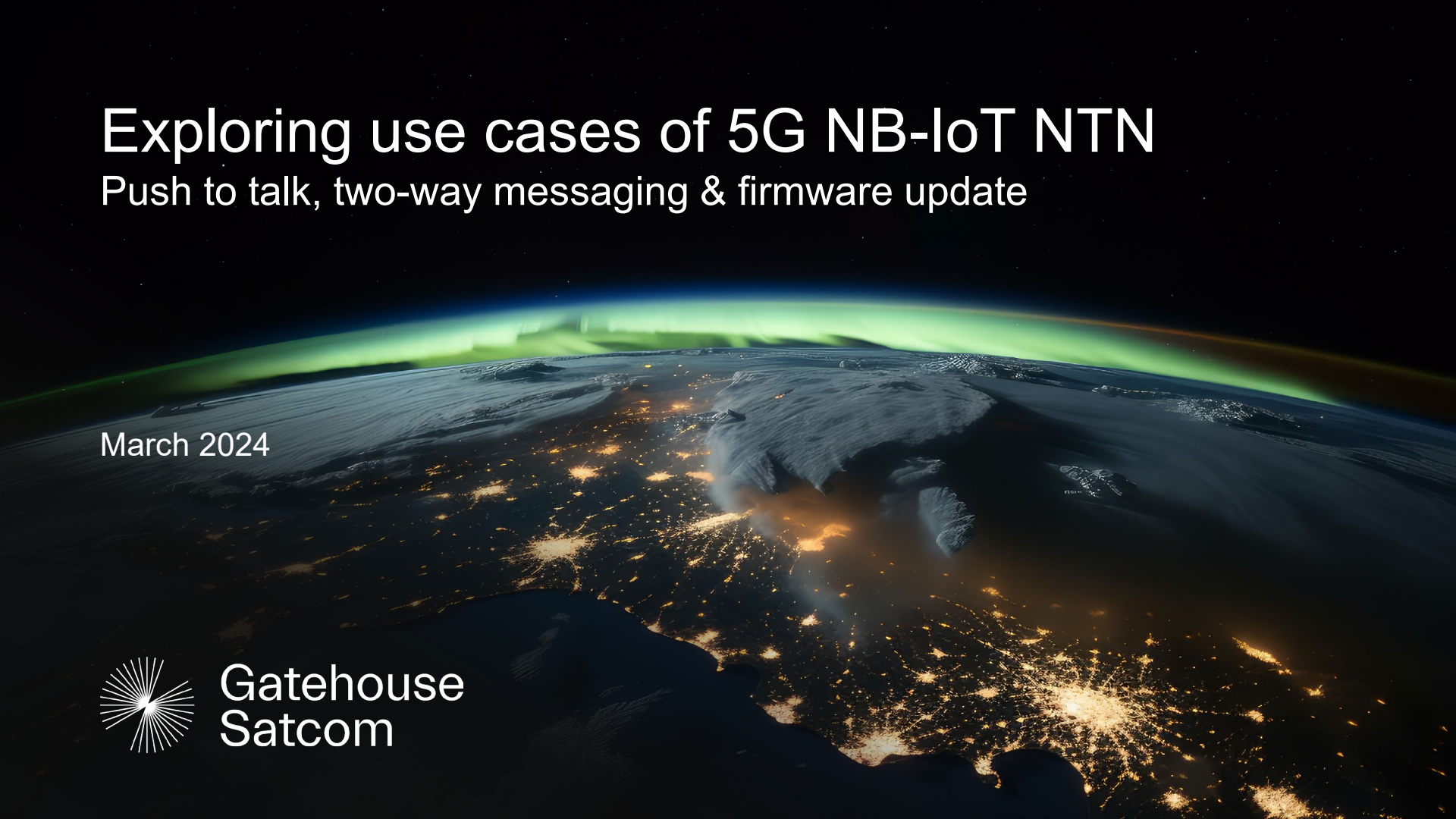
Exploring use cases of 5G NB-IoT NTN

Push to talk, two-way messaging & firmware update

March 2024



Gatehouse Satcom

Agenda

- Welcome and Introduction to Gatehouse Satcom
- What's the potential of 5G NB-IoT NTN?
- Technical requirements of push to talk, two-way messaging and firmware updates.
- Use-case feasibility with 5G NB-IoT in various satellite configurations
- What does it take to launch a 5G NTN service?
- Live Q&A Session

Presenters

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Gatehouse Satcom

Gatehouse Satcom

Global provider of embedded software, communications protocol stacks, waveforms and test tools for terminals, satellites, and network infrastructure.

