Impact of Multi-MEO GNSS on Consumer Products

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Consumers and Location

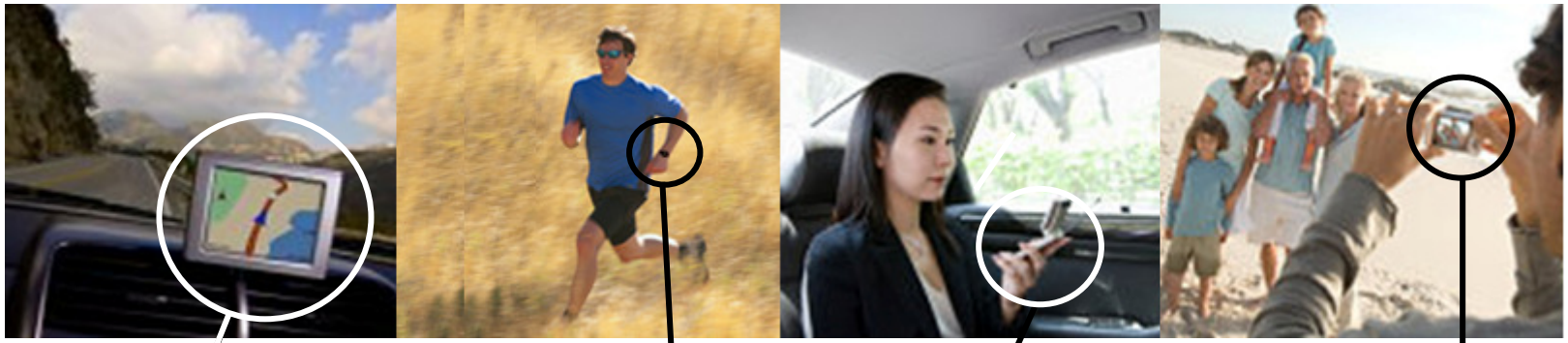
Last year 1.7 Billion people traveled abroad (world wide) for work or pleasure.

The average American drives 12,000 miles a year; only 3,600 are to work and back

In Japan and Korea, 38 million people subscribe to mobile TV.

