

# How cloud helps your IoT devices to get location data

A part of Mobile World Congress experience



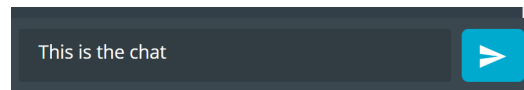
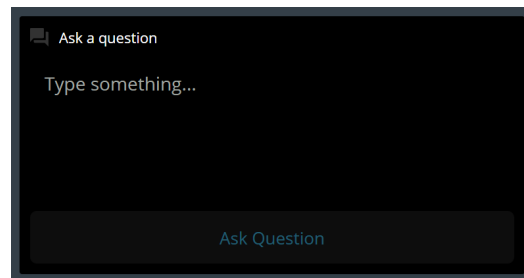
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# Agenda

- Practicalities
- Introduction to the speaker
- Help and technical support
- Introduction to “How cloud can help IoT devices with location data”
  - How Cloud Helps GPS
  - How Cloud Helps Cell Based Location Information
  - Summary
- Program for Mobile World Congress 2021
- Q&A

# Practicalities

- Duration: ~45 mins + Q&A
- Questions are encouraged!
  - Please type questions in the top of the right sidebar
  - All questions are anonymous
  - Try to keep them relevant to the topic
  - We will answer towards the end
- The chat is not anonymous, and do not use for questions
- Go to DevZone if you have more questions
- A recording of the webinar will be available together with the presentation at [webinars.nordicsemi.com](http://webinars.nordicsemi.com)



# Ville-Veikko Helppi, Product Manager Cloud



- M.Sc (Tech), Embedded Systems, 2002
- M.Sc (Econ & BusAdmin), Marketing, 2007
- Joined Nordic in 2020, based in Oulu, Finland
- 16+ years in product management roles
  - › Cloud products/SaaS, Embedded SW/HW and tools, 3D/UI graphic technologies
- 8+ years in embedded software & hardware engineering roles

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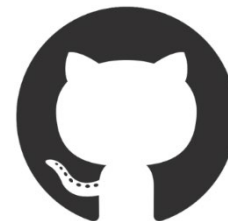


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# How cloud helps your IoT devices to get location data