25 years of experience working with +15 satcom technologies

Actively contributing to new 5G NTN standards in 3GPP

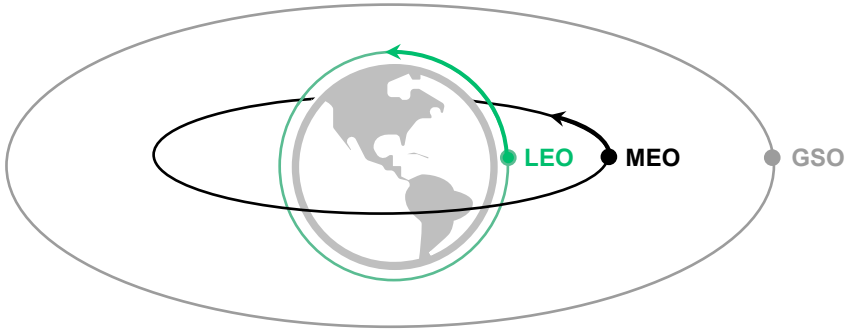
Roadmap validation, demonstration and deployment.

What’s the potential of 5G NB-IoT NTN?

Intro

Services

1. Two-way messaging
2. Push to talk
3. Over the air updates

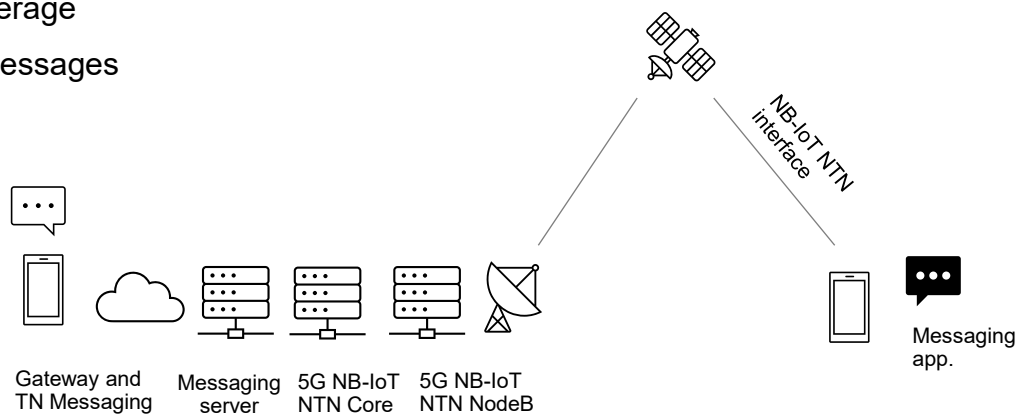


Constellations

	LEO	MEO	GSO
Height	600 km	10000 km	35800 km
RTT (Service + Feeder)	25.77 ms	186.9 ms	541.46 ms

Use case: Two-way messaging

1. Connectivity in remote areas with no TN coverage
2. Receive and send standard 160-character messages – preferably using existing messaging app
3. Delay not to exceed 10 minutes
4. Outdoor and LOS can be accepted initially



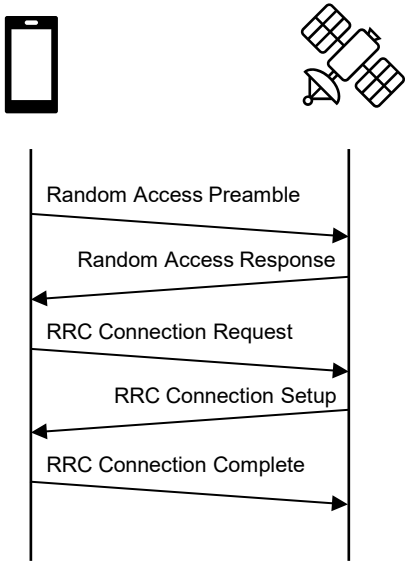
Use case: Two-way messaging

Setting

1. Rural, Outdoor, LOS
2. ST 3.75 kHz UL transmission
3. DL SNR is 6 dB lower than UL SNR
4. Scheduler chooses transport block (TB) segmentation for least resources used
5. A 28 Byte COAP header is assumed in addition to the 160 Byte text
6. 10% BLER target, HARQ enabled

