

**MICRODIS**



**COMPETENCE & RELIABILITY**



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# Agenda

9:00 Zahájení semináře

9:10 Technologie LPWA jako standard v síti LTE

9:50 Implementace NB-IoT v sítích Vodafone, jak začít s NB-IoT

10:00 Přestávka na občerstvení

10:10 Aplikace NB-IoT v zařízeních IoT

12:10 Přestávka na oběd

12:30 Demonstrace pracovních režimů NB-IoT v praxi

13:00 Novinky ve specifikaci Bluetooth 5

13:30 Přestávka na občerstvení

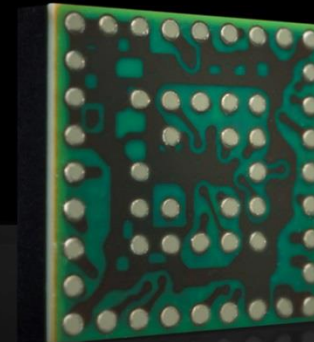
**13:40 Navigace pro IoT**

14:50 Diskuze, závěr semináře

# GNSS products

## Global Navigation Satellite Systems

Robert Panufnik, Microdis  
April 2018



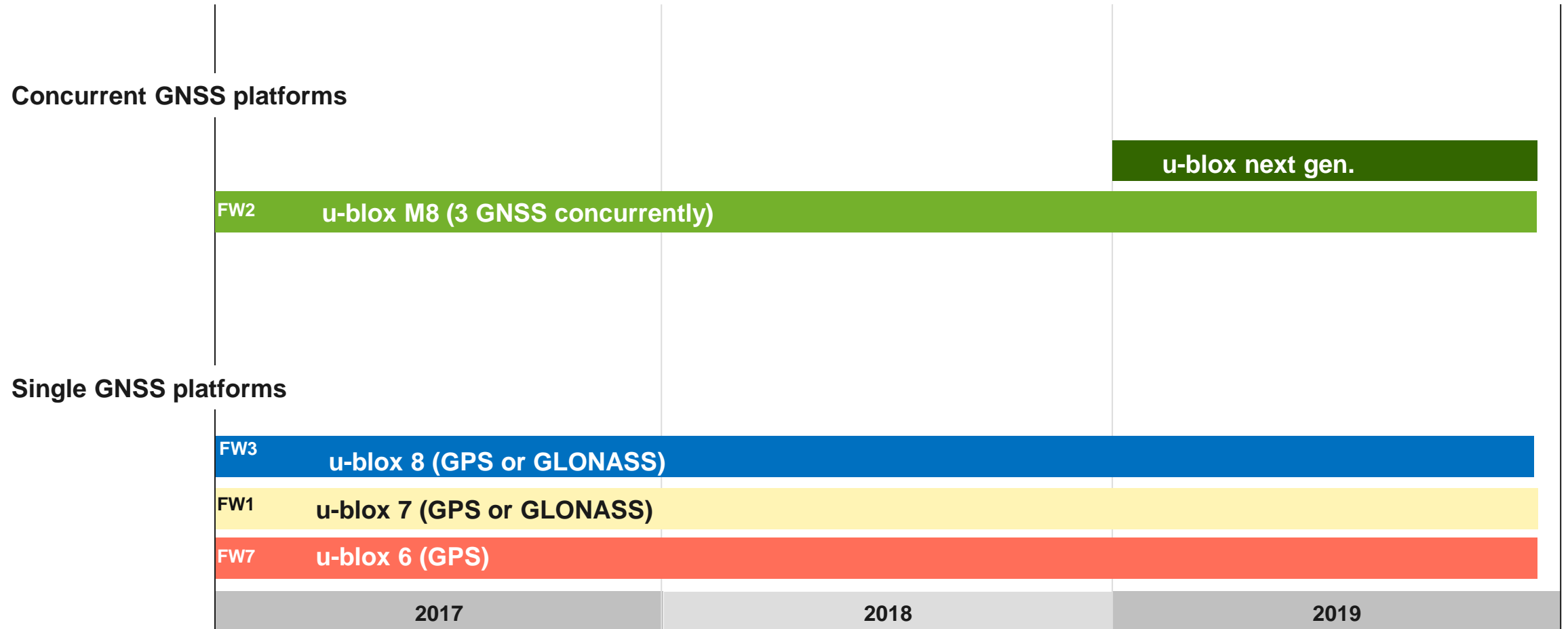
# Product portfolio overview



- **Standard precision**
  - Meter level accuracy
  - Cost-efficient product portfolio
  - Suitable for most applications
  - High tracking sensitivity
  - Low power consumption
- **High precision**
  - Centimeter to decimeter level accuracy
- **Dead Reckoning**
  - 100% positioning coverage e.g. parking garages & urban canyons
  - For road-vehicle applications
- **Timing & Frequency**
  - Reliable and high performance, plus skilled support



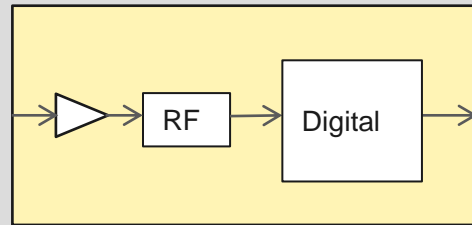
# Platform roadmap



# Platform roadmap

## Single constellation platforms

- One GNSS at a time:

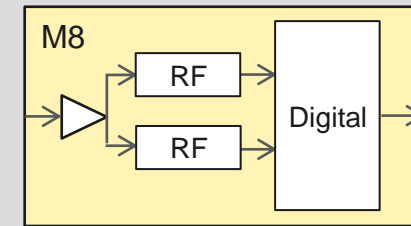


- The economical choice

- u-blox 7, u-blox 8

## Multi constellation platforms

- Multiple GNSS concurrently received



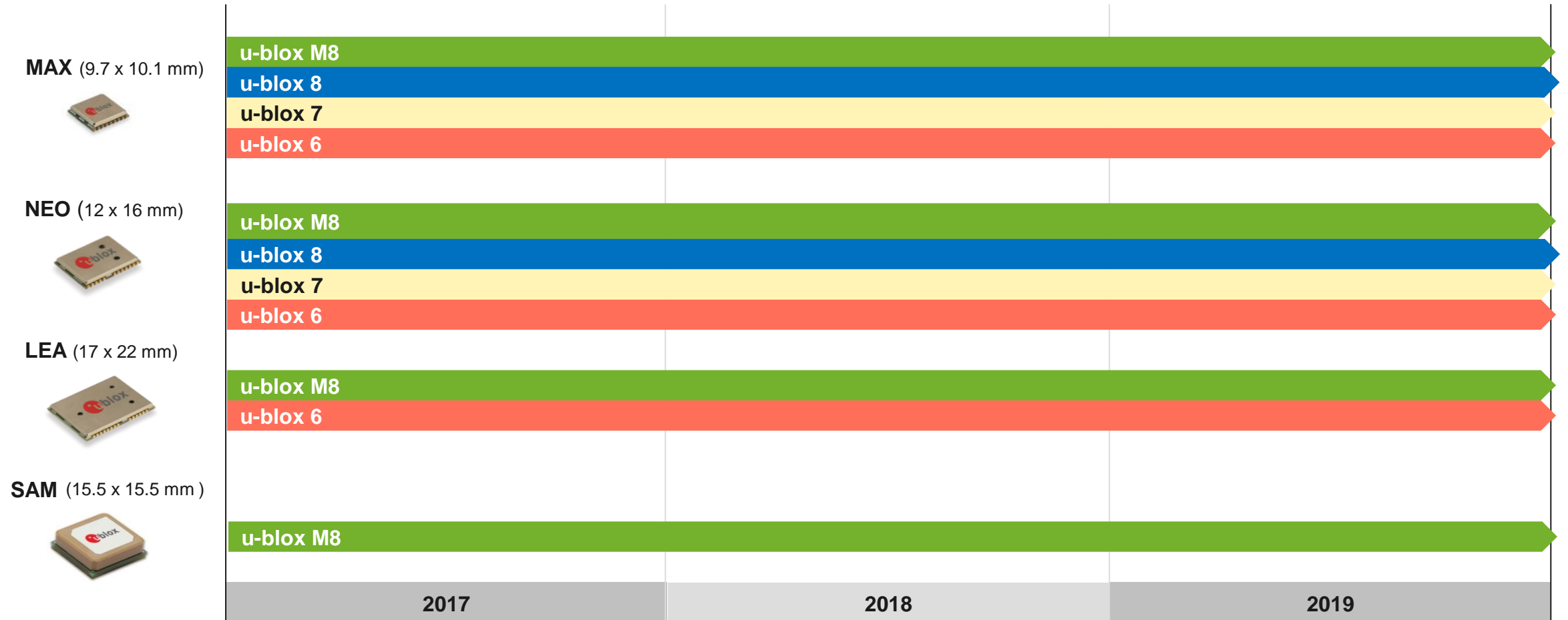
- The choice for maximum performance

- u-blox M8



# Product Roadmap

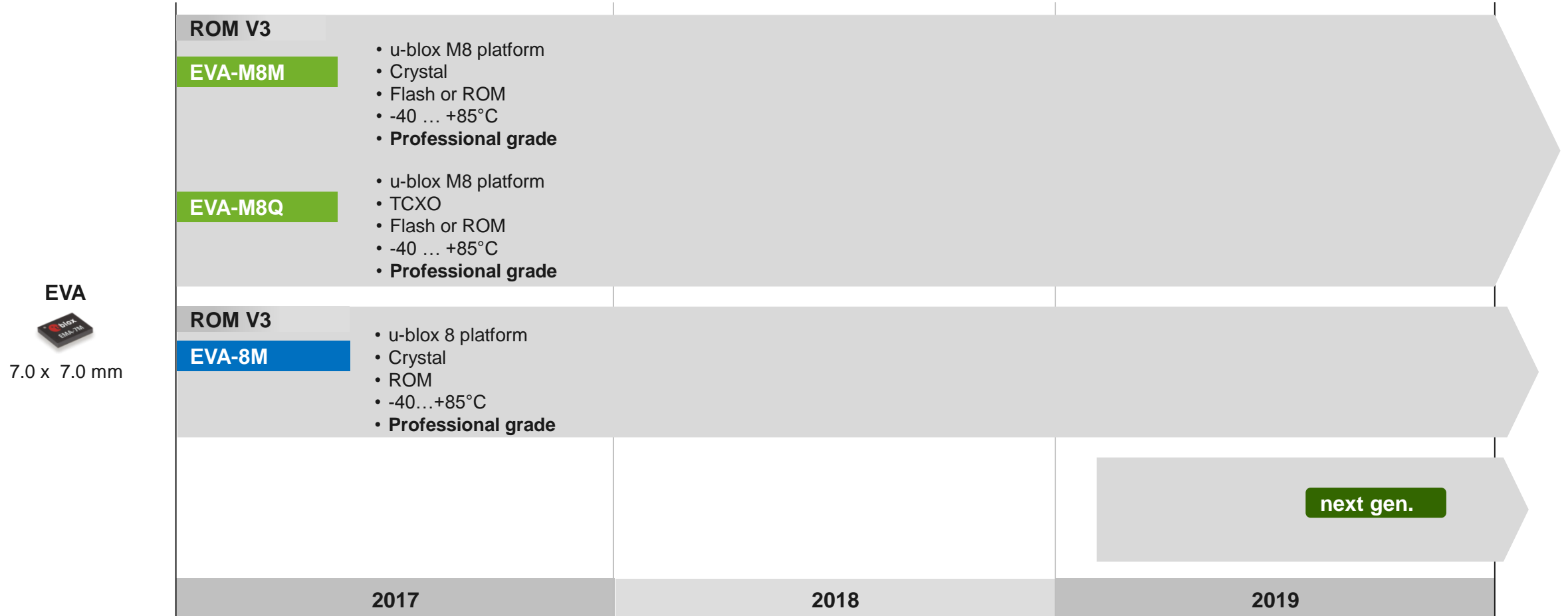
## GNSS LCC Modules Form-Factor





# Product Roadmap

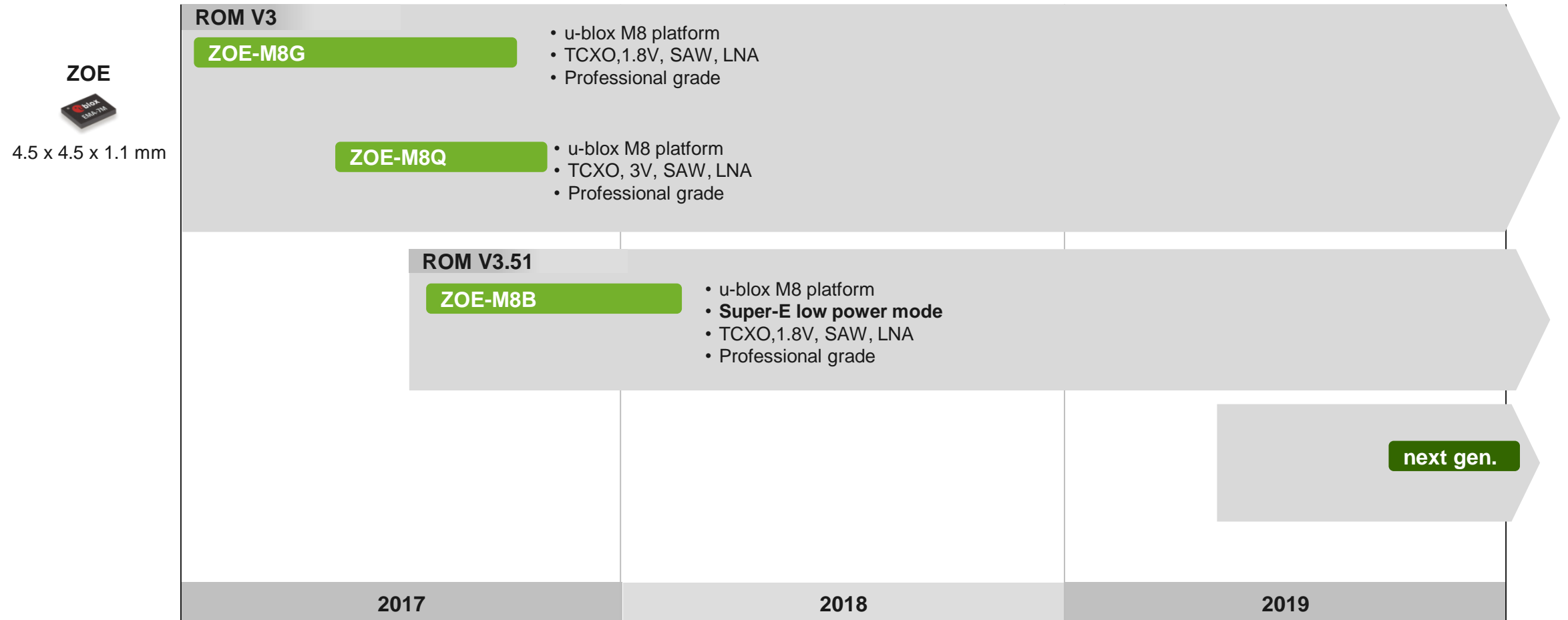
GNSS SiPs – size optimized



# Product Roadmap

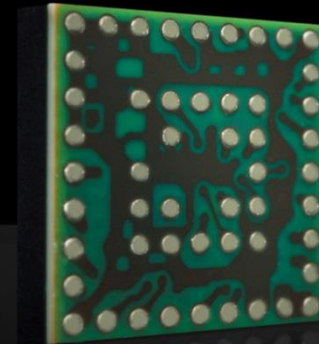


## GNSS SiPs – size optimized, high performance



# ZOE

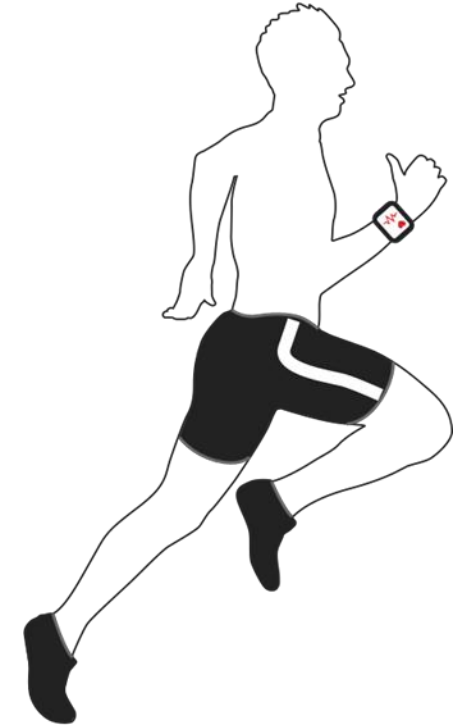
Ultra small module with superior performance