In the US 75 million people jog, walk, or run on a regular basis

SiRF is a leading provider of location technology solutions for all of them



Navigation & Videos that fit in a small PND

High Sensitivity GPS that tracks through the open and in the forest

Eco-systems that bring the latest application to market quickly

Location indexing that helps you find your photos years later

In over 75M Devices…

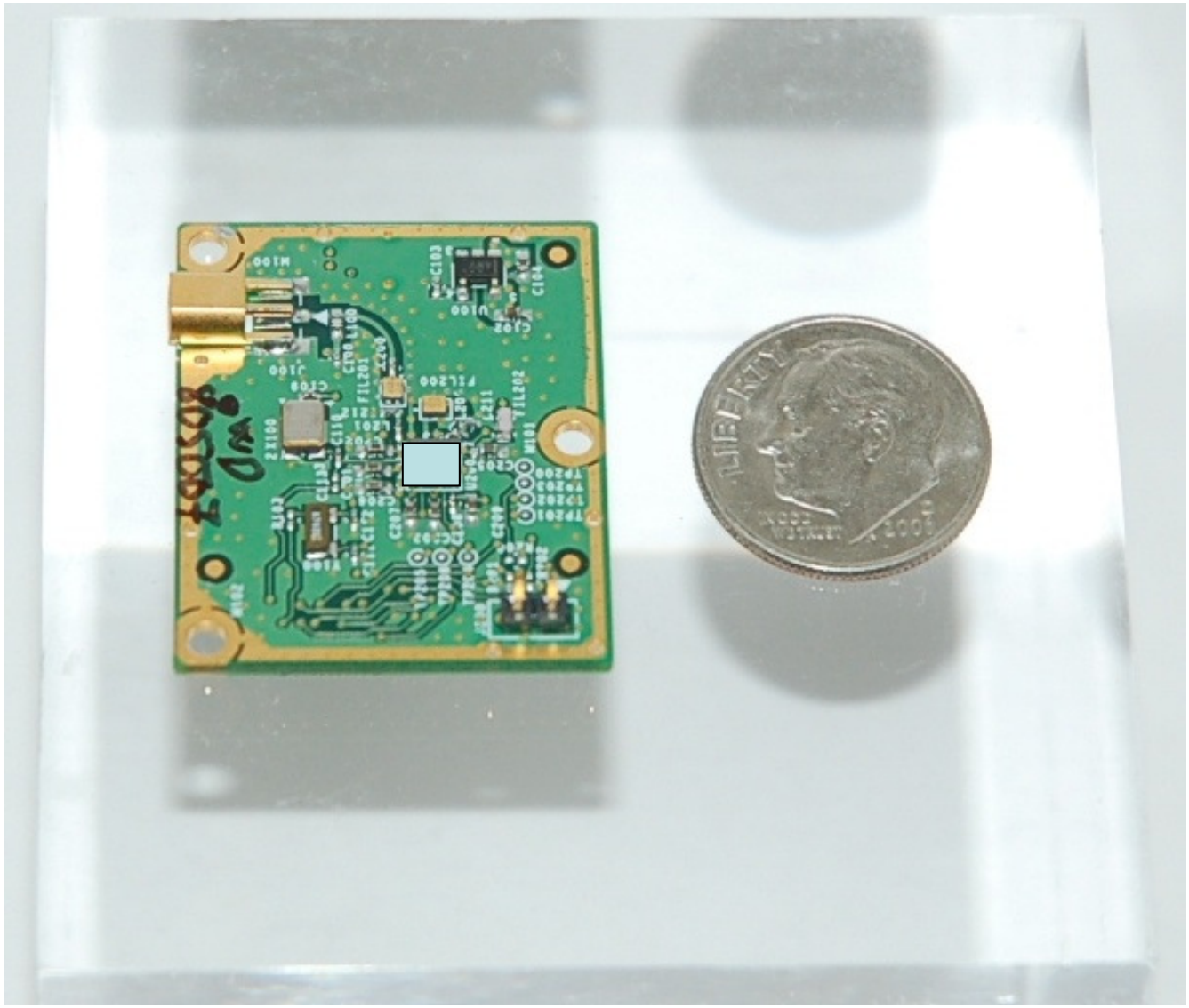
Who is SiRF?

- SiRF was founded in 1995 with a vision to bring GPS to mainstream consumers
  - Market was still focused on professional applications at product and module level
  - Breakthrough performance in sensitivity and time to first fix with a REDUCTION in power and price
- Our products fueled the growth of key consumer markets for car navigation, PC accessories and cell phones
  - Today we are a market leader and our chips can be found in leading PND and cell phone products around the world
- We were the first company to ship > 1M GPS chipsets in a single month
- We have always been a strong GNSS supporter
  - The SiRFstarII chipset was the first to support WAAS and EGNOS for consumer products in 1998
  - Our current SiRFPrima chip has hardware that can support GPS, WAAS, EGNOS, QZSS, GAGAN, COMPASS and Galileo
    - Not all software has been implemented

Key specifications for Consumers

	SiRFstarI	SiRFstarIII
year introduced	1997	2008
BB Technology	350nm CMOS	90nm CMOS
CPU/Memory	3 chips external	Internal
RF Technology	BiCMOS	Internal
Power (1Hz fix)	< 1W	<50mW
Total BOM	< $100	< $15
Chipset portion	>50%	<40%
Total Footprint	< 7500 mm2	< 20 mm2
Sensitivity	-142 dBm	-159 dBm
TTFF (hot)	12 seconds	<1 second

Current SSIII chip on an evaluation board



Key Consumer Wants

- All devices that need location are portable
  - Most portable devices are now connected
  - Data from satellites is slow and poor link margins
    - Primary use case by 2010 is ephemeris from other sources
- All portable devices have the same concernss
  - Size : must fit in the palm of your hand
  - Power: batteries should last a few days
  - Cost : cheaper things sell faster at WalMart
- Unfortunately, navigation performance is not the highest priority
  - Good enough to meet the bar
  - GPS itself is so much better today than 10 years ago
    - Accuracy of a few meters
    - TTFF of a few seconds
- All however is not lost
  - WE STILL DO NOT HAVE 100% AVAILABILITY