CP optimized Data over NAS message exchange

1. NAS containers for data in “RRC Connection Setup” and “RRC Connection Complete”



Use case: Two-way messaging

Verdict

1. The total exchange time is in the order of tens of seconds, even in the case of poor link conditions.
2. It is completely viable

Total exchange times for full eNB onboard SAN

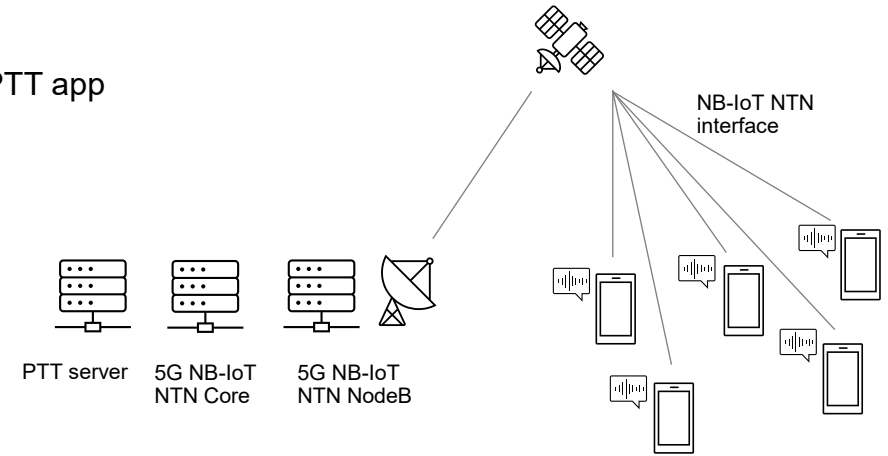
SNR (UL)	LEO	MEO	GSO
-5	14.6	16.3	20.1
-3	4.9	5.7	7.5
0	2.3	3.4	5.8
3	1.2	2.3	4.6
5	0.9	1.7	3.4

Total exchange times for a transparent payload

SNR (UL)	LEO	MEO	GSO
-5	14.9	18.3	26
-3	5	6.7	10.4
0	2.5	4.7	9.5
3	1.3	3.5	8.3
5	1.1	2.6	6

Use case: Push-to-talk – voice messaging

1. Push-to-talk voice messaging via satellite
2. Record and receive voice messages using PTT app of up to 30 seconds.
3. Delay not to exceed 1 minute
4. Outdoor and LOS can be accepted initially



Use case: Push-to-talk – voice messaging

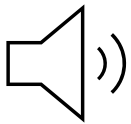
Setting

1. Rural, Outdoor, LOS
2. ST 3.75 kHz UL transmission
3. DL SNR is 6 dB lower than UL SNR
4. Scheduler chooses TB segmentation for least resources used
5. 10% BLER target, HARQ enabled

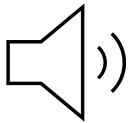
Technical aspects

1. CP optimized Data over NAS message exchange
2. LyRa codec can encode lossy speech audio at 3-4 kbps
    1. Sacrifice audio quality for recognizable speech at low bitrates
    2. A 30 sec audio clip is then 120kb

Original



Lyra at 3 kbps

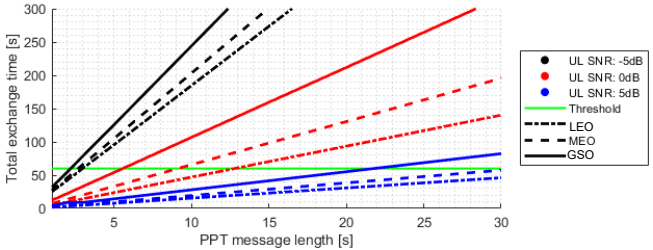


Use case: Push-to-talk – voice messaging

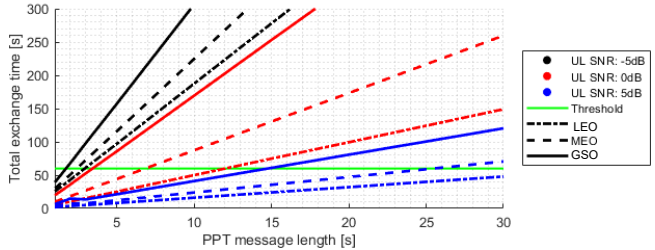
Verdict

1. Can be supported in good link conditions.
2. LEO and regenerative architectures can support longer message lengths at the delay threshold.