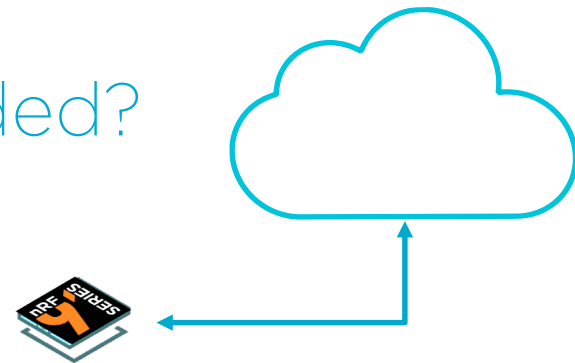
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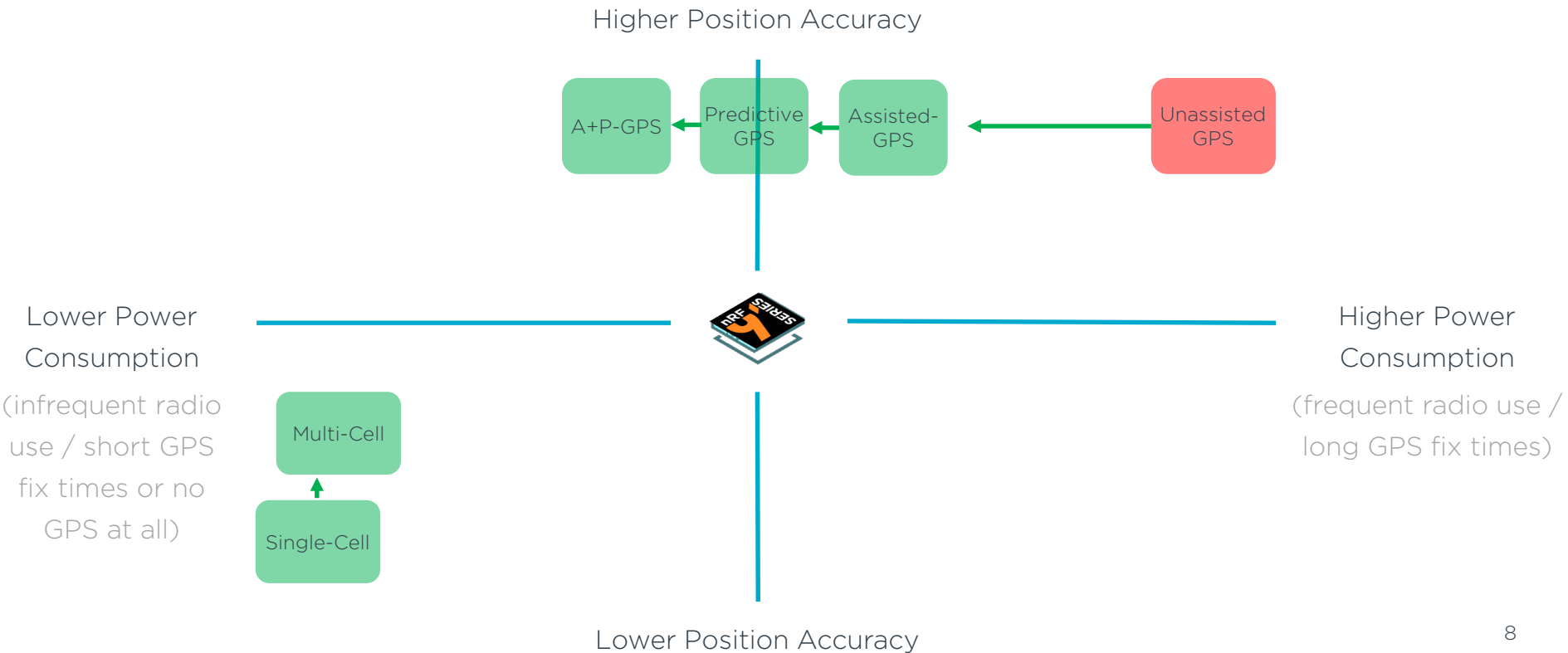
# Why Location Services Are Needed?

- Location information is critical and vital for multiple types of devices
- Multiple verticals where the same challenged can be solved
  - Asset tracking, Wearables, Smart & Connected Appliances, Automotive, Point-of-Sale/Payment terminals etc.
- By selecting the right technology + feature companies can increase their revenue and decrease costs



- Accuracy level defined by the use case
- Better battery life / power savings
- Fast method to get assistance/location
- Switching technology based on the use case / required accuracy
- Cloud can enable versatile use cases and enhance device a lot
  - › Computing, Memory, Storage etc.

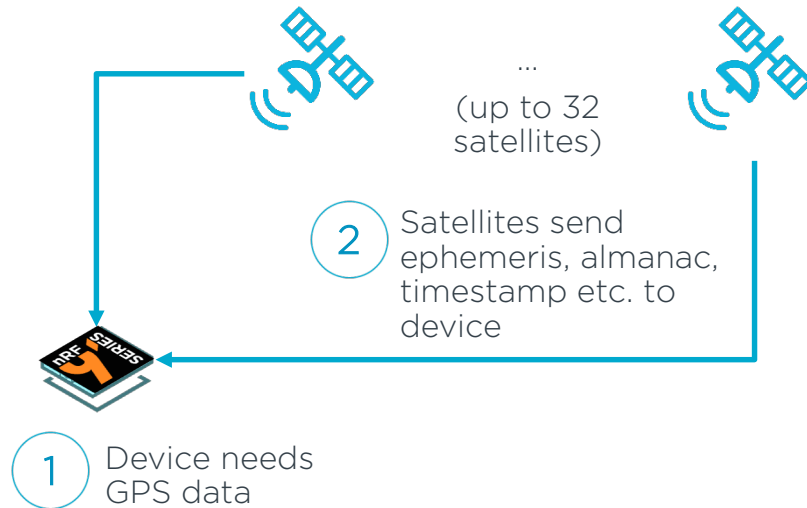
# What Location Service Fits My Use Case?





