



# Multi GNSS Receiver Trends

Consumer Market

Greg Turetzky – Sr. Dir. Of Marketing

10/18/2010

ICG - Turin



## Consumer Market Overview

- We divide the market into 3 main sectors
  - Handsets : anything with a modem
  - Automotive : In-dash and PND
  - Consumer : Computers, Cameras and other mobile electronics

	<b>AUTO</b>	<b>HANDSET</b>	<b>CONSUMER</b>
2009 Units	~60M	200M+	<4M
2010 TAM	150M+	~1.5B	500M+
2010 Units	~70M	300M+	>6M
Penetration	45%	20%	1%
Y on Y Growth	>15%	>50%	>60%

## End User Platforms Drive Technology Requirements

- PND platform in early 2000
  - Fast start-up and robust urban canyon and foliage performance without benefit of additional sensors
  - SiRFstarIII architecture with 300K correlators and -152 dBm sensitivity enabled mass market acceptance
- E911 mandate in early 2000
  - Low power fast start-up and high sensitivity
  - SiRFstarII/III + AGPS and Qualcomm AGPS helped meet the mandate
- Navigation Services on handsets
  - Low power “Always On” capability
  - SiRFstarIV + -160dBm Sensitivity provided necessary user experience
- Broad range of Location Enabled Services on handsets
  - High availability/low accuracy for social networking
  - High availability/high accuracy for “Pinpoint Mobile Promotions”
  - Requires extension into indoor environments
- Collision Avoidance and “Self Driven Cars” in automotive
  - High availability sub-meter accuracy

## Trends in Requirements

- For the past few years, the key performance requirement from customers was **SENSITIVITY**
  - Keyed by the development of AGPS techniques
    - Once you don't need data, signal processing takes over
  - Drove receiver architectures to accommodate large memories for long integration times at lower powers
    - SiRFstarII on 130nm, III on 90nm, IV on 65nm
    - New satellite signals (pilots) will continue to help
- The new upcoming performance requirement is now **AVAILABILITY**
  - Customers expect to receive location information anywhere, all the time
  - Additional GNSS systems are necessary, but not sufficient
    - GLONASS provides urban canyon improvement
    - Regional systems like QZSS provide clear improvement
  - They do not solve the indoor problem very well
    - Many applications require positioning where GNSS will never work
- Increasing availability will drive the continued penetration of GNSS into consumer products

## Improving availability

- To improve availability, receiver architectures are moving to hybrid location methodologies
- Radio hybrids: Using signals of opportunity or dedicated infrastructure to augment GNSS
  - Platform level integration keeps incremental costs low
    - Reuse of existing radios
      - Cellular, WiFi, BT
    - Software integration of additional measurements
- Sensor hybrids: Bringing motion sensor technology into personal electronics
  - Proven on automotive platforms with fixed reference frames
  - Far more challenging in handheld environment
  - Advances in MEMS technology opening new doors
- Initial accuracy of solutions likely to be significantly worse than outdoor GNSS

## Impact on GNSS architecture

- Very low cost GNSS receivers likely to remain L1 only
  - Driven by the need for large volumes of “good enough” location
  - Key factors are price, cost, size, power and price
- High performance location determination receivers moving to multi-frequency
  - Adding GLONASS bands provides immediate benefit
    - GLONASS requirements in Russia and in 3GPP
  - Radio hybrids require additional frequency support
    - 2.4 GHz worldwide band has strong attraction
    - Extension of Multiband RF/digital CMOS from WiFi/cellular
  - Multi-frequency is more immune to jamming
- Dual-band moderate bandwidth (6MHz) front ends will become the norm
  - L1 will always be the anchor with a second tunable radio for hybrid
    - Silicon can handle the tunability
    - Software can handle the flexible coding schemes
  - Antenna and filter will be the main hurdle at product level

## Future architectures

- With SENSITIVITY at maximum and AVAILABILITY at 100%, market focus will shift to ACCURACY
  - Probably 3-5 years out
  - Desire for 1-3m in all conditions will grow
  - GNSS architectures will become multi-band, wide bandwidth for maximum performance

## Summary

- Today's L1 only receivers will continue to gain market share but mostly at the low end
- Focus for next 1-3 years is on creating platforms that provide location everywhere
  - Hardware and software integration of all available information
  - Receivers will support more than one relatively narrow frequency bands and one of them will always be L1
- Future will see highly flexible, wide bandwidth GNSS receivers for maximum accuracy