Total exchange time for full eNB onboard SAN



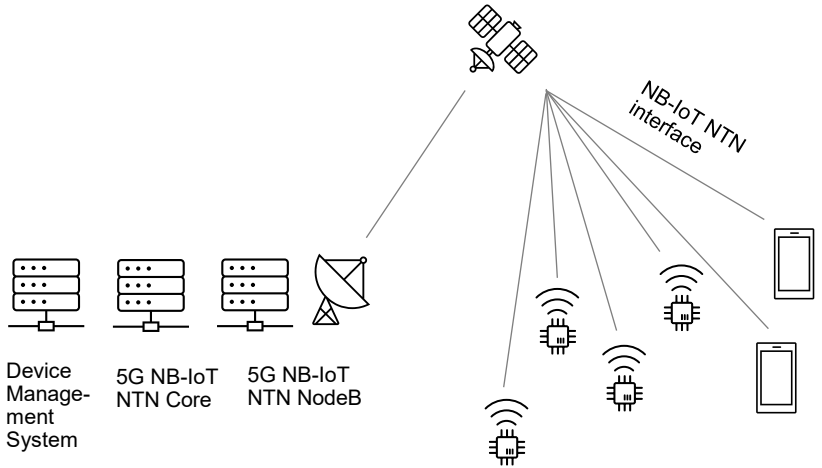
Total exchange time for transparent payload



Use case: Over-the-air update

Devices can be updated over-the-air without need for physical presence.

1. Minimum of 1000 bytes
2. Delivery within 1 week
3. Must include tracking of successful update
4. Possibility for priority service for instant update
5. Possibility for multicast updates to multiple devices



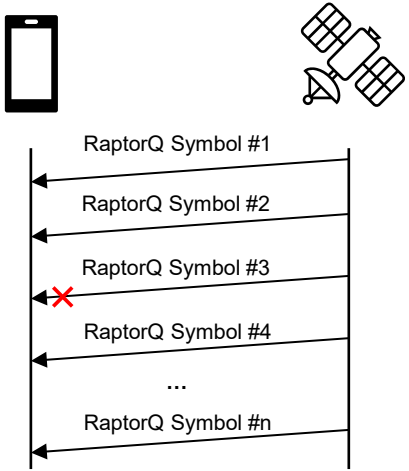
Use case: Over-the-air update

Setting

1. Rural, Outdoor, LOS.
2. DL SNR is selected to be -11 dB.
3. 10% BLER target.
4. Scheduler chooses TBS segmentation for least resources used.

Technical aspects

1. Multicast – SC-PTM on dedicated carrier
2. No HARQ - Fountain coding (RaptorQ , IETF RFC 6330)
    1. Greater than 99.9999% recovery probability with overhead of 2 TBs
    2. We add TBs to achieve greater than 99.99% probability of reception n+2 TBs at 10% BLER

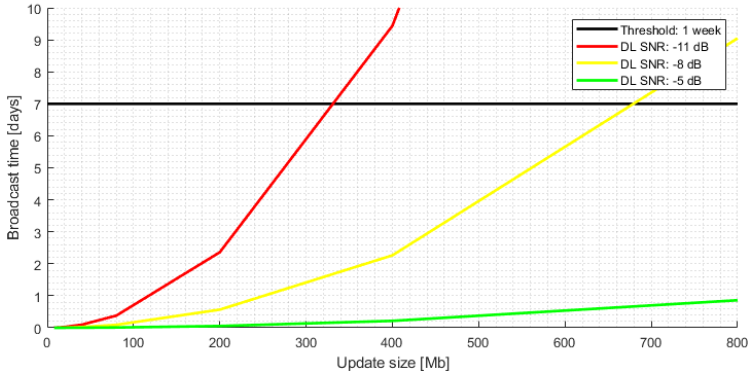


Use case: Over-the-air update

Verdict

1. Highly reliable for rather large transmissions within the use-case threshold.
2. Costly, in terms of occupying a full carrier for the broadcast period.
3. Reliability and throughput could be enhanced with an APP-level ARQ on missing RaptorQ symbols (TBs).