# How IoT Devices Typically Get Location?

Standard GPS coordinate acquisition for IoT devices

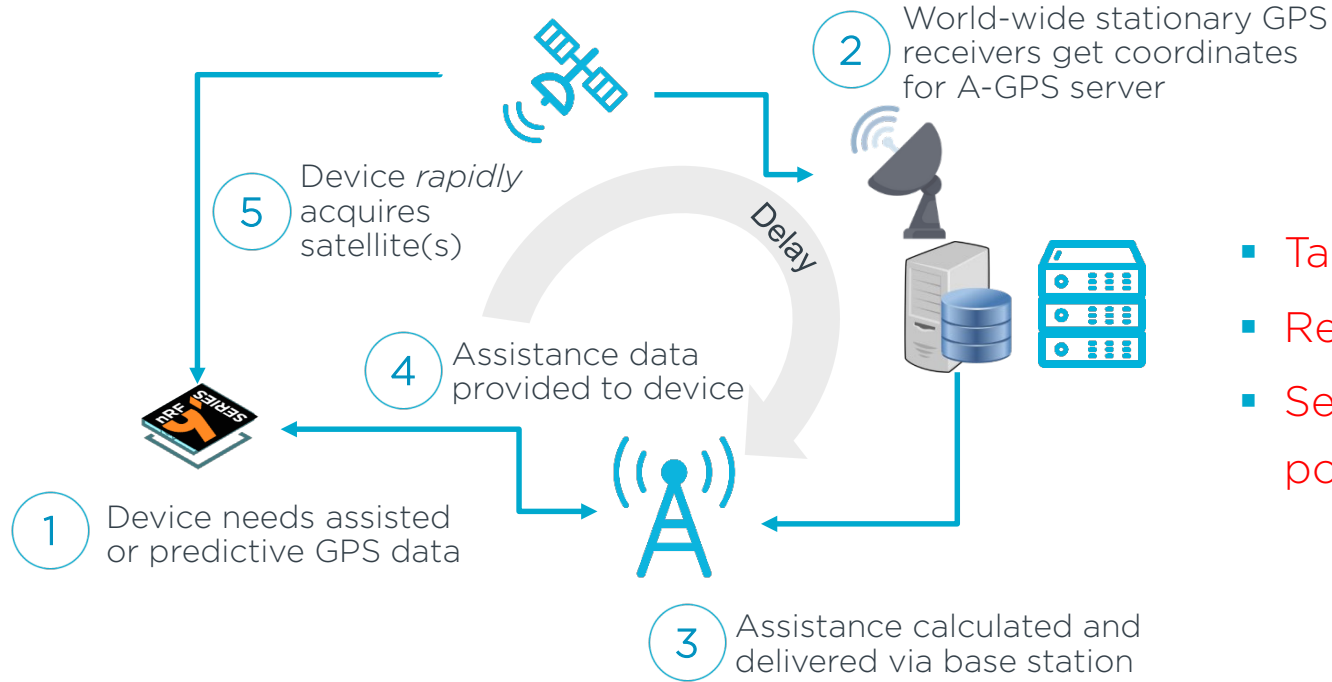


- Takes a lot of time
- Time-to-first-fix (TTFF)
- Uses a lot of power
- Device still needs to process data from satellites

Location using on chip GPS for coordinates

# How IoT Devices Get GPS Assistance Data?

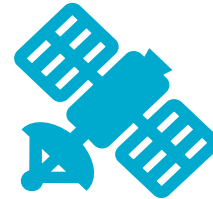
Standard GPS assistance and prediction data acquisition for IoT devices



- Takes a lot of time
- Requires infrastructure
- Several bottlenecks / potential failure points