# Highlights



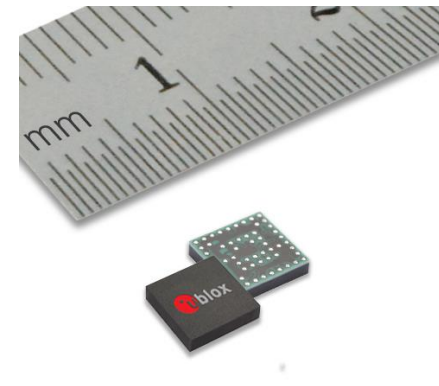
- Fully integrated and complete solution reducing total design effort
- Ideal for passive antenna designs due to built-in SAW and LNA
- High accuracy thanks to concurrent reception of up to 3 GNSS
- Industry leading -167 dBm navigation sensitivity
- Super-E lowest power version



# Size matters



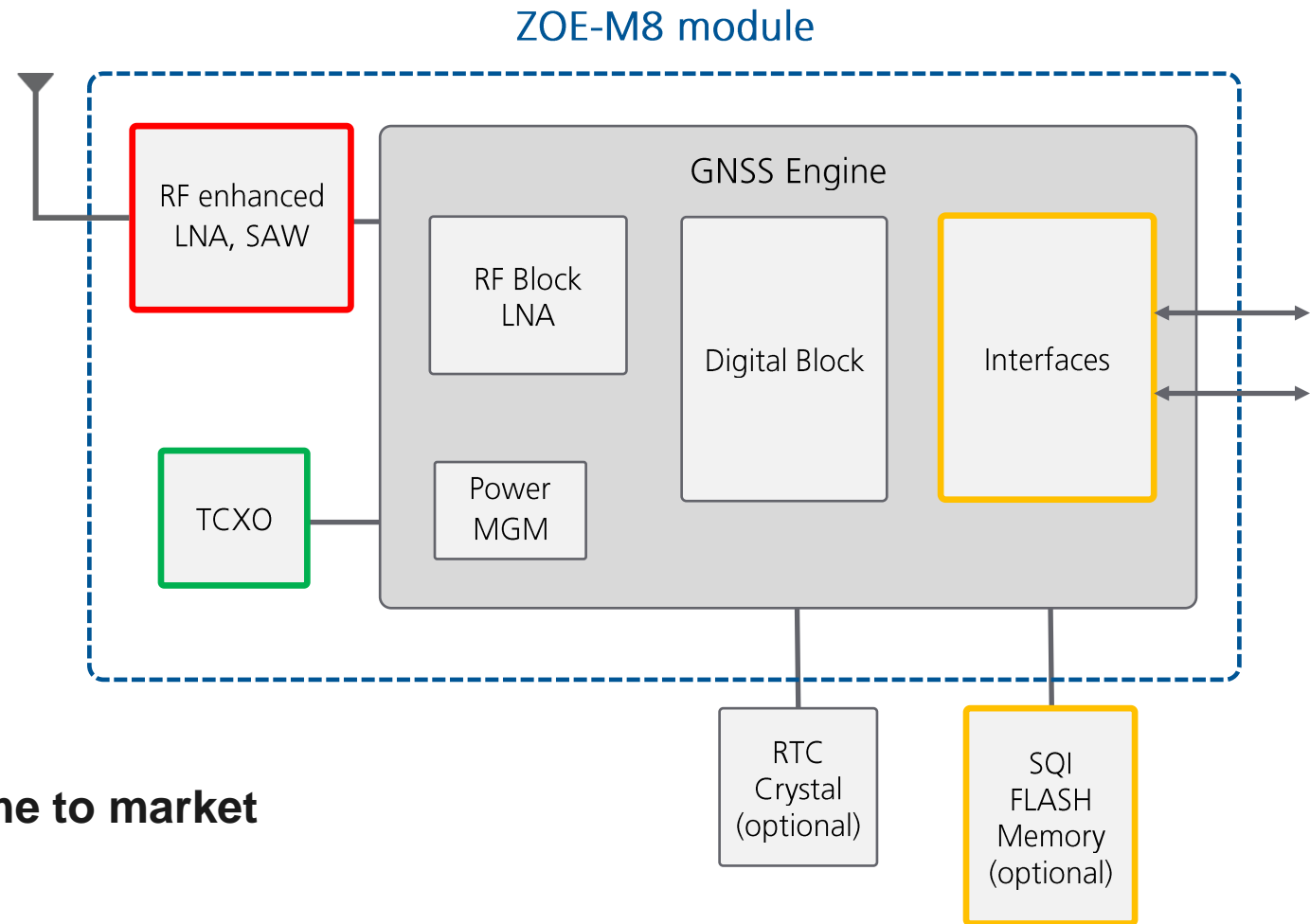
- ZOE-M8 is an ultra-small multi-GNSS receiver module
  - It measures 4.5 x 4.5 x 1.0 mm
    - Low height, 1.0 mm, fits into slim battery powered designs
    - Low weight, 0.04 grams
  - Fully molded 51 pin RoHS compliant S-LGA (**S**older-**L**and **G**rid **A**rray) package
  - Comes in 1 k standard size reels



# Fully integrated solution



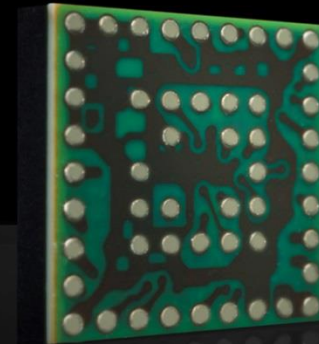
- Includes SAW & LNA (1)
  - Improved jamming performance
  - Optimized for passive antenna applications
- Includes TCXO (2)
  - Improves GNSS performance
- Multiple interfaces
  - UART, I2C, SPI, SQI (3)



**ZOE-M8 Reduces total design-in efforts and time to market**

# ZOE-M8B

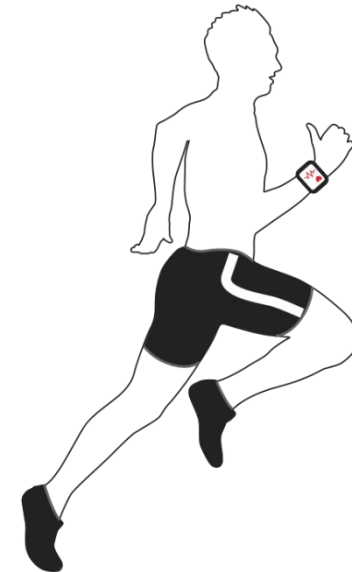
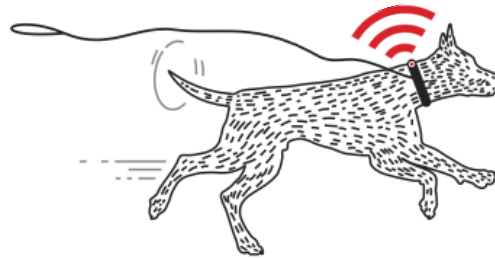
Ultra low power in Super-E technology



# ZOE-M8B with Super-E mode

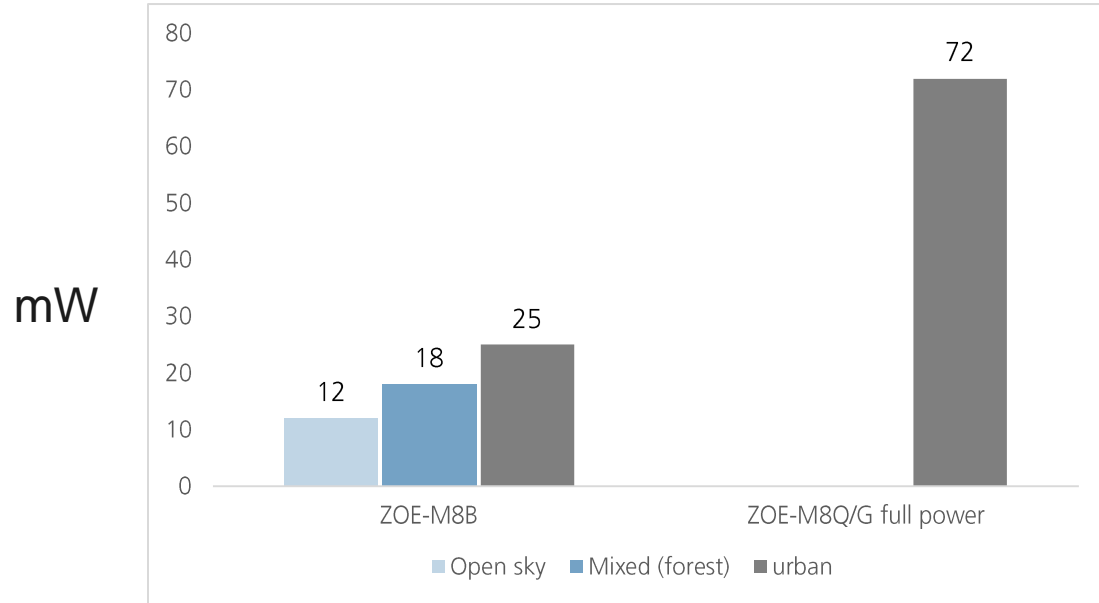


**ZOE-M8B with dedicated chipset enables any battery powered application to integrate GNSS reception or extend GNSS battery life with minimum impact on accuracy**

