UNDER EMBARGO UNTIL 31st October, 7am PDT, 3pm GMT


# Introducing Ensigma's Low-Power GNSS IP Solution

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# Ensigma IP Families

*Connectivity, Broadcast Decode and Location products*

## Ensigma

The most comprehensive range of wireless IP

### Connectivity

Broad range of low power and high performance connectivity solutions based on Wi-Fi, Bluetooth and 802.15.4

- **Wi-Fi**
  - High Performance/mm$^2$
  - Low Power/mm$^2$
- **Bluetooth**
  - Focused features
  - Power/mm$^2$
- **802.15.4**
  - Focused features
  - Power/mm$^2$

### Broadcast

TV & Digital Radio Decoders

- **TV Decode**
  - Fully featured
  - Performance/mm$^2$
- **Audio Decode**
  - Fully featured
  - Performance/mm$^2$
  - #1 in DAB

### Location

Integration into IoT and wearables

- **GNSS**
  - Focused features
  - Power/mm$^2$

# GNSS is more than the Satnav

*New markets and new opportunities…*

- **“Many of these products also need GNSS functionality, with varying degrees of accuracy.  Asset tracking is increasingly important as it enables new business models (such as the shared bikes).  Many of these applications are extremely price-sensitive and are combining GNSS semiconductors with their own connectivity”**

Source: Gartner Market Share Analysis: Wireless LAN, Bluetooth, GPS and NFC Semiconductors, Worldwide, 2017 (Published May 2018)

# GNSS is a key enabler for new markets

*GNSS is becoming an essential element of major technology developments*

| | | |
|---|---|---|
| **IoT** |  | Provides location and timing information. |
| **Agriculture** |  | Locates equipment and livestock plus location information for environmental monitoring. |
| **Smart Cities** |  | Used in the infrastructure design and mobility of smart cities. |
| **Logistics** |  | Enables monitoring of cargo along the entire supply chain for efficiency, security and safety. |
| **Mobile Health** |  | Disability assistance, preventive medicine and emergency, and leverage fusion of big data with GNSS. |

# IoT GNSS example: Agriculture

*GNSS is becoming an essential data source for agriculture*

- Integrated farm management aims to increase farm productivity using processes that improve the efficiency of farmland and equipment.
- Decisions are supported by data from GNSS enabled sensors and equipment.
- Currently about 10% of farms in the EU - estimated to be 30-40% by 2020
  - (source: EU GNSS Market Report | Issue 5, 2017)

| | Operations | | Monitoring | Other |
|---|---|---|---|---|
| Applications | Farm Machinery Guidance | Steering Variable Rate Application | Harvest/Yield & Biomass monitoring Soil Sampling | Livestock & Machinery Tracking & Virtual Fencing |
| Key GNSS Requirements | sub-metre Always-on | sub-decimetre Always-on | sub-metre ad-hoc | sub-metre ad-hoc |

# Power Consumption

*IoT solutions  are normally power and resource constrained*

- Many devices in these new markets must use either a battery or power harvesting.
  - Devices typically require long lifetimes, further constraining power consumption.
  - Devices must survive on  sub-milliwatt power budgets.
- Traditional GNSS receivers tend to require relatively high power consumption.

***Adding GNSS into equipment that  needs a longer battery life is a major challenge and requires a different approach***

# Pick your Constellation support with care

*Constellation you are using impacts power consumption*

- All GNSS is designed around a similar topology, but architected differently.
  - Support for each constellation has different power consumption implications.

- GPS and GLONASS has a lower sampling rate, requiring the least computation in the baseband processor.
- Galileo and BeiDou were designed with a larger signal bandwidth, more complex and longer codes, and higher navigation data rates for greater accuracy.
  - Requires a higher sampling rate.
- **This requires more processing**.

| Constellation | Power Consumption |
|---|---|
| GPS | 1x |
| GLONASS | 1x |
| Beidou | Up to 4~5x |
| Galileo | Up to 8x |

Source: Imagination Technologies internal testing

# Acquisition time

*Quick GNSS acquisition a key element in saving power*

- **RF is normally the major contributor to power consumption of GNSS systems.**
  - The quicker you can acquire the signal, the quicker you can switch off the RF.
    - “Capture and process” approach.
- **System receiver sensitivity affects how quickly you can acquire satellite signals .**
  - Better the sensitivity the quicker you can acquire the signals and hence the quicker that you can switch off the tuner.
  - High gain antennas can help, but at a cost ($$).
    - Difficult to do in small IoT type devices.