# How Cloud Can Help GPS

# What is the Assistance for GPS?



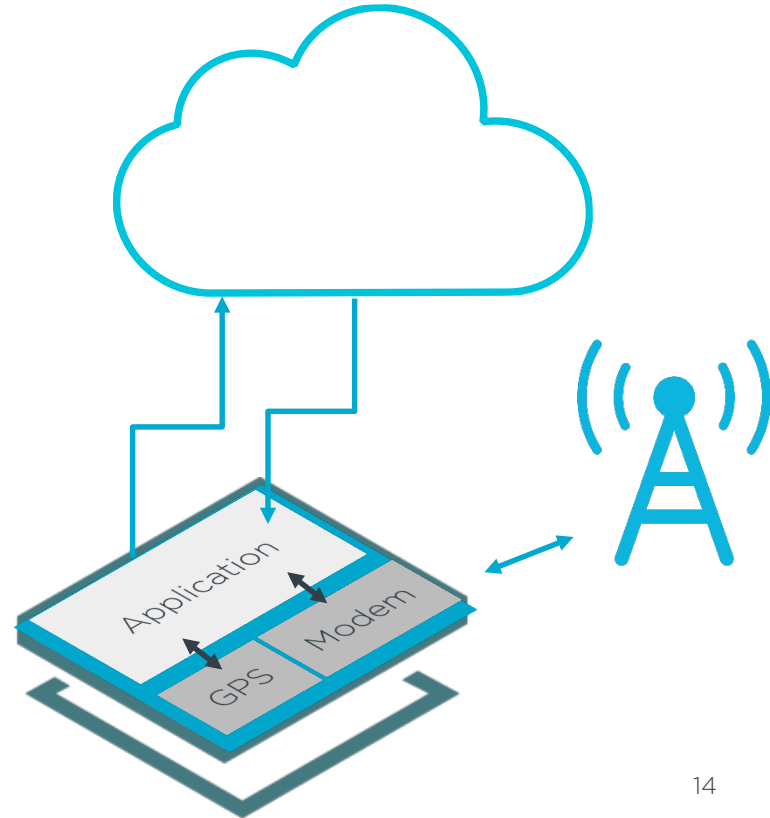
- GPS Receiver
  - Searches for satellites overhead
  - Locks on to their signals
  - Decodes and downloads their data (50 bits per second)
  - Computes your location using your distance to each satellite and the exact location of each satellite in space
- Assistance shortens the search
  - Narrows down which satellites are there
  - Narrows down each satellite's possible carrier frequency and phase range
  - Shortcuts time to download data (thousands of bits per second)

# The Components for Assistance

- Date and Time (time)
- Rough Location on Earth (position)
- Approximate Satellite Orbits (almanac)
  - › Good for a month or more (the same for all satellites)
  - › Not accurate enough to compute a fix
  - › Not required if ephemerides are available
- Accurate Satellite Orbits (ephemerides)
  - › Good for only 4 hours (very rarely for 6)
  - › Must be updated in GPS unit on time
  - › Required for a GPS fix
- Other helpful info (ionospheric correction; integrity data)