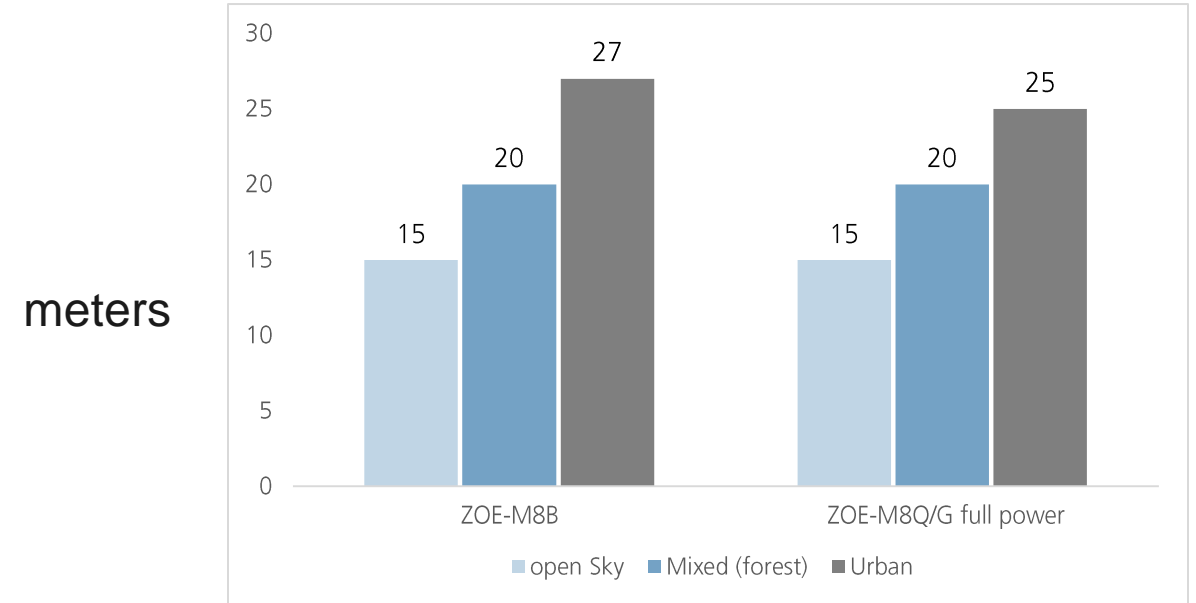




# ZOE-M8B with Super-E mode 3x less power ... is really Low Power

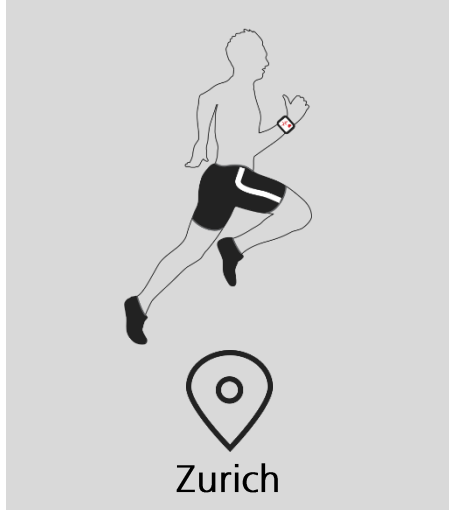


Average power, 30 minute log, 1 Hz, aided start

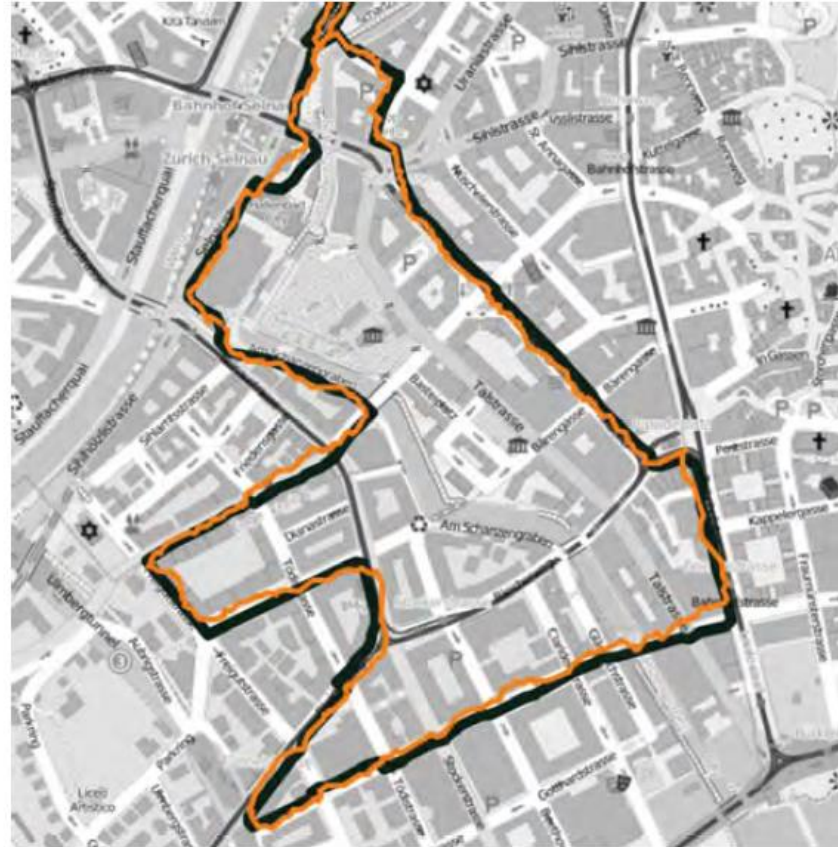


2D error (95%), 30 minute dynamic log, 1 Hz, aided start

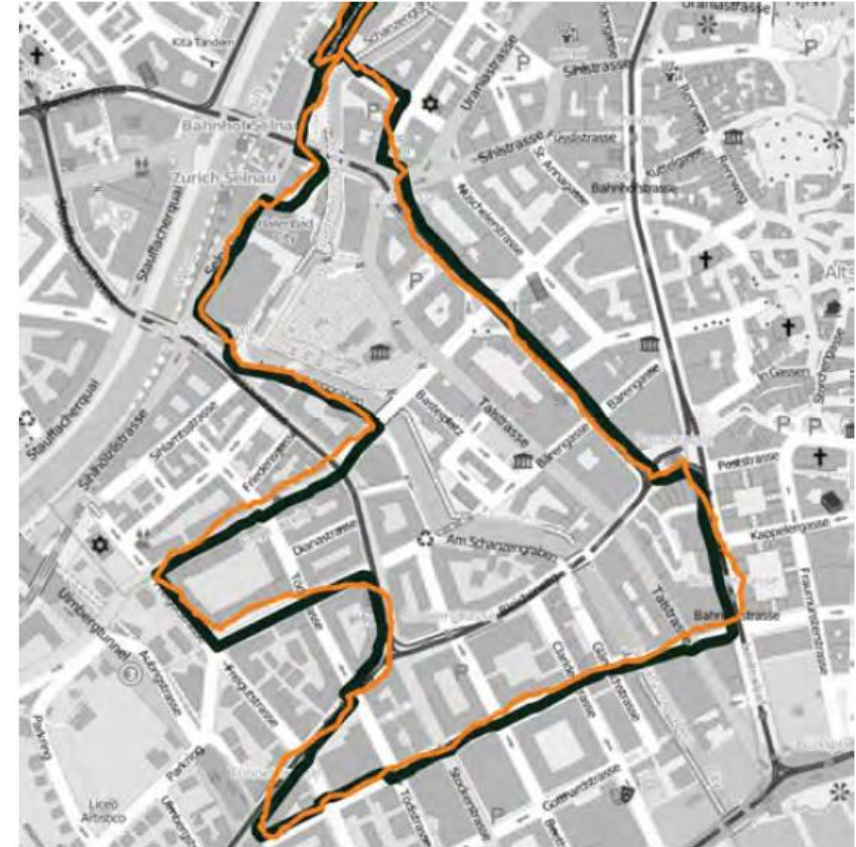
# High accuracy and leading navigation sensitivity



-  True path
-  ZOE-M8 performance



ZOE-M8B Super-E Low Power

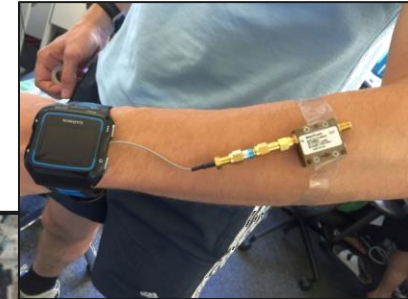
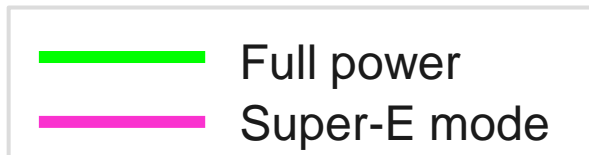


ZOE-M8Q

# Log example – Super-E mode used in the city

- Urban environment (Zurich city)
- Real industrial antenna design
- Walking scenario

|                   | Average Power |
|-------------------|---------------|
| Full power        | 54 mW         |
| Super-E mode 1 Hz | 17 mW         |

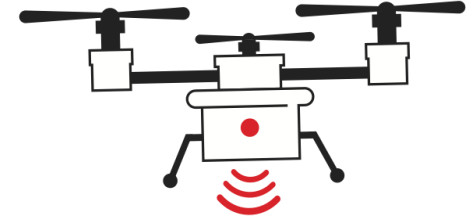


# Targeted Market and Applications



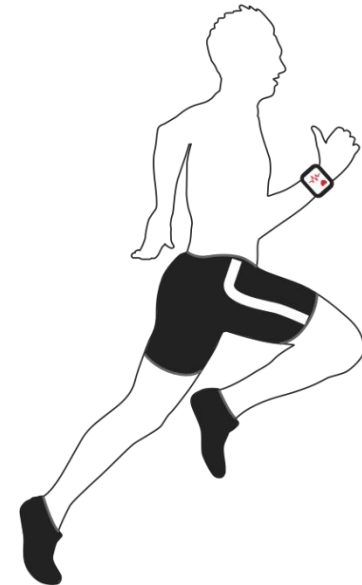
## ZOE-M8G/Q:

- Applications aimed for either 1.8 V or 3.0 V power rail
  - OBD dongles, UAV's, eBikes, Vehicle tracking, telematics



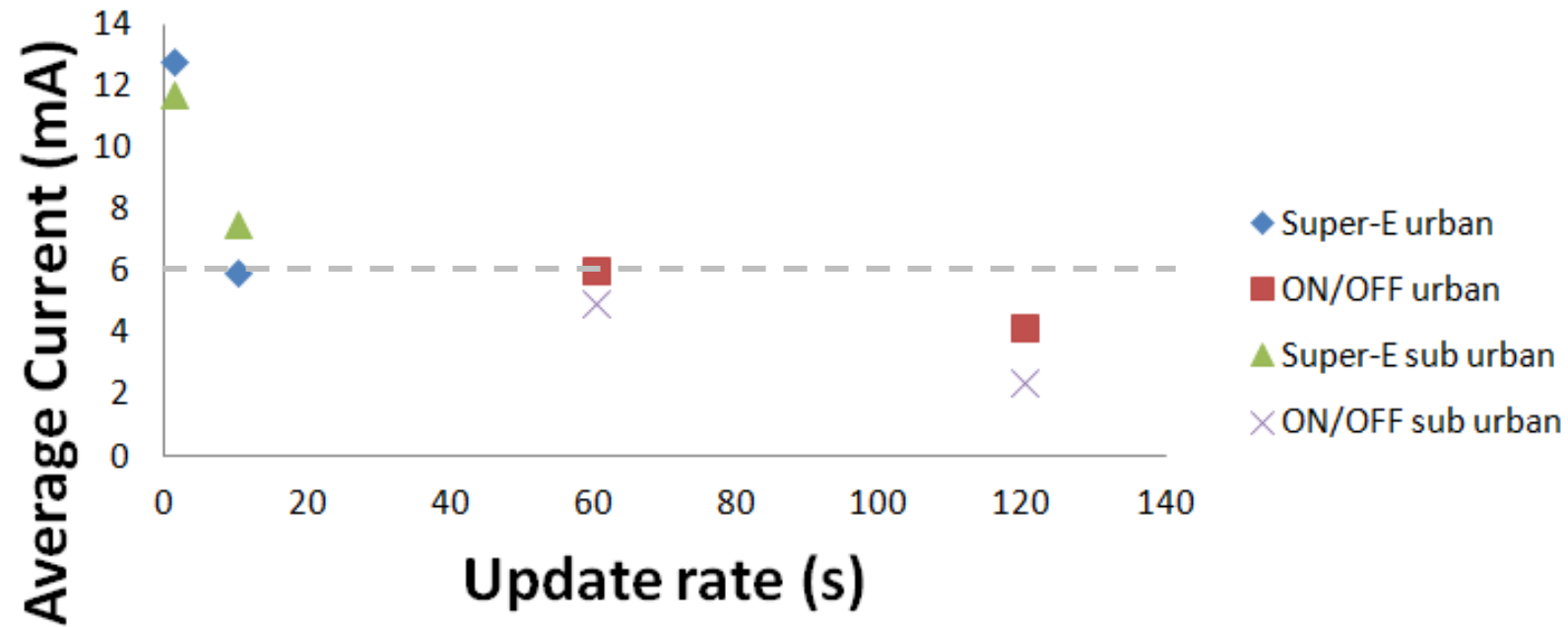
## ZOE-M8B:

- Size constrained applications
- Passive antenna applications
- Portable and industrial applications
  - UAV
  - Asset tracking
  - Wearable applications
  - Smart-watches
  - Personal trackers
  - Tracking

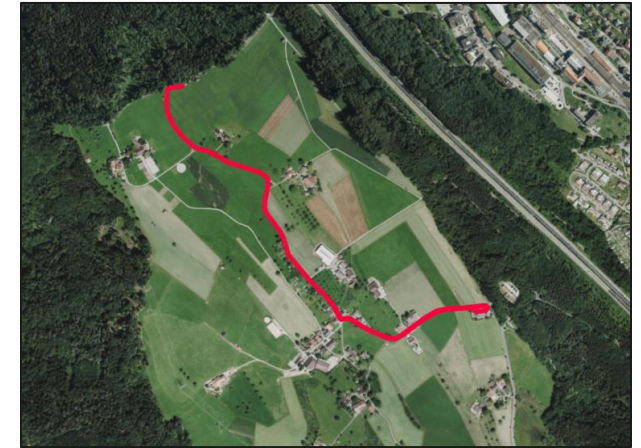


# Super-E vs. ON/OFF

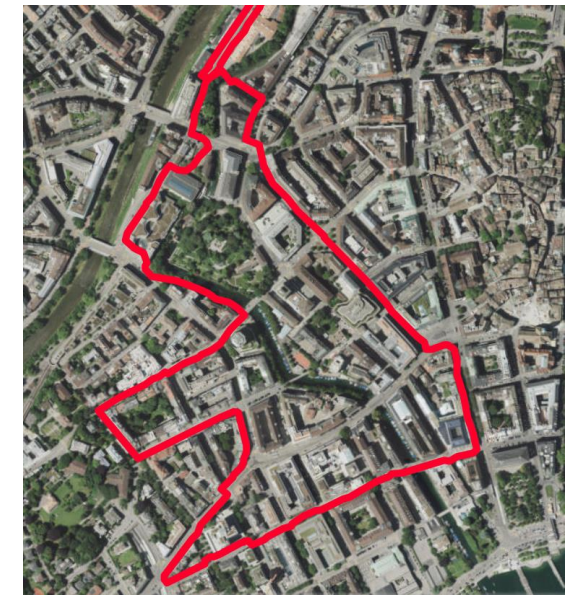
## Current consumption w/ AssistNow offline



### Open/Suburban



### Challenging (urban)



Super-E makes sense for applications requiring update date < 60s

# High Precision

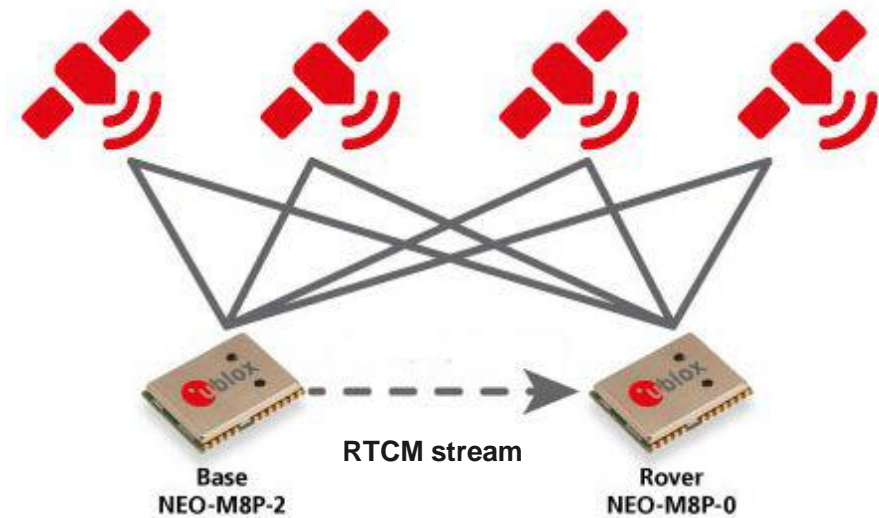
Bringing High Precision  
GNSS performance  
to the mass  
market