# “Snapshot”

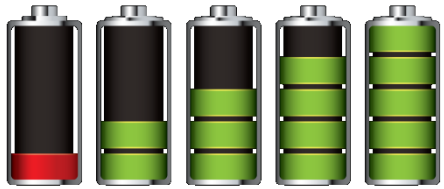
*Reduced acquisition time when traditional “tracking” is not required*

- **Many markets do not require “always-on” location.**
  - Only needed at specific times or  when a specific action happens (e.g. geo-fencing).
- **Snapshot is a short recording of the satellite signal which is processed “offline”, after the receiver is powered down.**
- **Snapshot has many features to reduce power consumption.**
  - No need to track satellites or decode navigation messages which are computationally intense and energy demanding tasks.
    - Instead of tracking satellites for tens of seconds to decode the navigation message, only milliseconds of information are required.
    - The receiver can be aggressively duty cycled, reducing power.

# Duty Cycle Operation

*Continuous Capture and Process can reduce power consumption*

- **RF on for a fixed time every fix period**
  - Typically 100 to 500msec
- **Fix update rate**
  - Typically 1 sec to 20 sec
- **Power saving**
  - RF power saving (Fix time - On time) / Fix Time
  - 100msec, 1sec = 90% RF saving
  - 500msec, 20sec = 97.5% RFsaving
  - 100msec, 20sec = 99.5% RF saving

