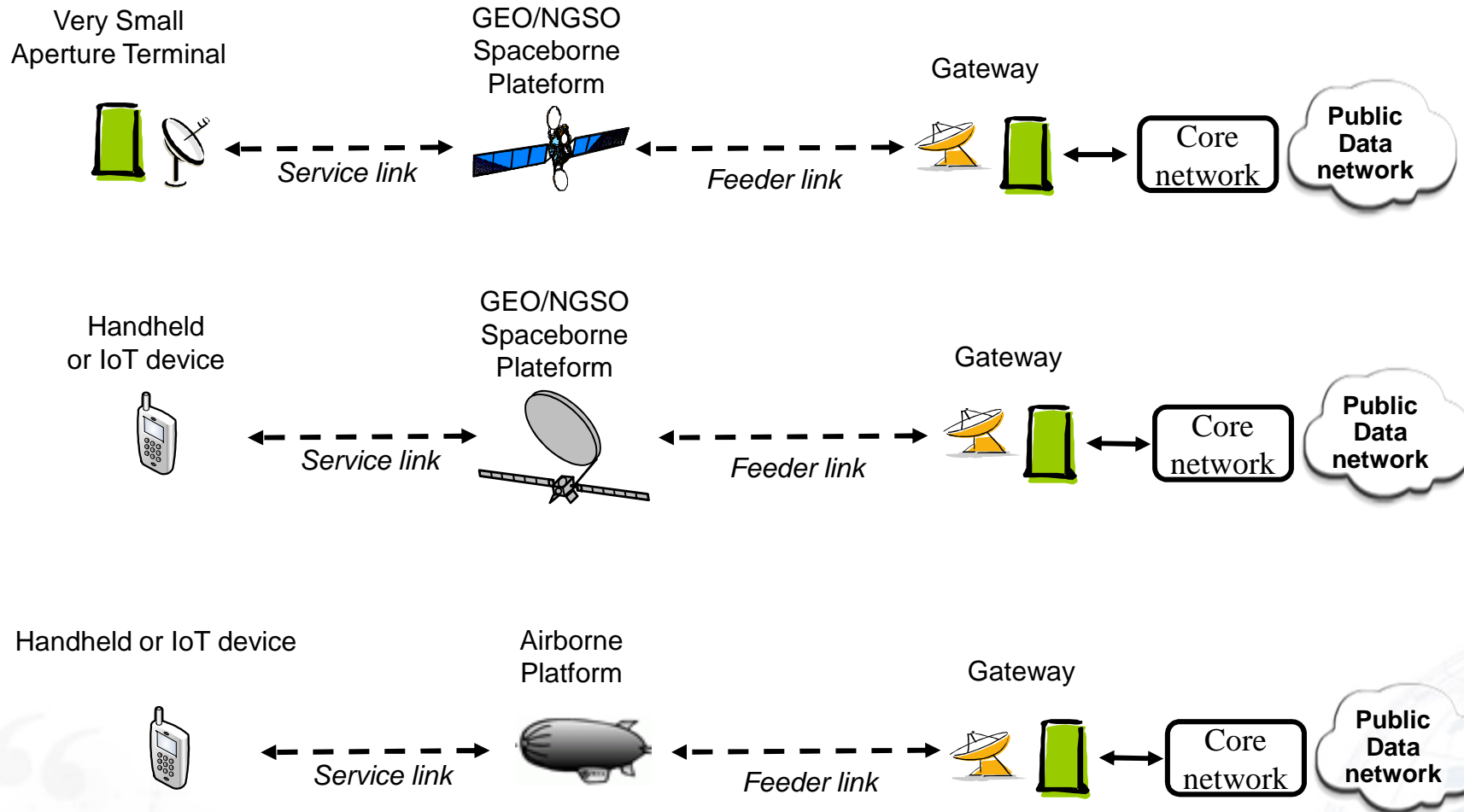


THALES ALENIA SPACE INTERNAL

ThalesAlenia  
A Thales / Finmeccanica Company *Space*

83230353-DOC-TAS-EN-003

# 5G NR a candidate radio interface on the service link of Non Terrestrial networks



# Areas of NR Impacts to support Non-Terrestrial Networks (outcomes of 3GPP TR 38.811 v1.0.0) 11

Non-Terrestrial network specifics	Effects	Impacted NR features	Potential areas of impact to be further studied	Comment
Motion of the space/aerial vehicles	Moving cell pattern	Hand-over/paging	Higher layers impact	Paging and Hand-over procedures may need to be adapted
	Delay variation	TA adjustment	Physical layer impact	Alignment of uplink signals may need to be considered
	Doppler	Initial downlink synchronisation	No impact	Preferred SCS may be 60 KHz for < 6 GHz and 240 KHz > 6 GHz.
DMRS time density		No impact	-	
Altitude	Long latency	HARQ	Higher Layers & physical layer Impact	Deactivation or enhancements of NR HARQ may need to be considered
		Physical layer Procedures (ACM, power control)	Physical layer impact	The operation/configuration of Adaptive power and coding/modulation control loop protocols may need to be adapted.
		MAC/RLC Procedures	Higher layers impact	Timers limit may need to be extended
Cell size	Differential delay	TA in Random access response message	Physical layer impact	Doppler/Delay compensation technique may need to be implemented.
		Random access	Physical layer impact	
Propagation channel	Impairments	DMRS frequency density	No impact	-
	Impairments	Cyclic prefix	No impact	-
Spectrum	Regulatory constraints	Duplexing mode (TDD/FDD)	Higher layers impact	FDD is preferred. TDD can be considered for HAPS and for LEO
Satellite or aerial Payload performance	phase noise impairment	PT-RS	Physical layer	Enhancing solutions may need to be considered
	Back-off	PAPR	Physical layer	Enhancing solutions may need to be considered



WE LOOK AFTER THE EARTH BEAT

# Satellite roadmap in 3GPP

02/07/2018

THALES ALENIA SPACE INTERNAL



83230353-DOC-TAS-EN-003

# 3GPP Release focus

## SA: Services & Systems Aspects

SA WGs	Possible objective
<b>SA1: Services</b>	Ensure that 5G service requirements cover satellite use cases
<b>SA2: Architecture</b>	Ensure that the architecture requirements cover satellite use cases
<b>SA3: Security</b>	Ensure compatibility of the security architecture with integrated satellite scenarios
<b>SA4: Codec</b>	Not relevant
<b>SA5: Telecom Management</b>	Ensure compatibility of the network management architecture with integrated satellite scenarios