# Highlights



## NEO-M8P is high precision for the mass market

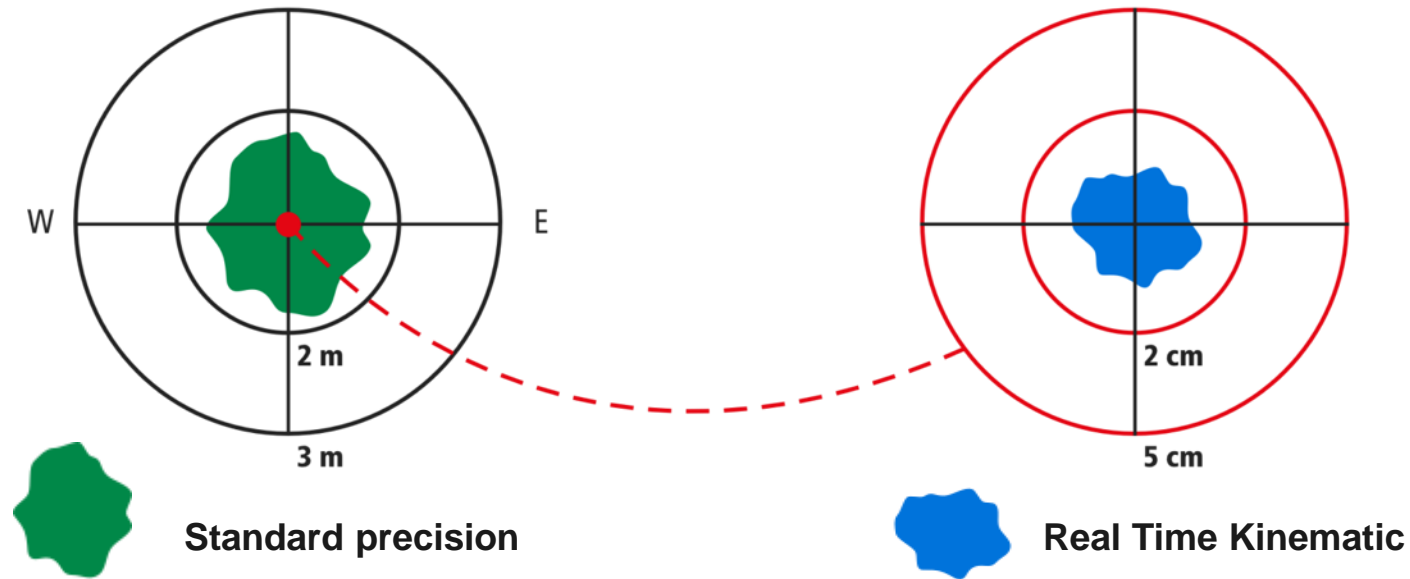
- Affordable cm-level GNSS solution
- Integrated Real Time Kinematic (RTK)
- Small, light, and energy-efficient
- A complete and versatile solution
- World-leading GNSS positioning technology



# NEO-M8P delivers centimeter-level accuracy



- Ability to control and automate applications down to cm-level



- Designed for applications that operate in:
  - close proximity of a base station ( $< 10$  km)
  - unobstructed environments



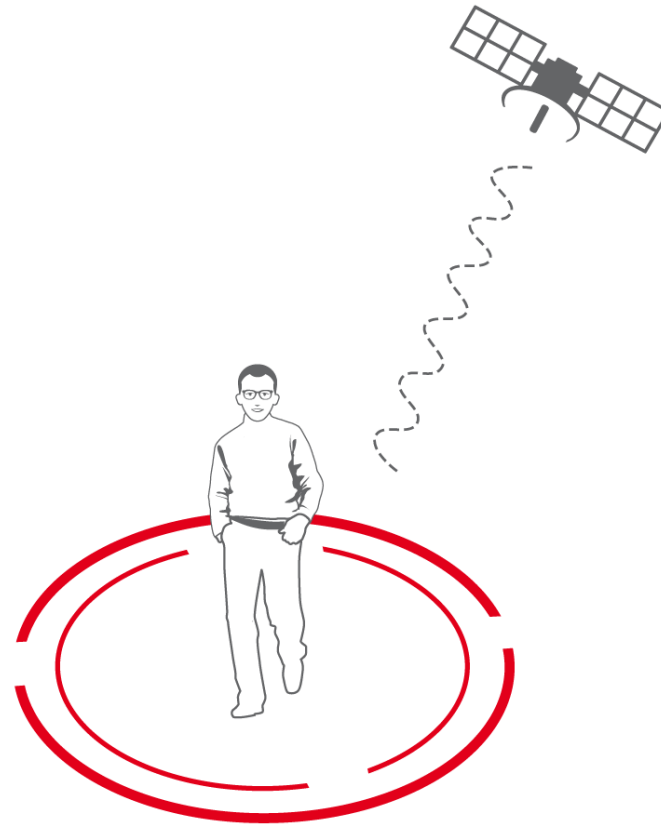
# NEO-M8P is the smallest, most energy-efficient RTK system

- RTK technology is integrated
  - Size, power and cost optimization
  - Reduces cost of ownership – no in-house RTK development required
- Existing high precision solutions can cost over \$1000



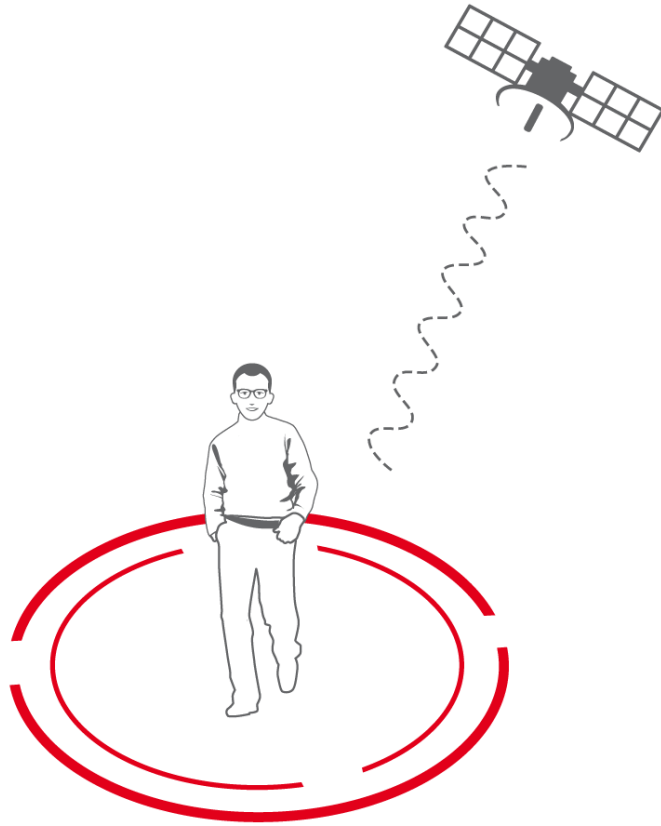
**Cost, size, and power benefits mean mass market applications  
can integrate cm-level technology**

# Standard GNSS accuracy

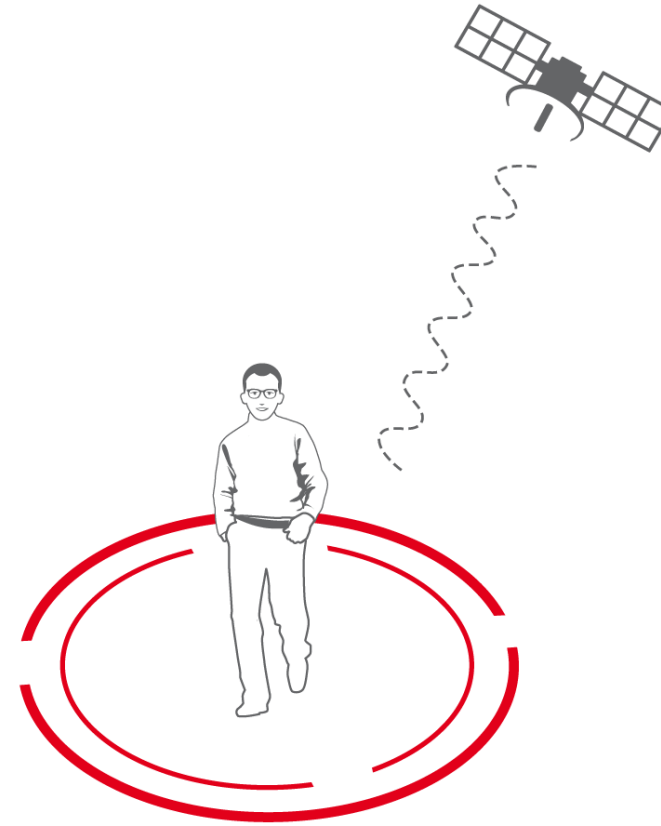


**2 – 3 m**  
Standard GNSS

# Several errors are common

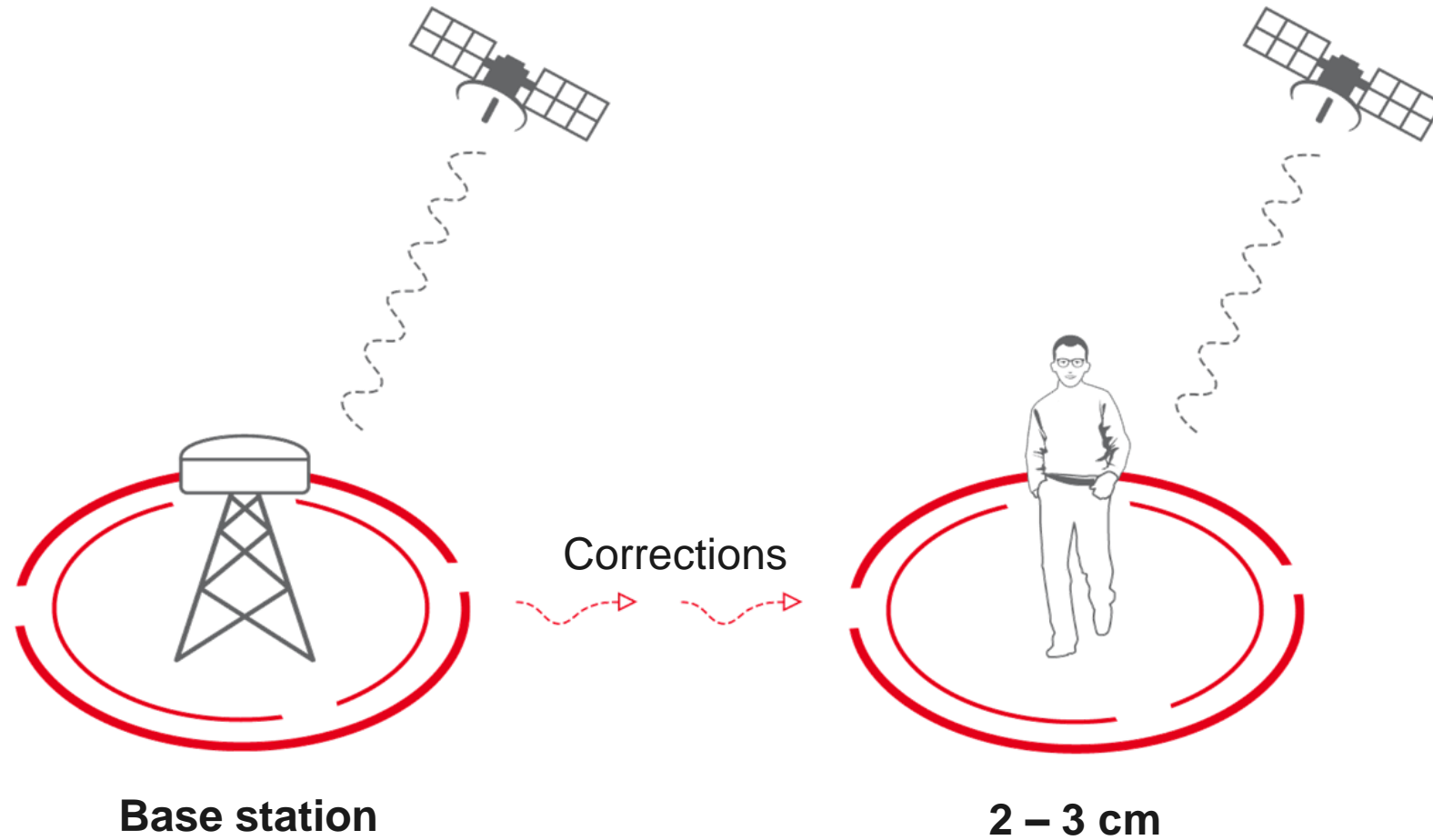


**2 – 3 m**



**2 – 3 m**

# Position accuracy improvement



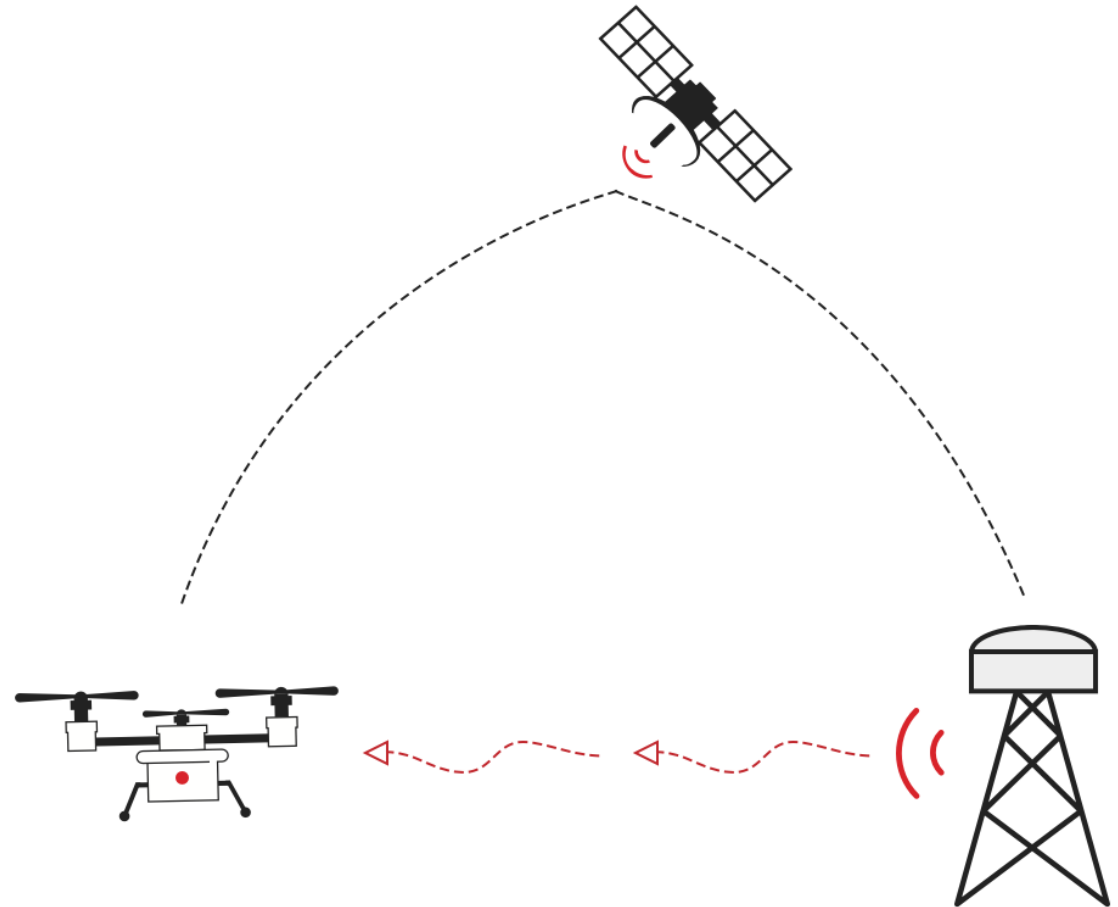
Bar

errors cancel out.