# How Assisted and Predictive GPS Work?

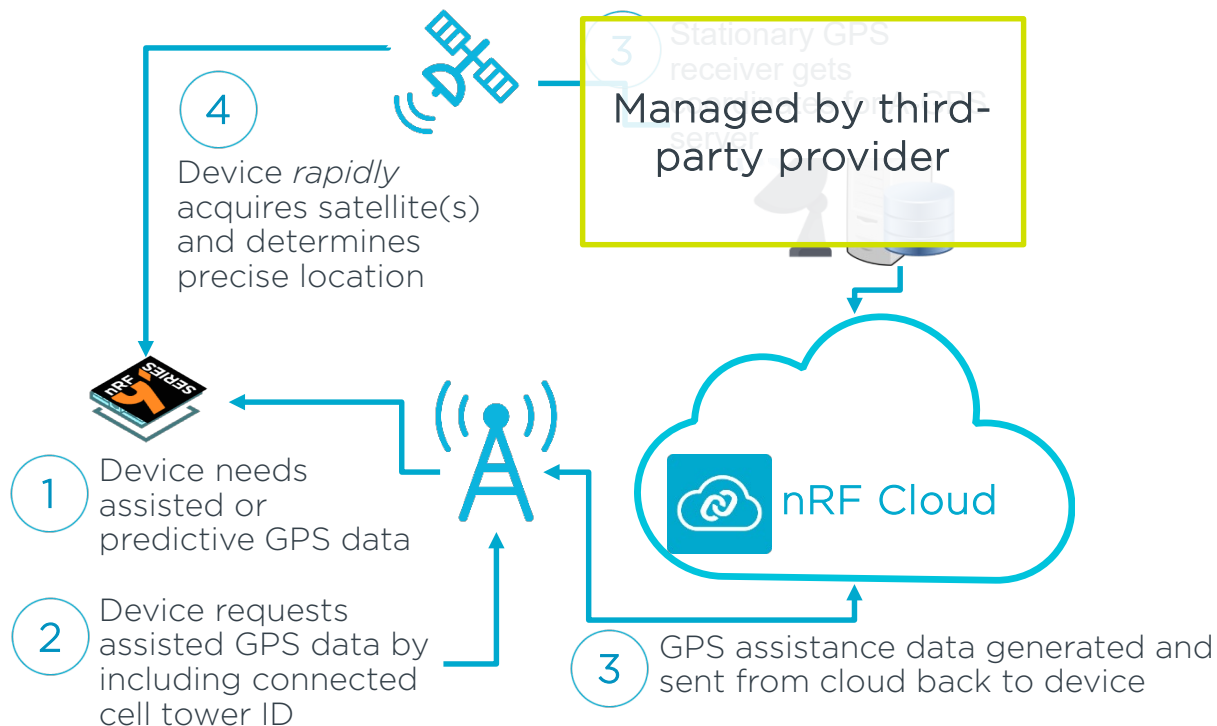
- Application needs to get a GPS fix
- Application starts GPS
- Modem requests assistance
  - Provides LTE cell tower identification
  - Lists which assistance components are needed
- Application sends request to cloud
- Cloud responds with assistance data
- Application injects assistance to modem



# Location as a Service with nRF Cloud

Service to get assistance & prediction data for IoT devices

- Power-friendly
- Fast method
- Accurate
- The best fit for multiple use cases
- No need to integrate with multiple clients
- Data always-on-time



# How to Choose Between P-GPS vs. A-GPS?

Cloud

Frequent cloud use is acceptable and possible?

Use A-GPS

Cloud should be used sparingly?

Use P-GPS

Cloud use is OK when available, but might be spotty?

A-GPS + P-GPS

Device

Very little free flash memory (can't even use MCUboot)?

Cell-based location

Regardless, actual position fix is the same!

Not better or worse.

The choice impacts:

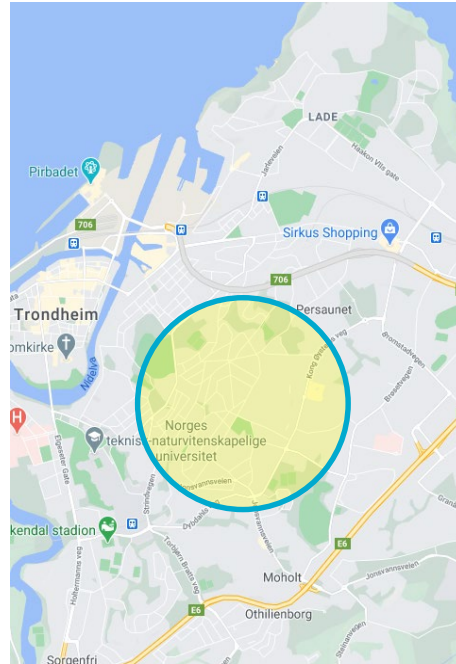
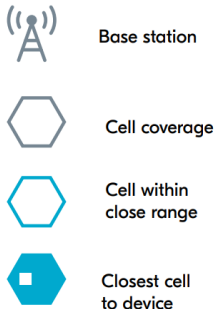
- Battery life
- Data bandwidth consumed
- GPS fix times