Total broadcast time for FOTA



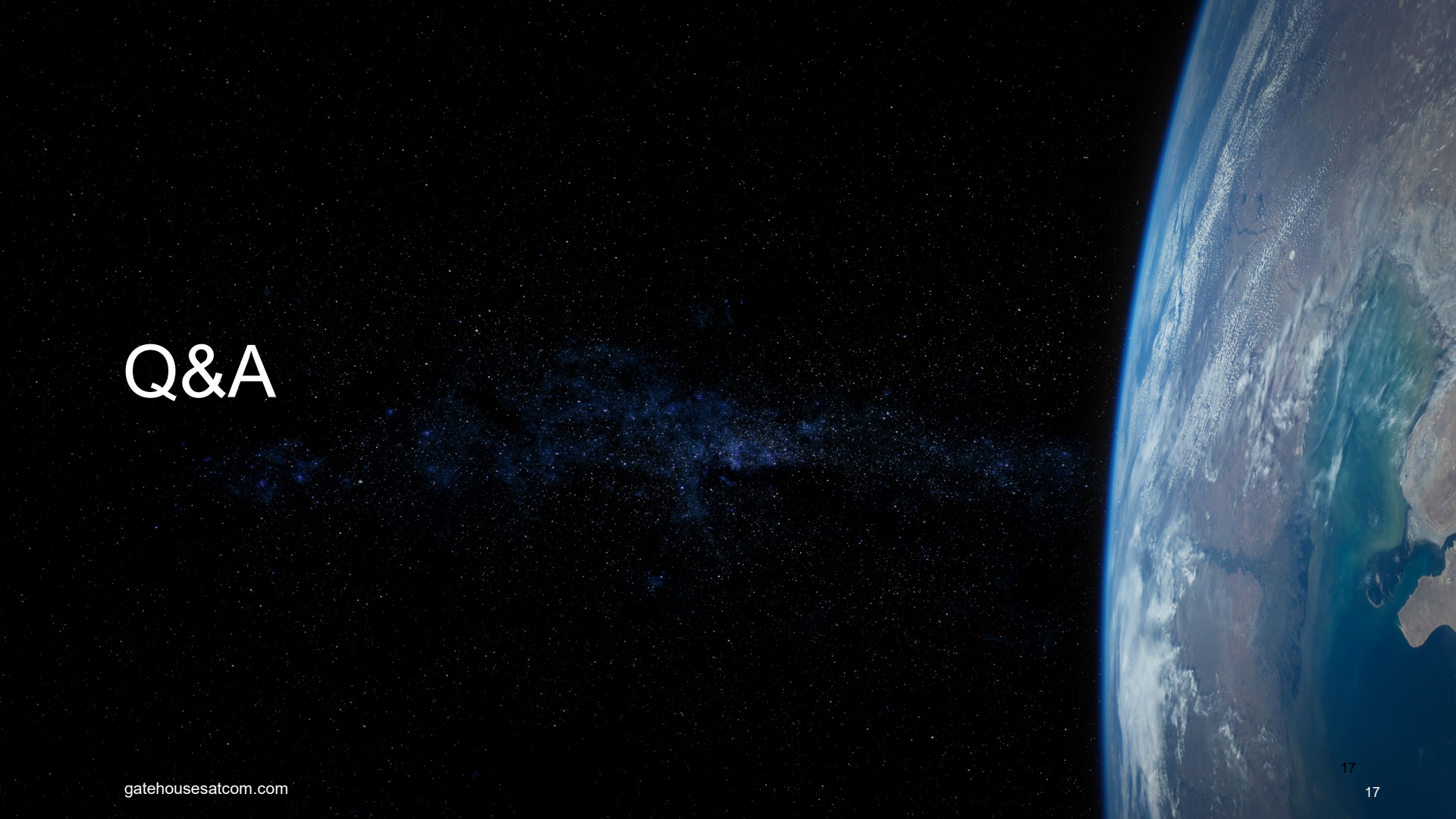
What does it take to launch a 5G NTN service?

Dedicated study: Be ready before the market adopts the technology.

Design and adapt your system to your future solutions.

Confidently enter the 5G NTN market – with a validated plan.

Q&A



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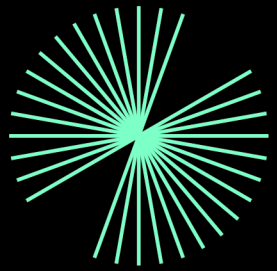

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