G

- ~~Sat. clock error (~1.5m)~~
- ~~Ionosphere (~5m)~~
- ~~Troposphere (~1m)~~
- Multipath (~2-20m)
- Receiver noise (~0.5m)

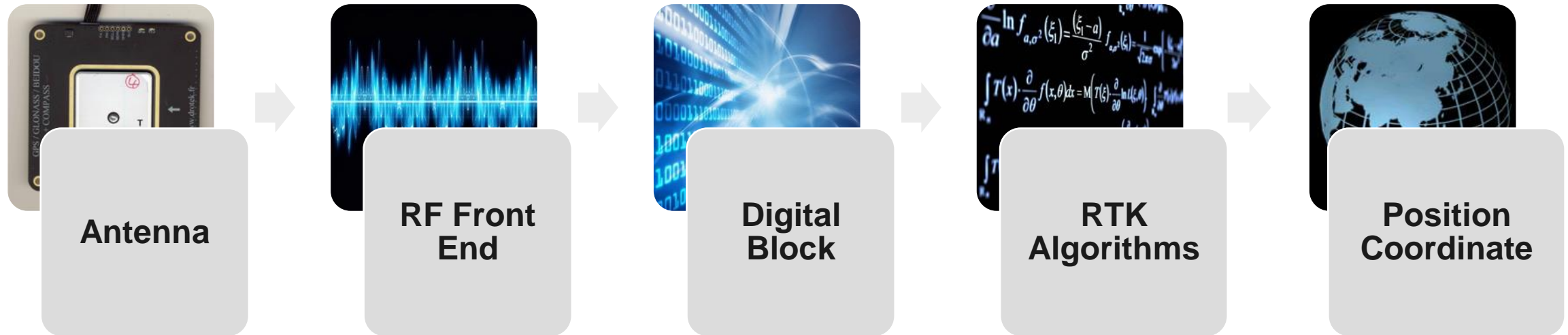


# NEO-M8P benefits

## leading technology



NEO-M8P leverages u-blox's 20-year history of GNSS expertise to deliver the leading RTK positioning performance



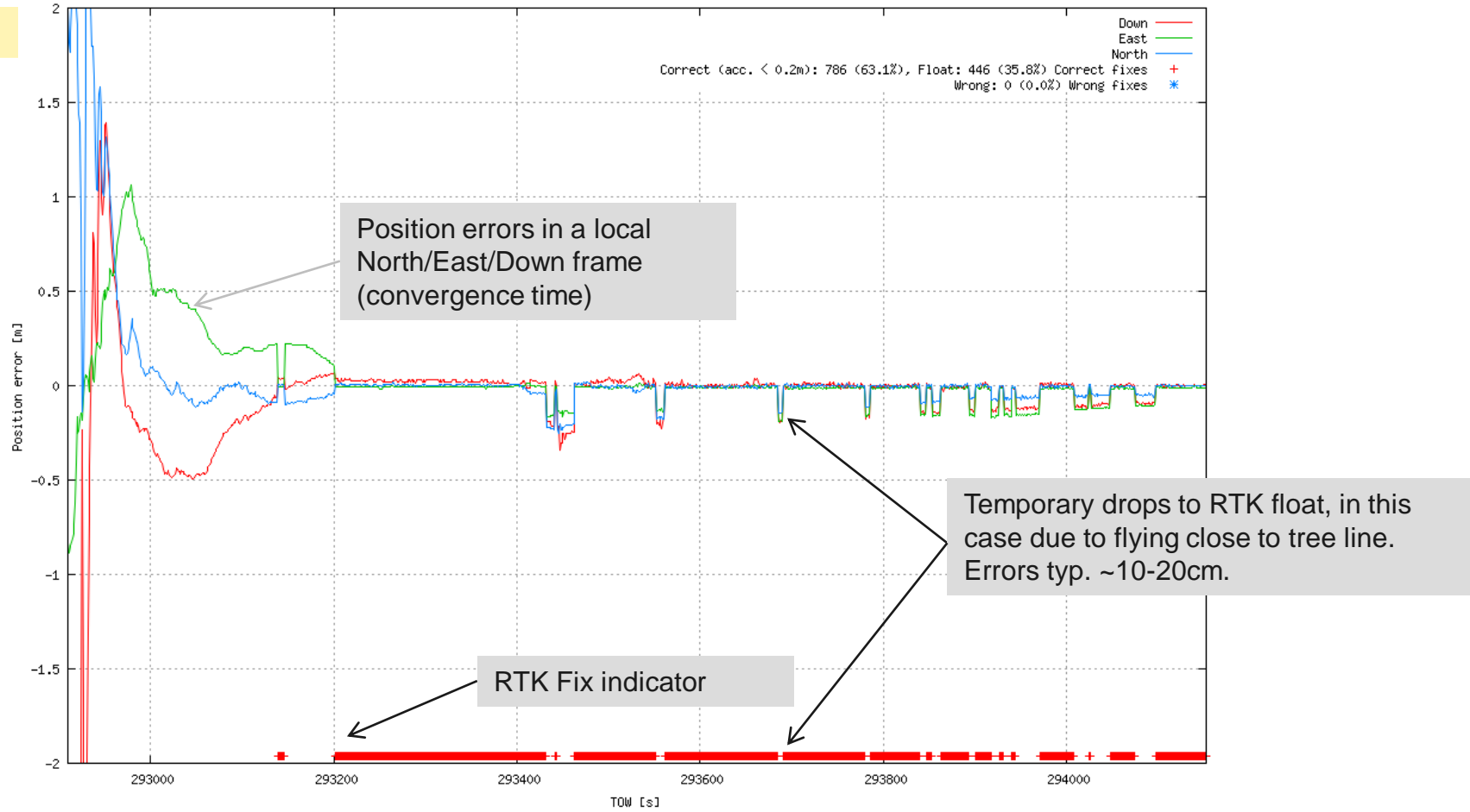
**Expertise on each element of the GNSS chain delivers robust & reliable positioning performance**

# NEO-M8P Performance Comparison ES2 to IP

# UAV Test, patch antenna, flying next to tree line



## ES2 performance

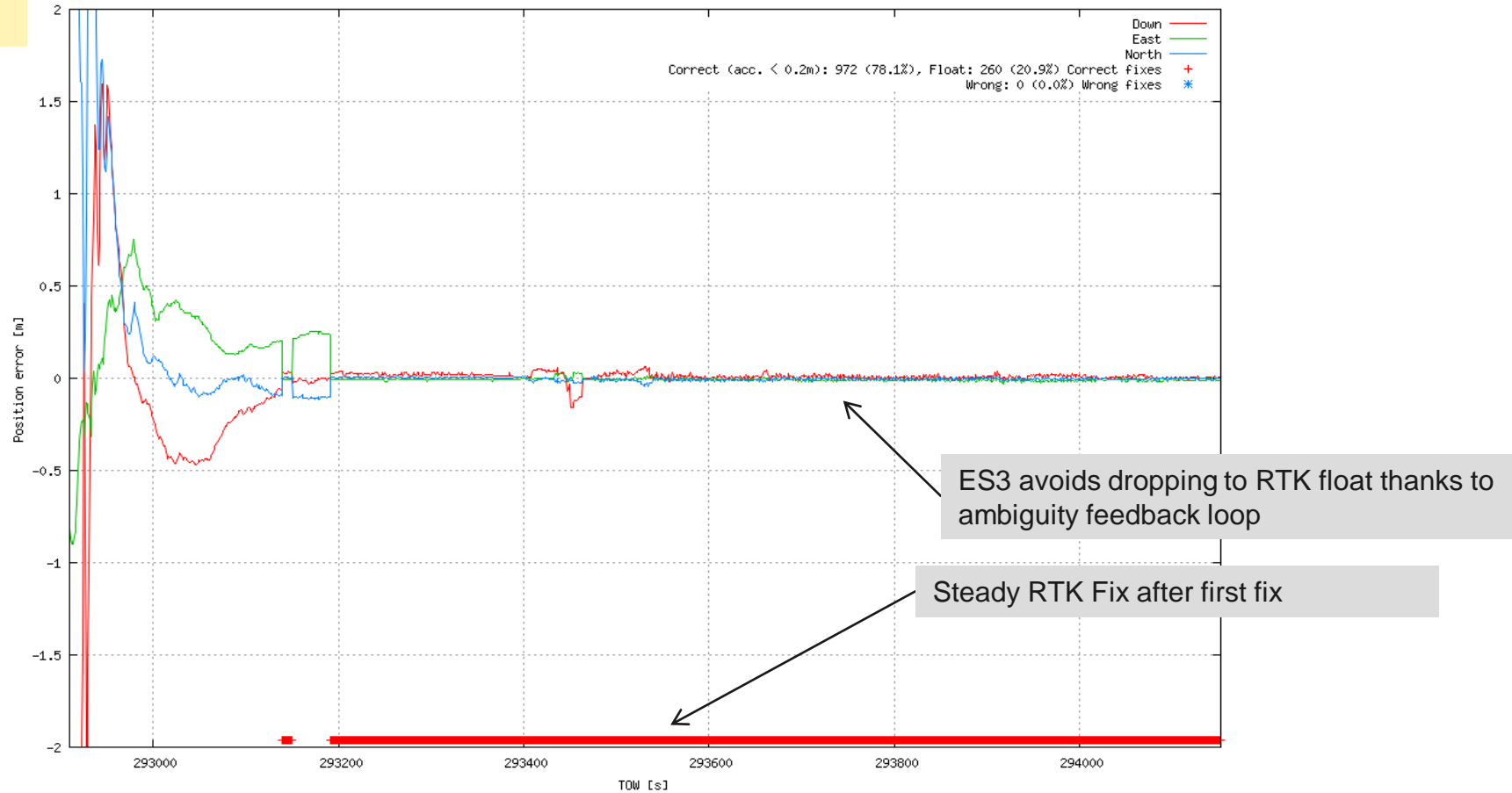




# UAV Test, patch antenna, flying next to tree line



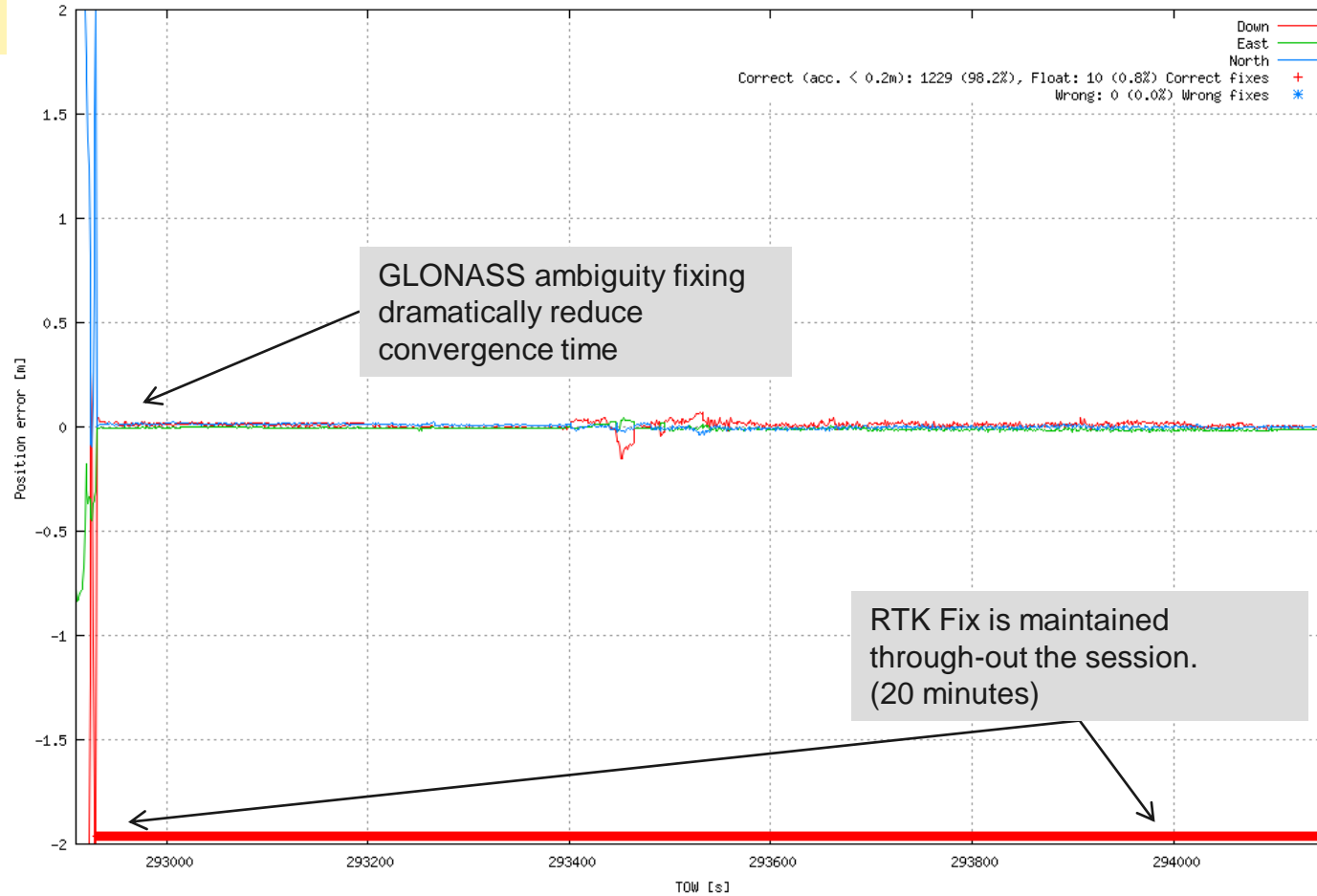
## ES3 performance



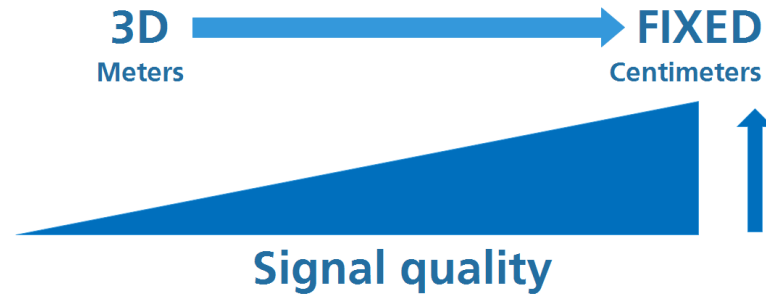
# UAV Test, patch antenna, flying next to tree line