# How Cloud Helps with Cell Based Location Information

# Single-Cell LTE Location

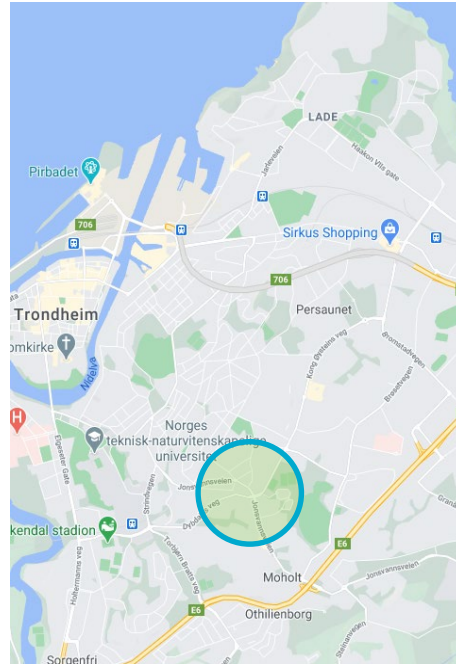
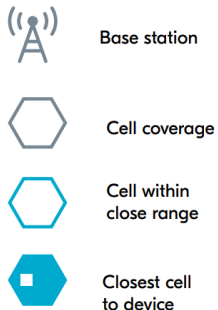
Optimized for Constrained and Embedded Devices



- Simple lookup in database
- Data available once connected
- Zero time-to-first-fix
- No added power consumption
- Very useful to decide if a more accurate tracking is needed
- Both indoor and outdoor usage
- Accuracy
  - 1000m
  - Level of “What part of the city”

# Multi-Cell LTE Location

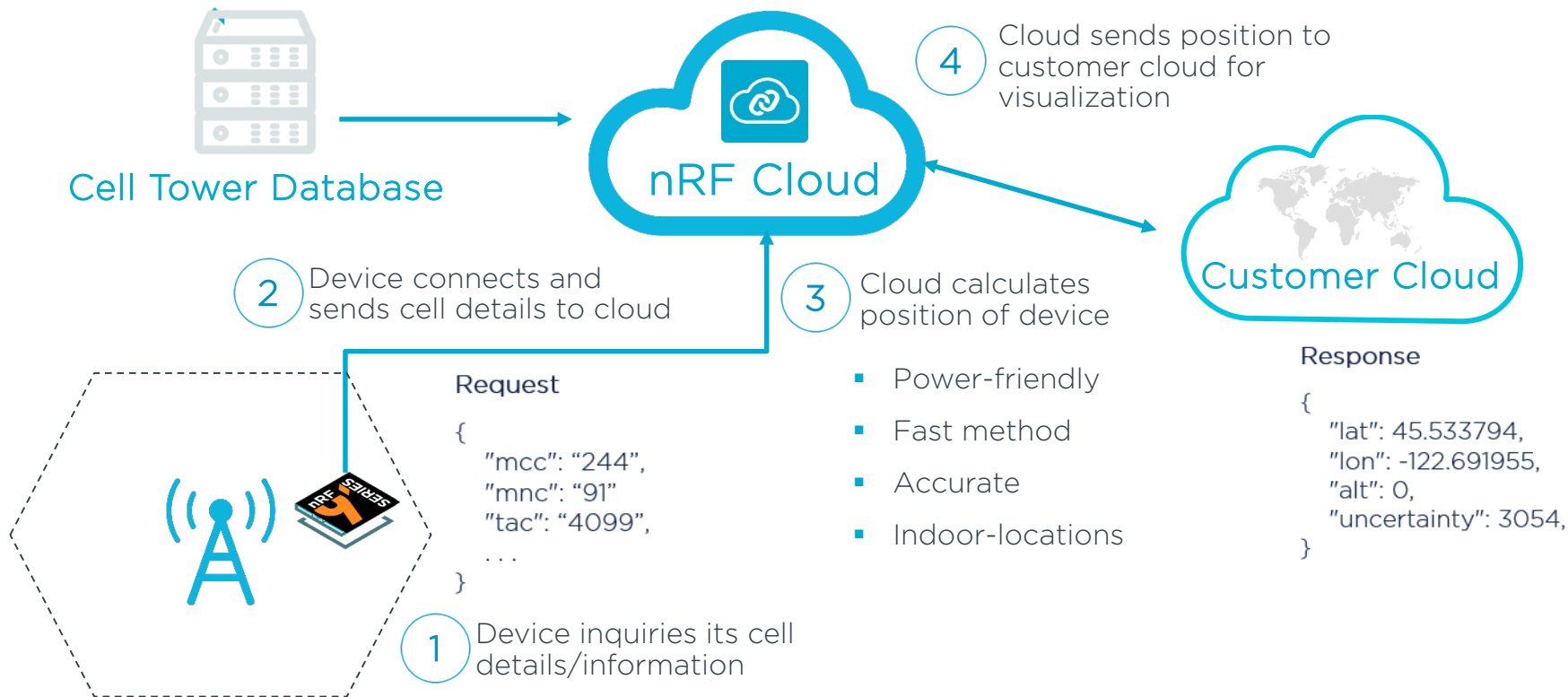
Utilizes More Cells for Improved Accuracy