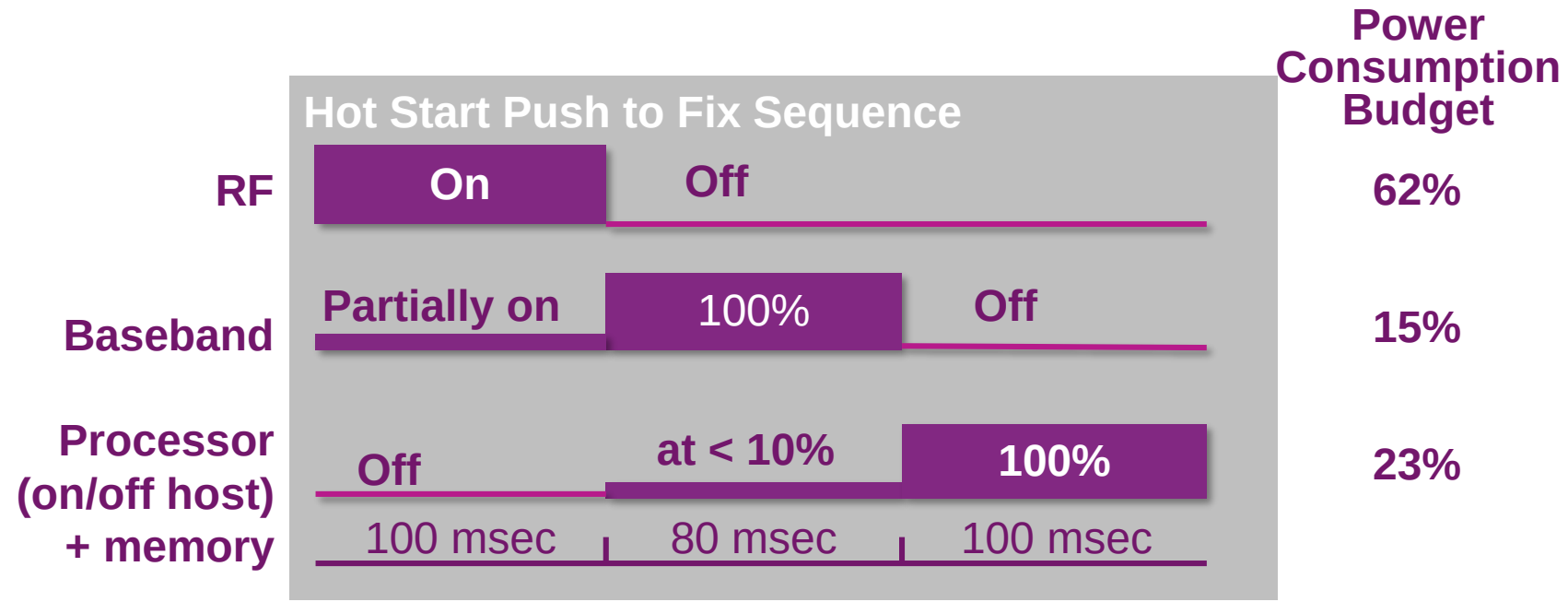



# Snapshot in action

*Energy Consumption Example for GPS/GLONASS*

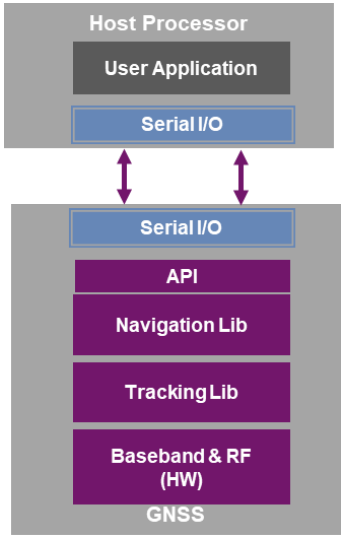
**Grab the data and store it in memory, switch off the RF quickly**