## IP performance



# RTK Signal quality requirements



Ideal location for RTK

- RTK requires a higher Satellite signal quality than standard, 3D fix GNSS
- RTK fixed mode will be achieved if CNo levels, number of satellites, multipath conditions are good enough



challenging



possible use case

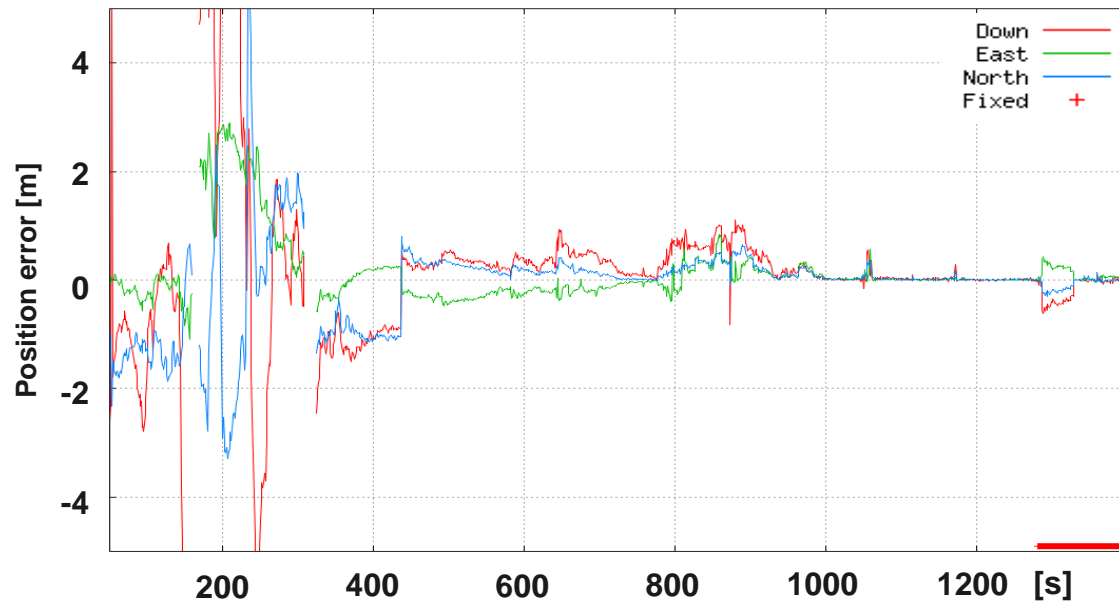


challenging

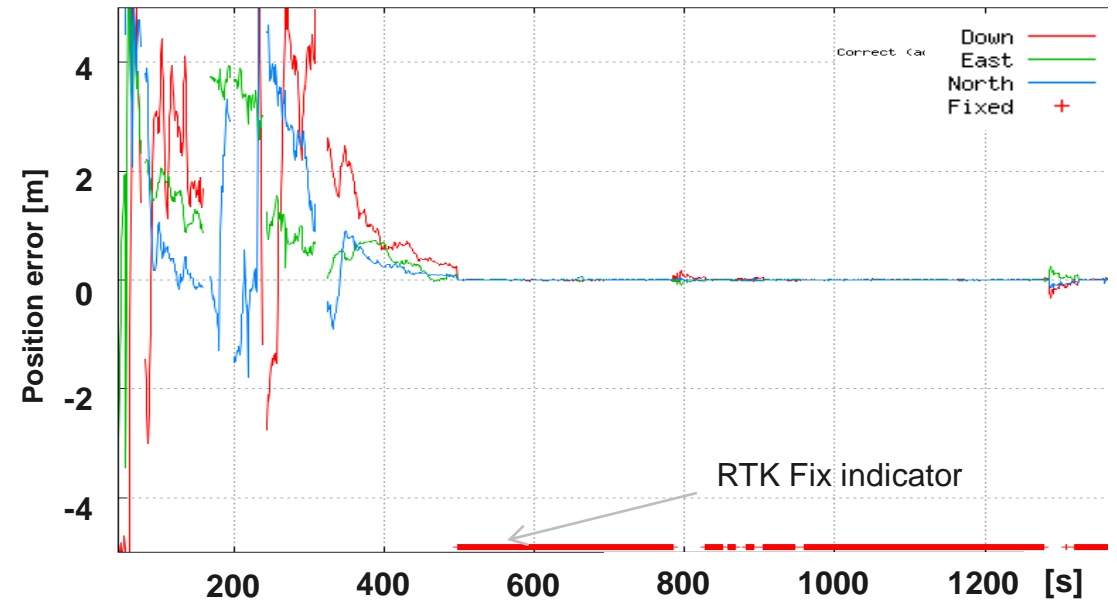
# NEO-M8P performance vs. high cost receiver



## Receiver T (price: 4000€ )



## NEO-M8P



NEO-M8P performance matches very expensive receivers

# Target markets



UAV



Agriculture



Machine Control



Robotic Guidance



Pro Sports



Survey & Mapping



**Anything that needs cm-level accuracy, and that accepts baseline constraints & open sky environments**

# Target markets

## UAV

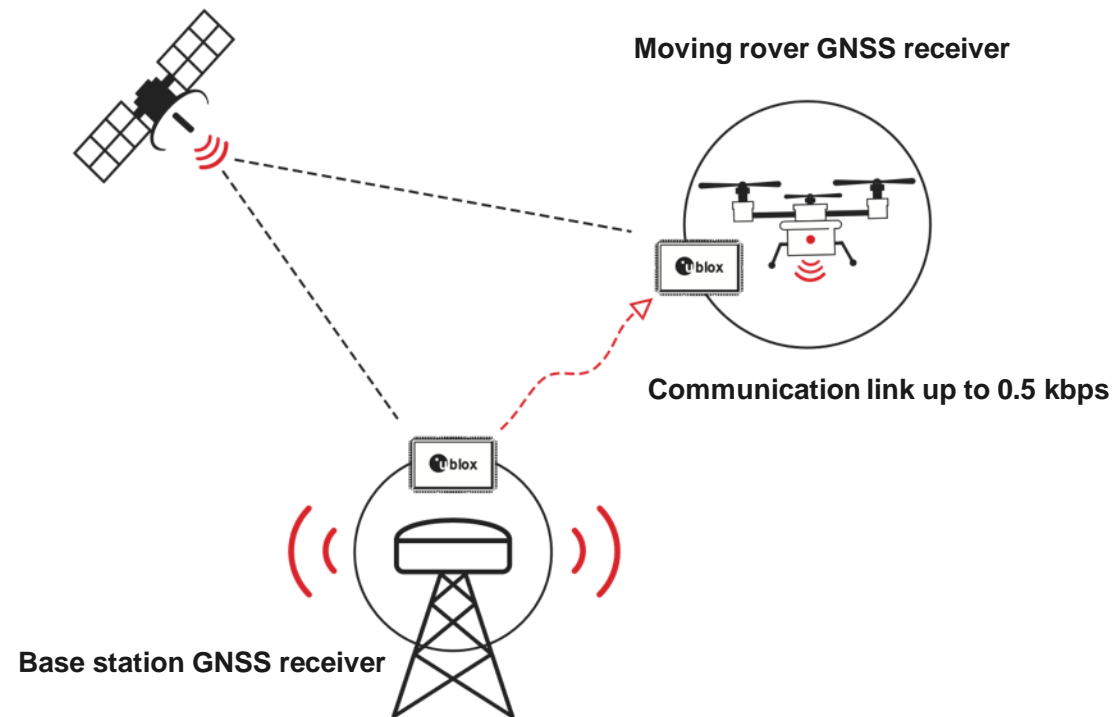
- **NEO-M8P** delivers **affordable** cm-level positioning for **improved flight trajectory**



Remote Monitoring



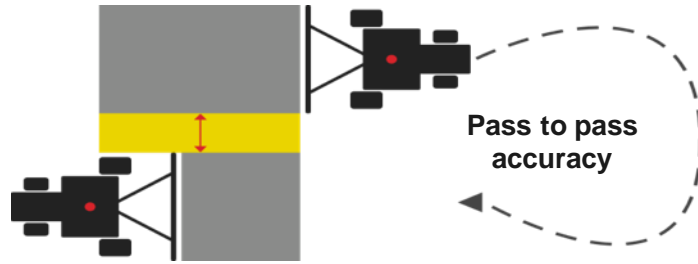
Infrastructure Inspection



# Target markets

## Precision agriculture

- **NEO-M8P** increases productivity at a **disruptive** price point



Guidance Systems



Autonomous Systems



# Target markets

## Machine control

- **NEO-M8P** enables affordable cm-level performance for all applications



Guidance Systems



Autonomous Systems

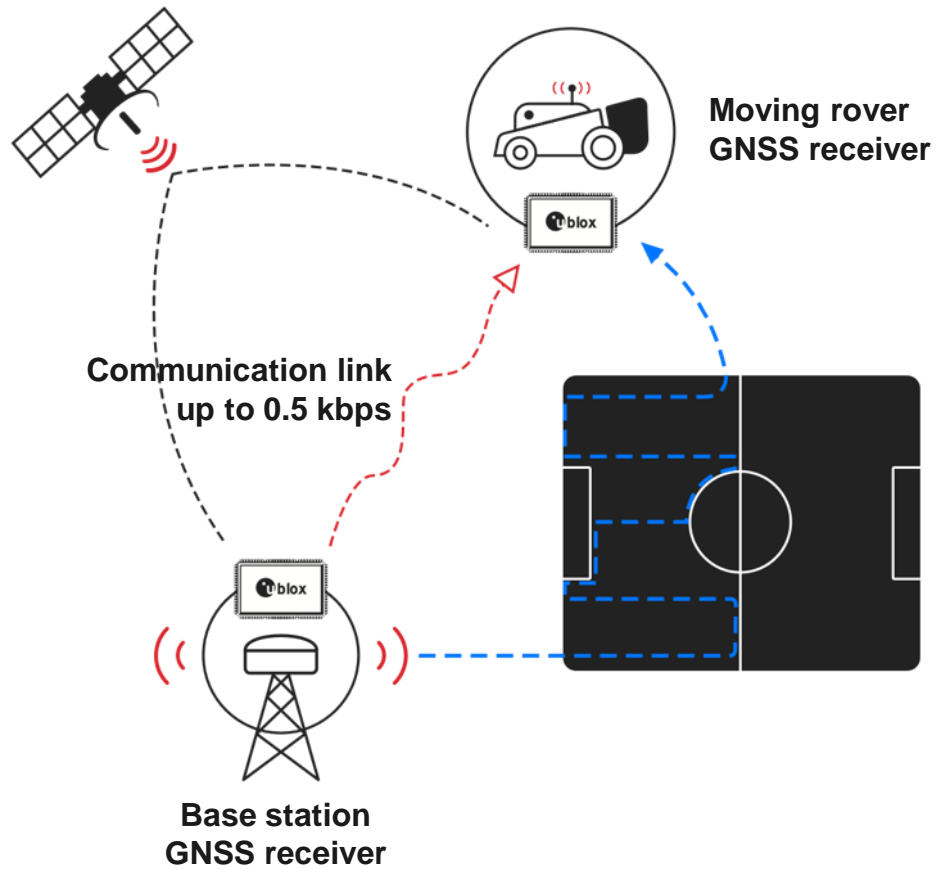




# Target markets

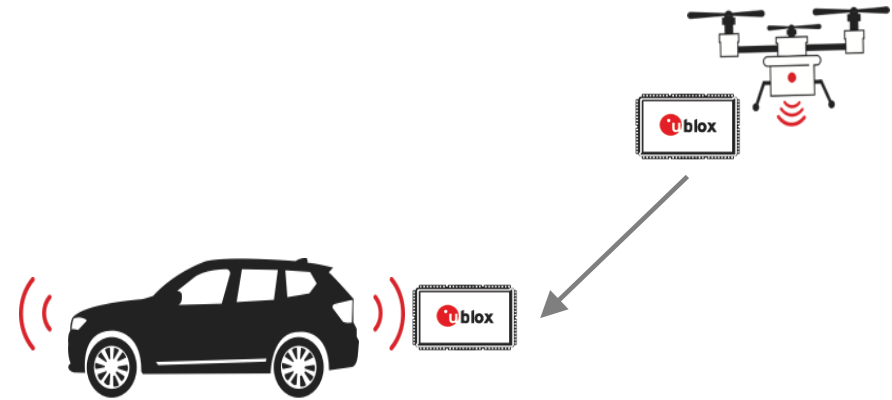
## Robotic lawn mower

- **NEO-M8P** delivers **precision guidance** to optimize mowing efficiency



# Moving Baseline Follow Me Setup

- Moving baseline feature enables **follow me** & **guided landing** applications
- Setup
  - 1<sup>st</sup> NEO-M8P-2 on the UAV
  - 2<sup>nd</sup> NEO-M8P-0/2 on the car
- **Follow me** setup delivers centimeter level 3D vector between vehicles to enable:
  - UAV to accurately follow a moving vehicle.
  - UAV will find landing platform when the vehicle is moving (e.g. boat, delivery truck, etc.).

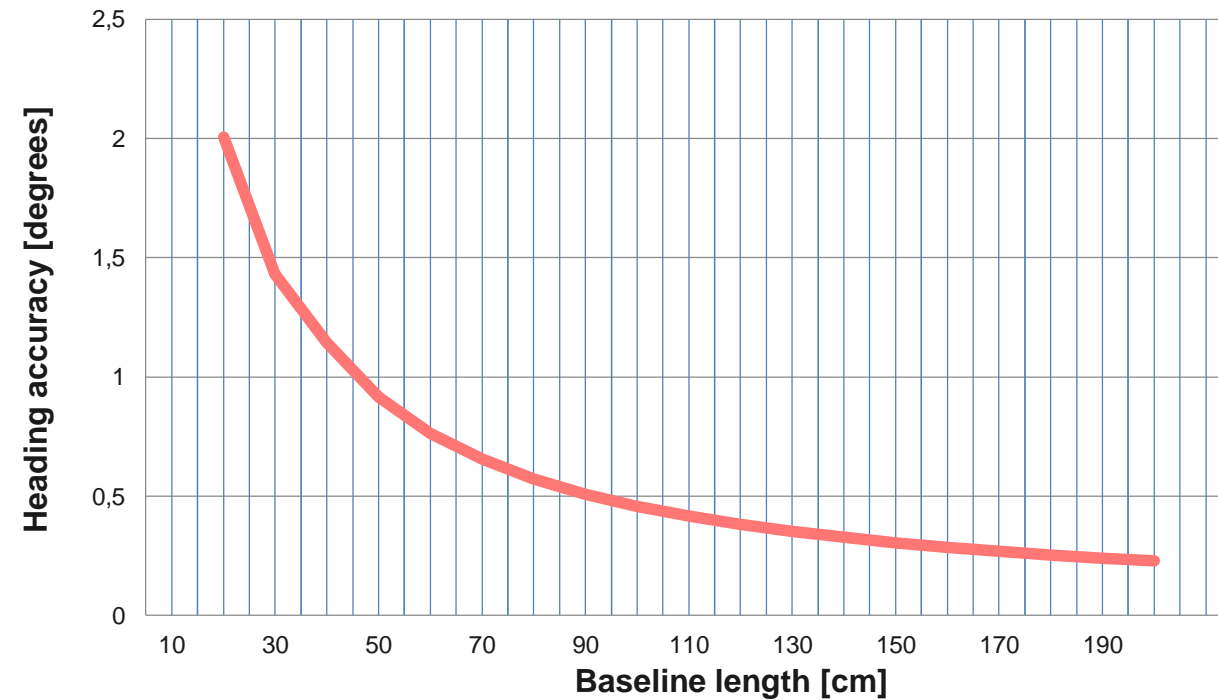


# Attitude sensing setup

## Expected performance



- Heading accuracy is a function of baseline length.