- Similar benefits as Single-Cell
  - 100s of ms range to get cell information
  - Tiny/minor add to power consumption
  - Both indoor and outdoor usage
- Search for nearby cells on device
- Location accuracy significantly improved vs. Single-Cell
- Accuracy
  - 300m
  - Level of “street/building”

# Location as a Service with nRF Cloud

Location data using Single/Multi-Cell method

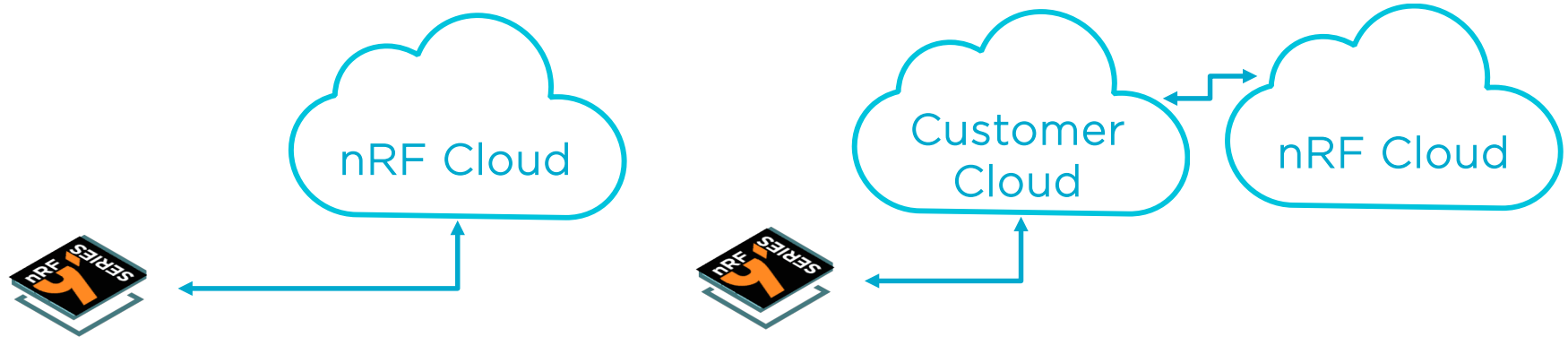


# Summary

# Comparison of Different Location Features

Feature	Accuracy	Power savings	Requires GPS	Description
Assisted GPS (AGPS)	High	Good	Yes	<ul style="list-style-type: none"> <li>Provides assistance data to the device.</li> <li>Enables a faster time-to-first-fix (TTFF) for the GPS modem.</li> <li>Gets assistance data over the cellular connection and uses the GPS modem to obtain a fix.</li> </ul>
Predicted GPS (PGPS)	High	Better	Yes	<ul style="list-style-type: none"> <li>Provides up to two weeks of predicted assistance data to the device.</li> <li>Enables a faster time-to-first-fix (TTFF) for the GPS modem.</li> <li>While it still uses the GPS modem, the power savings comes from reducing the frequency to request new assistance data.</li> </ul>
Single-Cell (SCELL)	Low	High	No	<ul style="list-style-type: none"> <li>Gets the coarse location of the device based off of the nearest cell tower.</li> <li>Does not use the GPS modem.</li> <li>Saves power by eliminating the need to use the GPS modem.</li> </ul>