<b>SA6: Mission-critical applications</b>	Ensure that the specifications allows extension over satellite component (backhaul or direct access)

## RAN: Radio Access Networks

13

RAN WGs	Possible objective
<b>RAN1: Radio Layer 1 specification</b>	Ensure compatibility of 5G physical layer for operation via satellite
<b>RAN2: Radio Layer 2 and Radio Layer 3 RR specification</b>	Ensure compatibility of 5G access layer for operation over MSS-Constellation and over VHTS
<b>RAN3: Iub Iur and Iu specification - UTRAN O&amp;M requirements</b>	Ensure compatibility of backhaul protocols/architecture with VHTS
<b>RAN4: Radio performance and protocol aspects (system) - RF parameters and BS conformance</b>	Assess performance of NRAT via satellite
<b>RAN5: Mobile terminal conformance testing</b>	For conformance test definitions (in the future)
<b>RAN6: Legacy RAN radio and protocol</b>	Not relevant
<b>RAN AHG1: Ad-hoc group on ITU (internal) co-ordination</b>	Liaisons between 3GPP and ITU

02/

THALES ALENIA SPACE INTERNAL

Ref.:

This document is not to be reproduced, modified, adapted, published, translated in any material form in whole or in part nor disclosed to any third party without the prior written permission of Thales Alenia Space - © 2014, Thales Alenia Space

## 1. Release 15 items: Approval of TRs

- **TR 38.811 v1.0.0 “New radio support Non-terrestrial networks”:** RP-181393
- **TR 22.822 v1.0.0 “Feasibility of 5G Satellite access”:** SP-180335

## 2. Release 16: Approval of new study/work items

- **SA1 Work Item to « Normalisation phase of Satellite Integration »:** SP-180326
- **SA2 study item “Satellite in 5G system Architecture”:** SP-180505
- **RAN1/2/3 study item “Solutions for NR to support non-terrestrial networks (NTN)”:** RP-181370

■ Study a set of necessary features/adaptations enabling the operation of NR protocol in non-terrestrial networks for 3GPP

■ ***Physical layer***

- Physical layer control procedures
- Uplink Timing advance/RACH procedure
- delay-tolerant retransmission mechanisms (HARQ).
- Performance assessment

■ ***Layer 2 and above, and RAN architecture***

- Propagation delay: Identify timing requirements and solutions on layer 2 aspects
- Handover
- Architecture including Paging



WE LOOK AFTER THE EARTH BEAT

## Contacts

[nicolas.chuberre@thalesaleniaspace.com](mailto:nicolas.chuberre@thalesaleniaspace.com)

[cyril.michel@thalesaleniaspace.com](mailto:cyril.michel@thalesaleniaspace.com)

02/07/2018

THALES ALENIA SPACE INTERNAL

ThalesAlenia  
A Thales / Finmeccanica Company  
Space