**Longer baselines give better heading accuracy**

# Product deliverables

# Product Roadmap

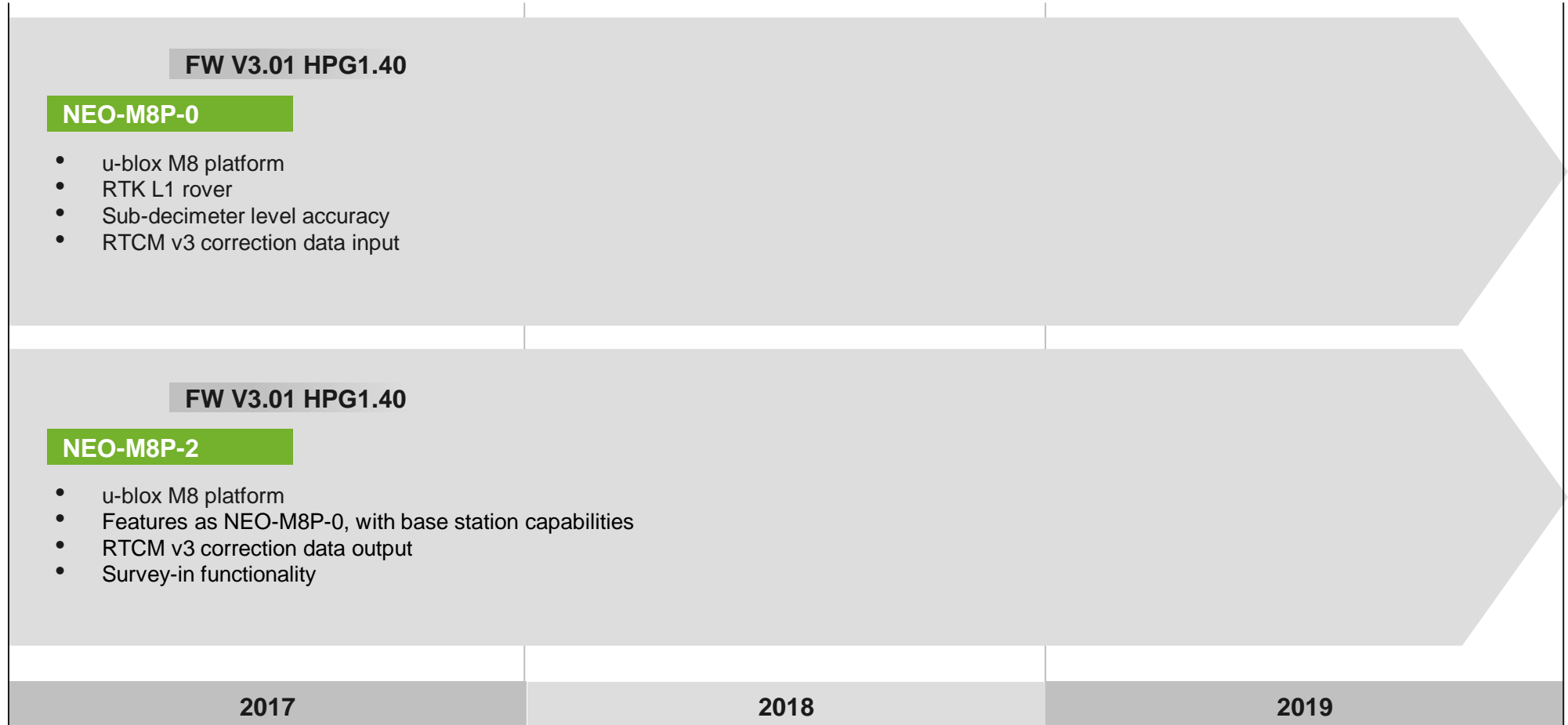
Affordable, professional grade high precision modules



NEO



12 x 16 mm



# C94-M8P

## the application board



An application board package contains two boards

- Both boards include NEO-M8P-2 (Base Station capabilities)
- RF link
- Connectors for CEL/SHO application board



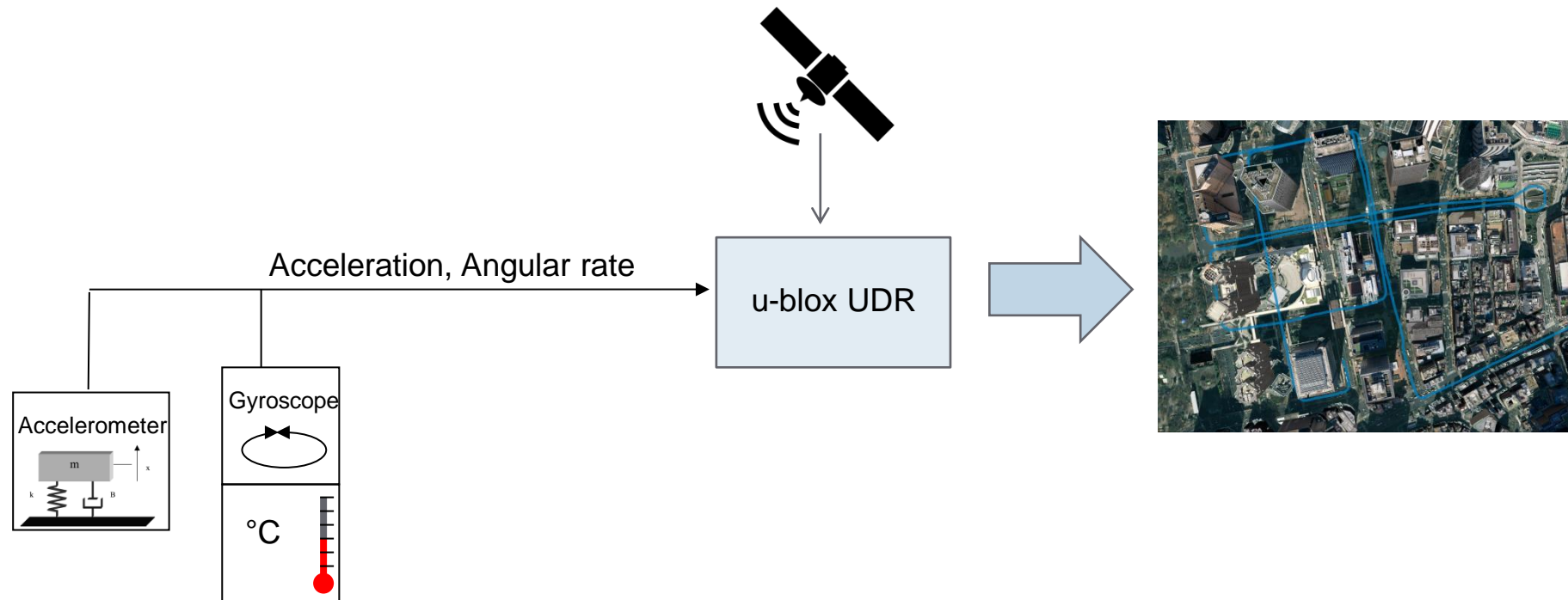
**With this application board users can swiftly integrate and evaluate our RTK solution**

# DR: Dead Reckoning

# Dead Reckoning at a glance

DR combines inertial sensing data and GNSS signals (sensor fusion)

- ADR (Automotive DR) requires vehicle speed information
- UDR (Untethered DR) does not require vehicle speed information



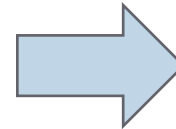
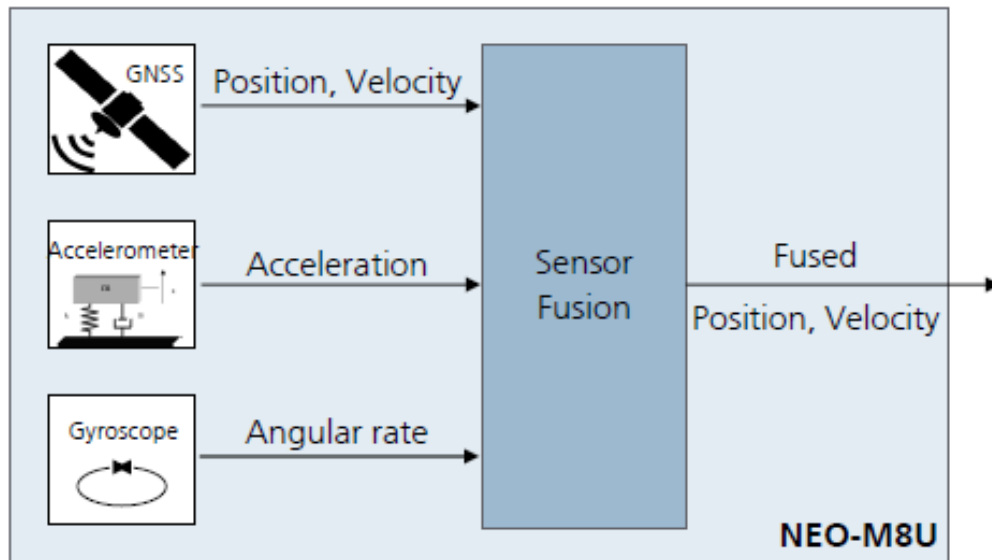


# Dead Reckoning with NEO-M8U

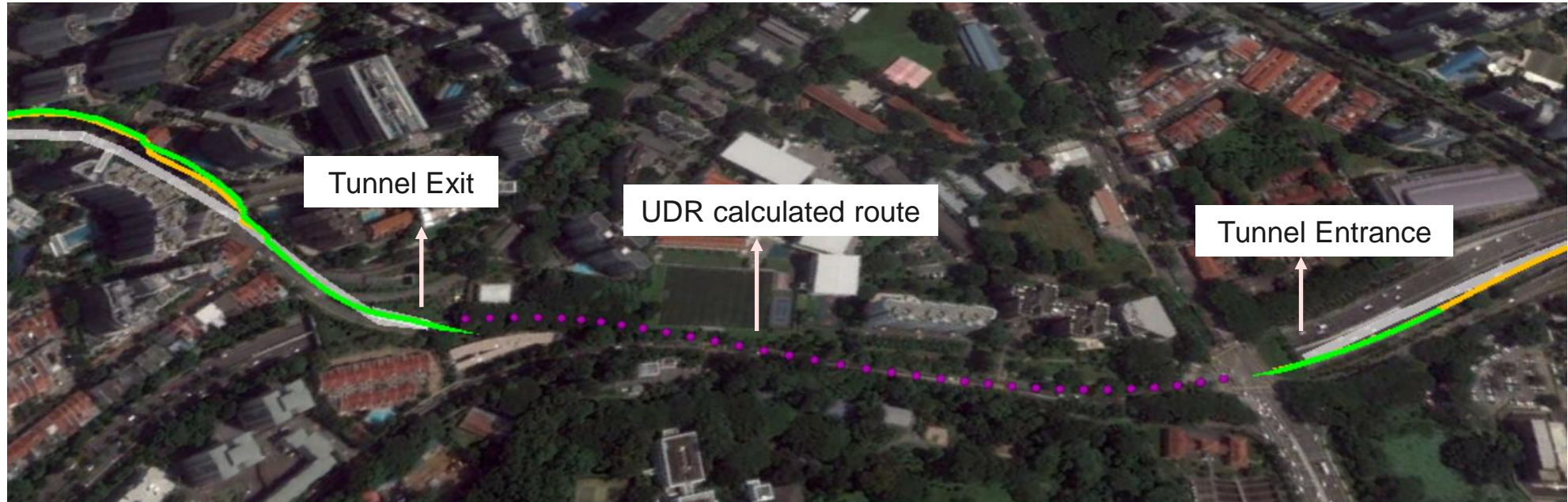


DR combines inertial sensing data and GNSS signals (sensor fusion)

- NEO-M8U combines inertial sensors (built-in) and GNSS signals
- NEO-M8U works as stand alone, no additional information from the car are necessary



# Navigation during short signal loss



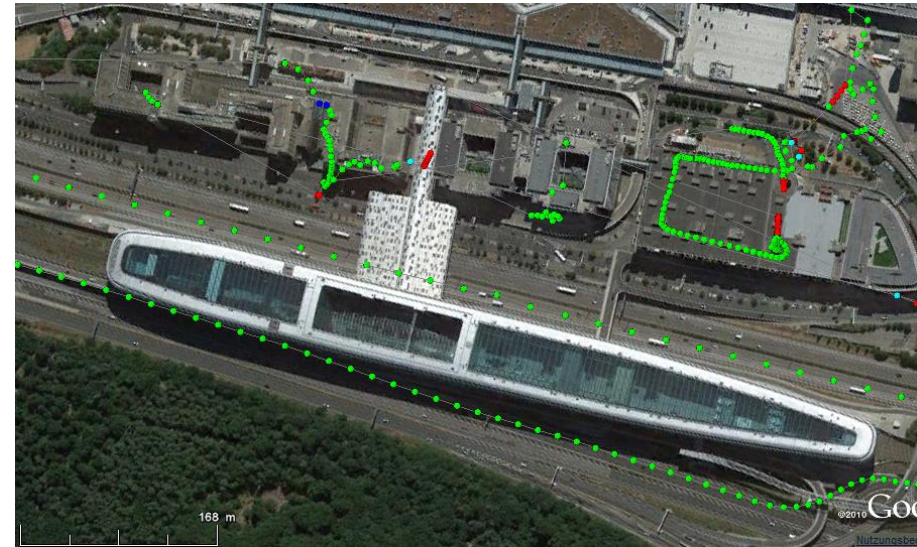
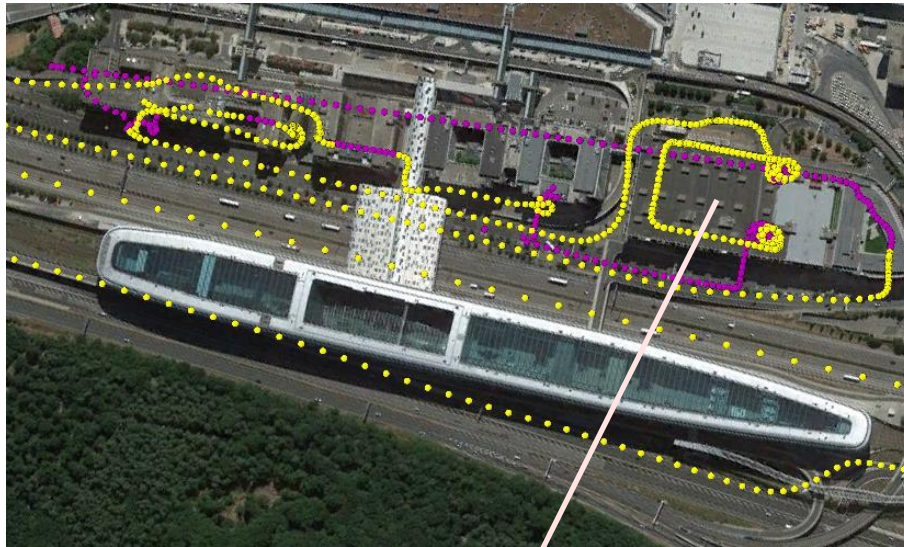
UDR+GNSS