**Do the correlation and get the processor to turn it into a location fix**



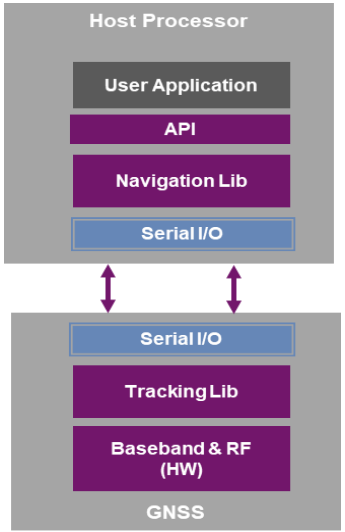
# System Architecture

*Moving GNSS features to the host can reduce power consumption*



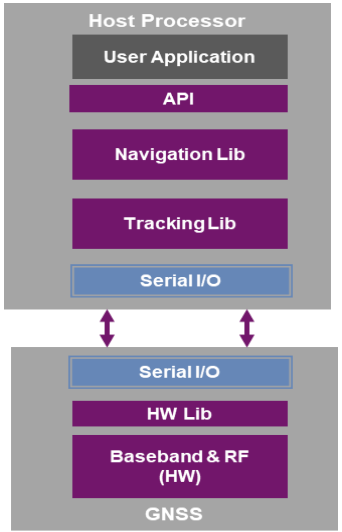

**Fully Embedded**

GNSS operation without host interaction except on first start-up




**Partially Embedded (host tracker)**

Software operation split between host and GNSS

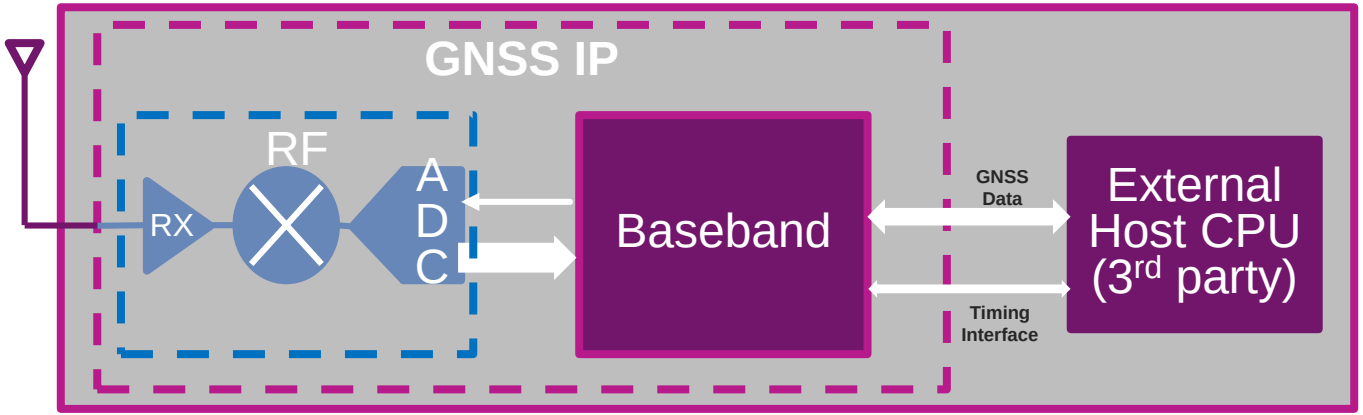



**Host/Thin IP Configuration**

SW operation split between Host and GNSS

# Ensigma Series 4 GNSS

*IP Hardware and Software GNSS solution for "battery constrained" devices*




- **Features**
  - ✓High sensitivity receiver
  - ✓Provides the signal processing for digitised receiver samples.
  - ✓Performs the primary functions of signal acquisition, tracking and navigation
  - ✓Enables industry leading Time To First Fix (TTFF), location accuracy

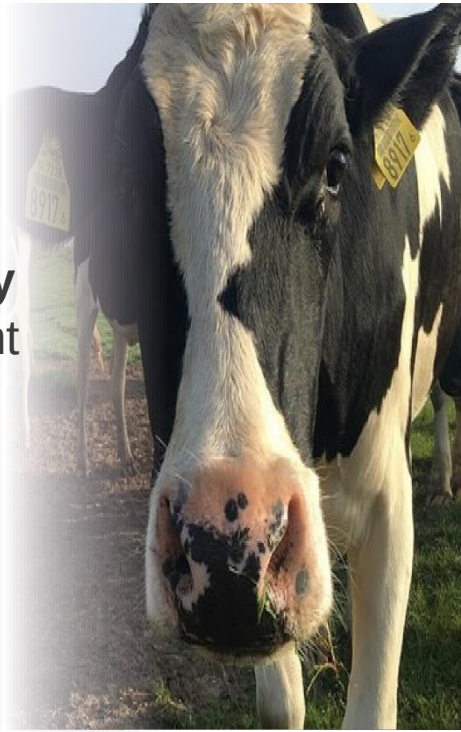
# Series 4 GNSS Features

- ✓**Standard GNSS continuous fix operation**
  - ✓support for standard constellation features.
- ✓**Push to fix operation (snapshot)**
  - ✓Intermittent positioning on command (external/internal)
- ✓**RF capture and process**
  - ✓RF is on for minimum time
  - ✓Optimises power
  - ✓Samples post processed for optimised performance.

# Series 4 GNSS Time to Fix Performance

- **Coldstart/Warm Start**
  - Time to acquire << 1 sec for signals to -150dBm
  - Total TTFF  between 19 and 31 seconds for signals better than -147dBm
- **Hot Start/Aided Start**
  - Time to fix 1 sec for signals to -154dBm
  - No data download required if RTC time accuracy is better than 10 secs
  - Standard hot start to -157dBm
  - Aided hot start to -160dBm
- **Tracking**
  - Sensitivity of -163dBm

# Ensigma Series 4 GNSS Key Features



- ✓**Designed for “snapshot” operation**
  - Short signal acquisition time, processing on the baseband or offloaded to external host
- ✓**Mix of hardware and software for performance and flexibility**
  - Can be configured to support only the GNSS systems you want to support
  - Can support all three system architectures
- ✓**Low power consumption**
  - Less than 5 mW average power for 100msec capture to memory and process
- ✓**Low area**
  - Less than 2.5mm$^2$ laid out on 40nm


**Thank you**

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