Multi-Cell	Medium	High	No	<ul style="list-style-type: none"> <li>Gets the coarse location of the device based off of the nearest cell towers.</li> <li>Does not use the GPS modem.</li> <li>Provides a higher level of accuracy by using multiple cell towers to obtain location.</li> <li>Saves power by eliminating the need to use the GPS modem.</li> </ul>

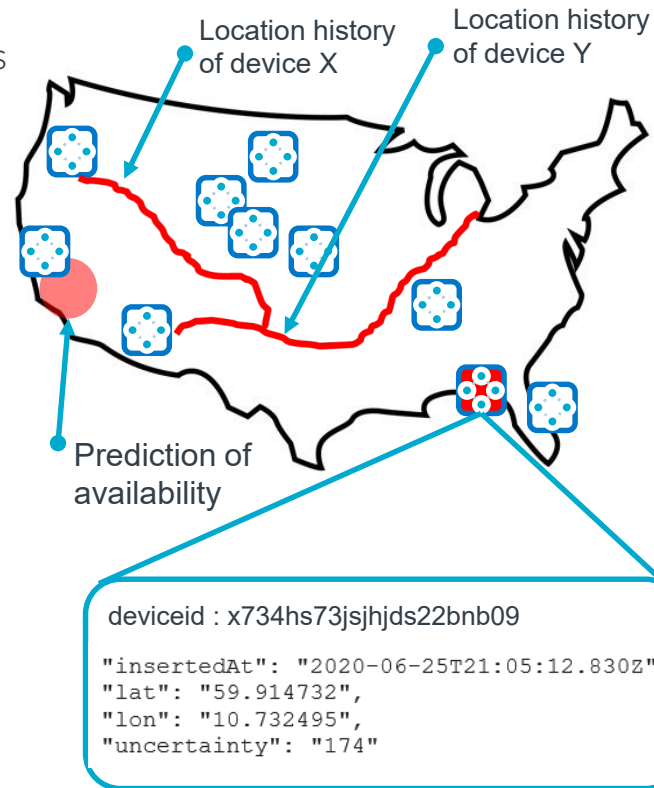
# Options for Cloud Transports



- Device-to-Cloud
  - Device connects directly to the cloud
  - Maintains bi-directional connection using MQTT over TLS
- Cloud-to-Cloud
  - Connects to customer cloud, which connects nRF Cloud REST API
  - Provides greater flexibility and control over device communication workflow
  - Allows centralized connection model for all devices

# What Cloud can provide for IoT devices?

- Detailed, accurate and fast location service for IoT devices
- Use of different technologies - GPS and Cell ID based
- The best possible technology + feature for the use case
- Utilization of the cloud for assets where devices lack of something
  - › History of the location easy and cheap to store in cloud
  - › Location with timestamp information
- Location Services combined with comprehensive IoT device management capabilities and other useful features





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Date	Topic
June 28, 10:00 CEST	How to power optimize with the latest features in the nRF9160 SiP
June 29, 09:00 CEST June 29, 18:00 CEST	Expand cellular IoT coverage with Ibasis IoT connectivity
June 30, 10:00 CEST	How cloud helps your IoT devices to get location data
July 1, 09:00 CEST July 1, 20:00 CEST	Exciting new features in nRF Connect SDK v1.6

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Q&A