GNSS only

UDR only

# Leading performance under poor signal conditions

Example of parking house in Frankfurt Airport



UDR+GNSS



GNSS only

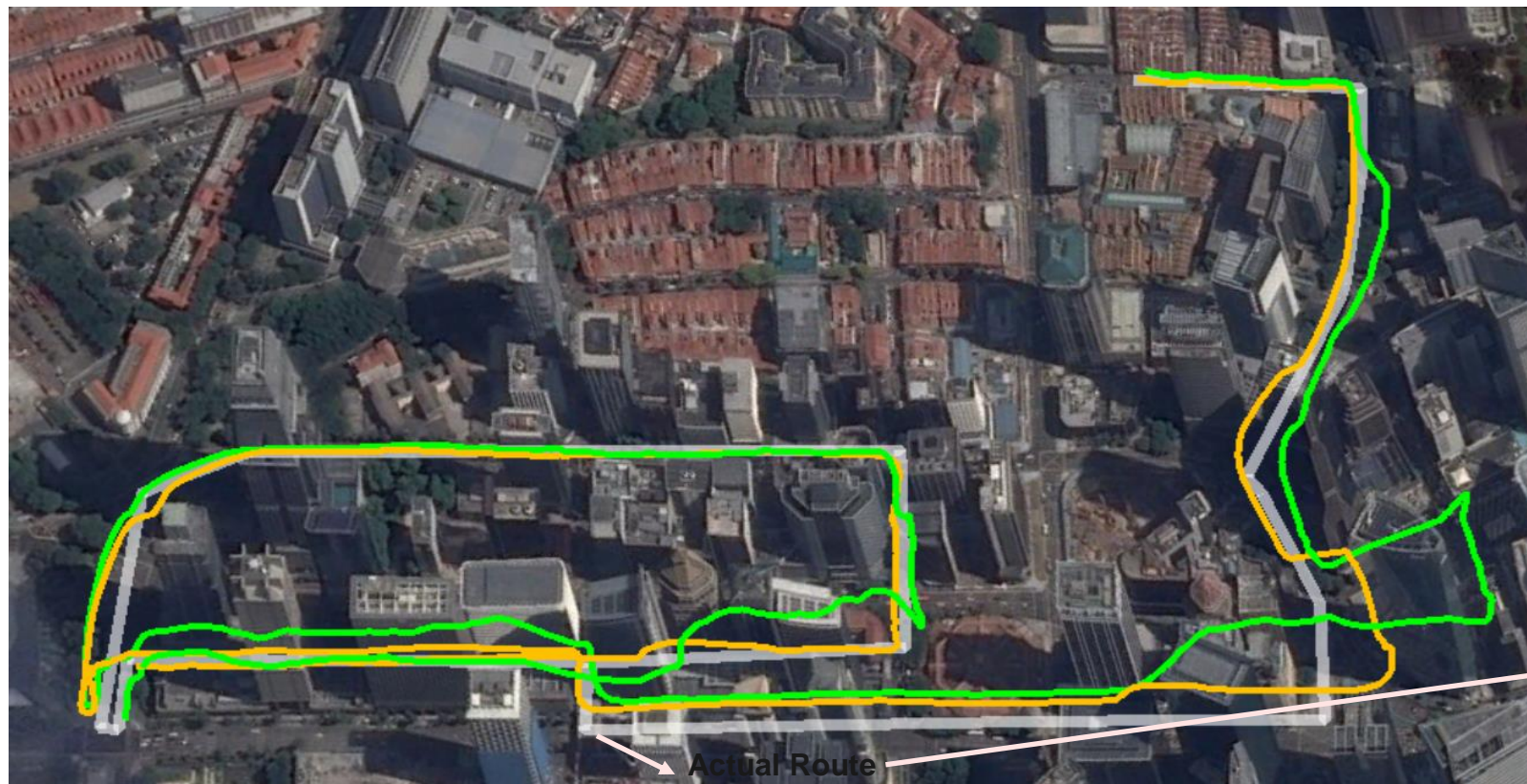


UDR only



# Leading performance under poor signal conditions

UDR reduces multipath effects greatly (e.g. downtown Singapore)

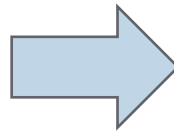


UDR+GNSS  
GNSS only



# Leading performance under poor signal conditions

Better navigation performance at weak signals (~20-25 dBHz) vs. GNSS only



Possible location of the device, which may be placed anywhere in the vehicle.

UDR+GNSS

GNSS only

# Product Roadmap

## Aftermarket Dead Reckoning



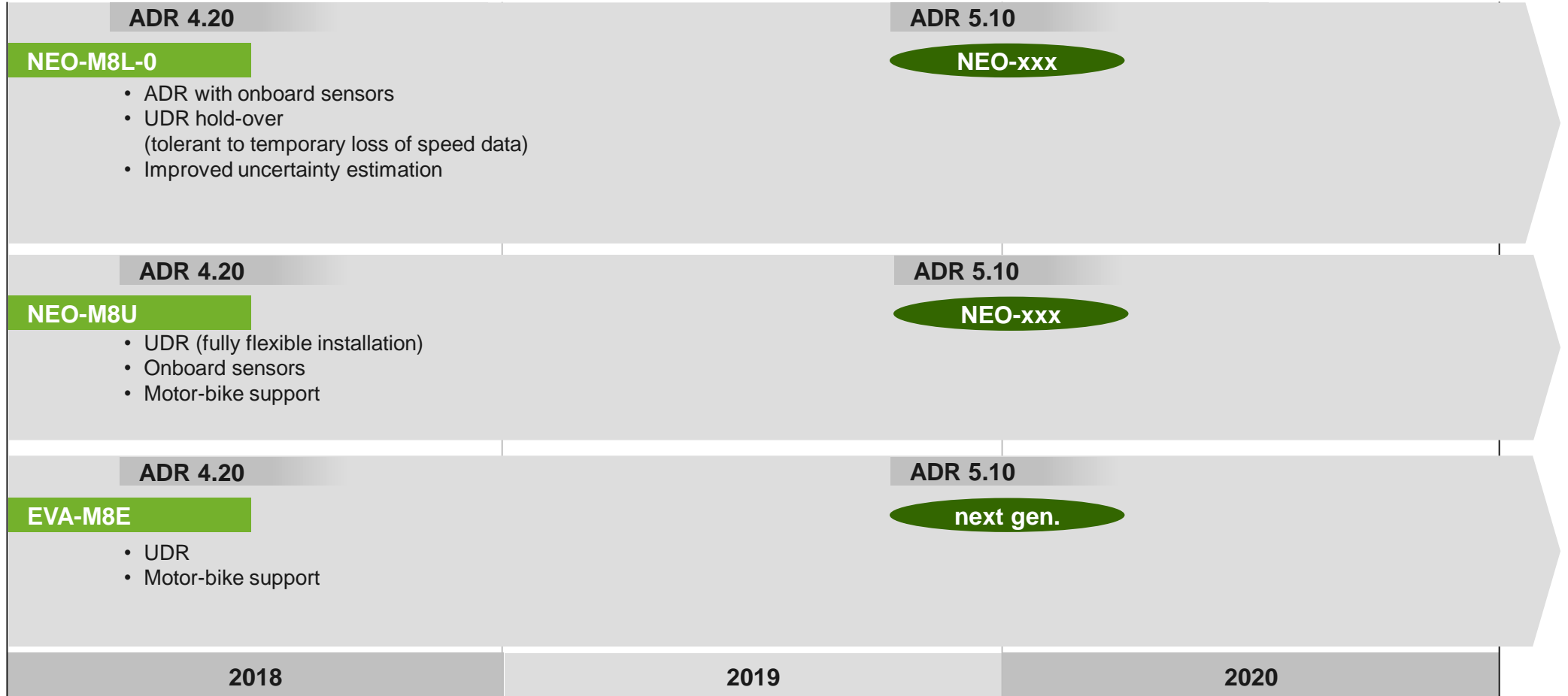
12 x 16 mm



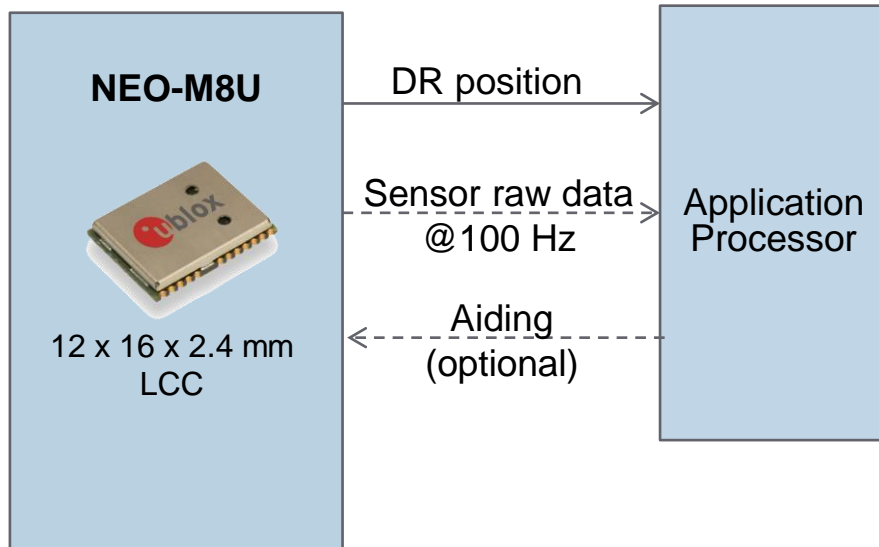
12 x 16 mm



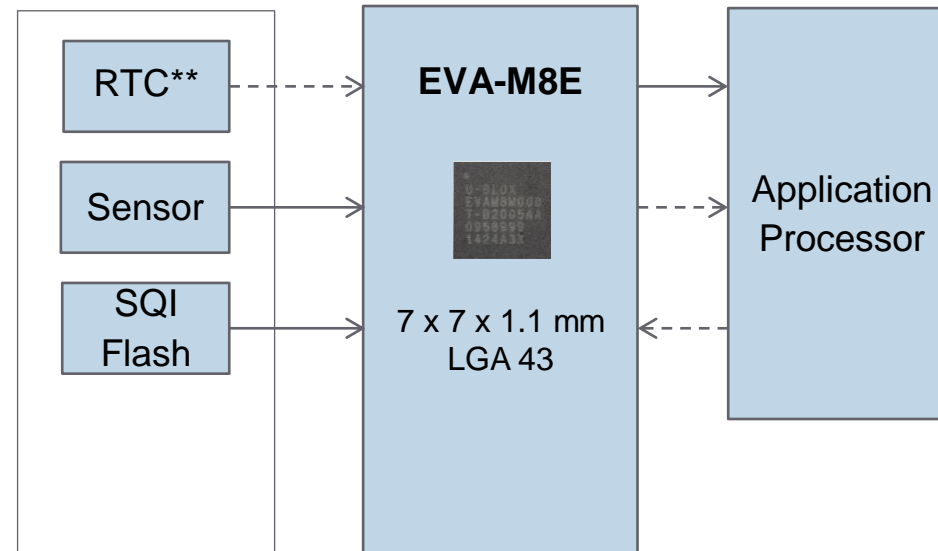
SIP



# UDR module product portfolio



- A complete solution
  - sensors within NEO-M8U
- Interchangeable with other u-blox NEO family receivers



- Full design flexibility
- Small sized

# Different configurations of GNSS device



NEO-M8U and EVA-M8E: pin-to-pin compatible with their respective families



NEO-M8M



NEO-M8Q



NEO-M8P



NEO-M8L



NEO-M8U



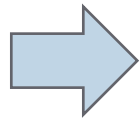
EVA-M8M



EVA-M8Q



EVA-M8E



**UDR is the next step after GNSS for any application requiring reliable positioning data in a vehicle**








# UDR applications examples

Designed for applications mounted in a road vehicle looking for:

- Differentiation over GNSS only
- Enabling new markets through:
  - Enhanced GNSS performance in most of conditions
  - Cost/size reduction thanks to extra performance

Typical industrial vehicle based tracking solution:

|                 |  |  |   |  |  |  |
|-----------------|--|--|---|--|--|--|
| <b>Examples</b> |  |  |  |  |  |  |
|                 | <b>Security – car alarm</b>  | <b>Insurance telematics</b>  | <b>Navigation (aftermarket)</b>   | <b>Road tolling</b>  | <b>OBD-retail</b>  | <b>Fleet management</b>  |

# GNSS getting started - hardware

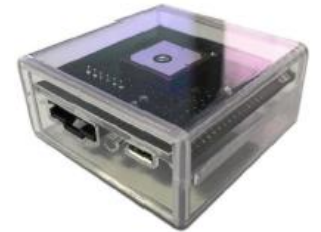
- Modules
- GNSS evaluation kits and application boards
- C030-xxx IoT starter kits (w/ GNSS, 3G/LTE Cat.M1)
  - ✓ Cortex-M4
  - ✓ ARM mbed envir., Arduino interface
- Reference Designs



**GNSS modules**



**Evaluation kits**



**Application Boards**



**Mbed enabled IoT starter kit**

# GNSS application support

- Dedicated application engineers in place:
  - ✓ [ubloxFAE@microdis.net](mailto:ubloxFAE@microdis.net)
- Documentation incl. Application Notes, System Integration Manuals
- Test & debug tools
- u-center – evaluation PC tool for:
  - ✓ monitoring performance
  - ✓ testing different receiver configurations
  - ✓ collecting logfile
  - ✓ saving/restoring configuration and fw



**u-center evaluation tool**

**MICRODIS**



**COMPETENCE & RELIABILITY**

**THANK YOU FOR YOUR ATTENTION**



**UDR Demonstration**