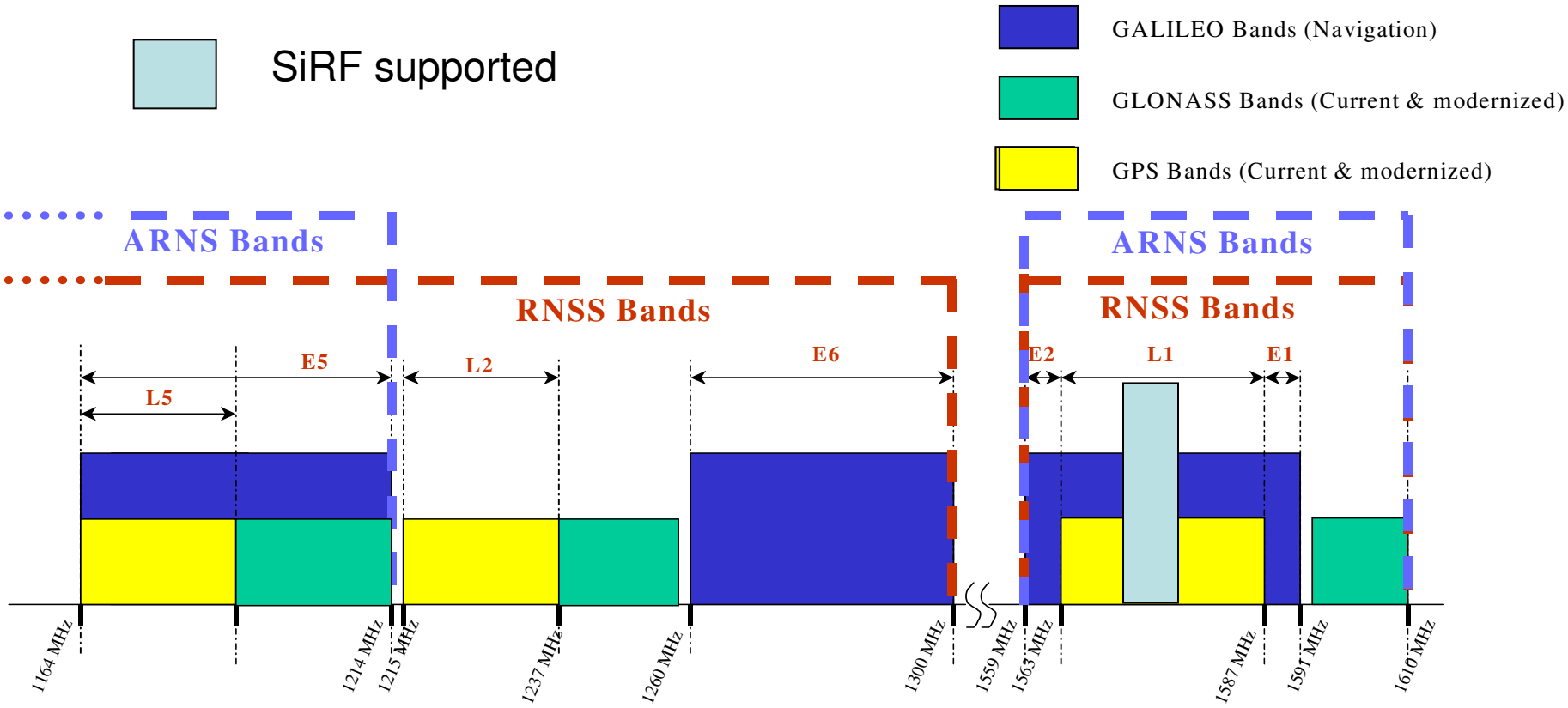
GNSS impact on availability

- Problem #1: Outdoors – the urban canyon
  - More satellites is always better
    - More satellites at high elevation is even better
  - SBAS GEOs are ideal for this situation
    - QZSS and iGEO (COMPASS) are even better
  - More MEOs help, but there is a limit
- Problem #2: Indoors – the shopping mall
  - More satellites is always better
    - Distribution is less important
    - More power is what is really needed
  - Local infrastructure solutions are the competition
    - Cellular and WiFi positioning

Use cases for consumers

- Two distinct markets have different characteristics
- Automotive Navigation, Telematics and PND systems
  - Key product features: screen size, maps, voice support
  - Secondary focus is on turn by turn navigation performance
  - Product specs don't usually include GNSS specs at ALL
- Cellular and other wireless devices
  - GPS penetration is still relatively low (<25%)
  - Coexistence with other radios is paramount
  - Cost, size and power dictate penetration
  - Location performance under aided (AGPS) conditions is focused on availability
- Neither market considers multi-MEO GNSS a "must have"
  - GPS is good enough
  - However, GNSS support is a differentiator especially locally

GNSS Spectrum chart circa 2006

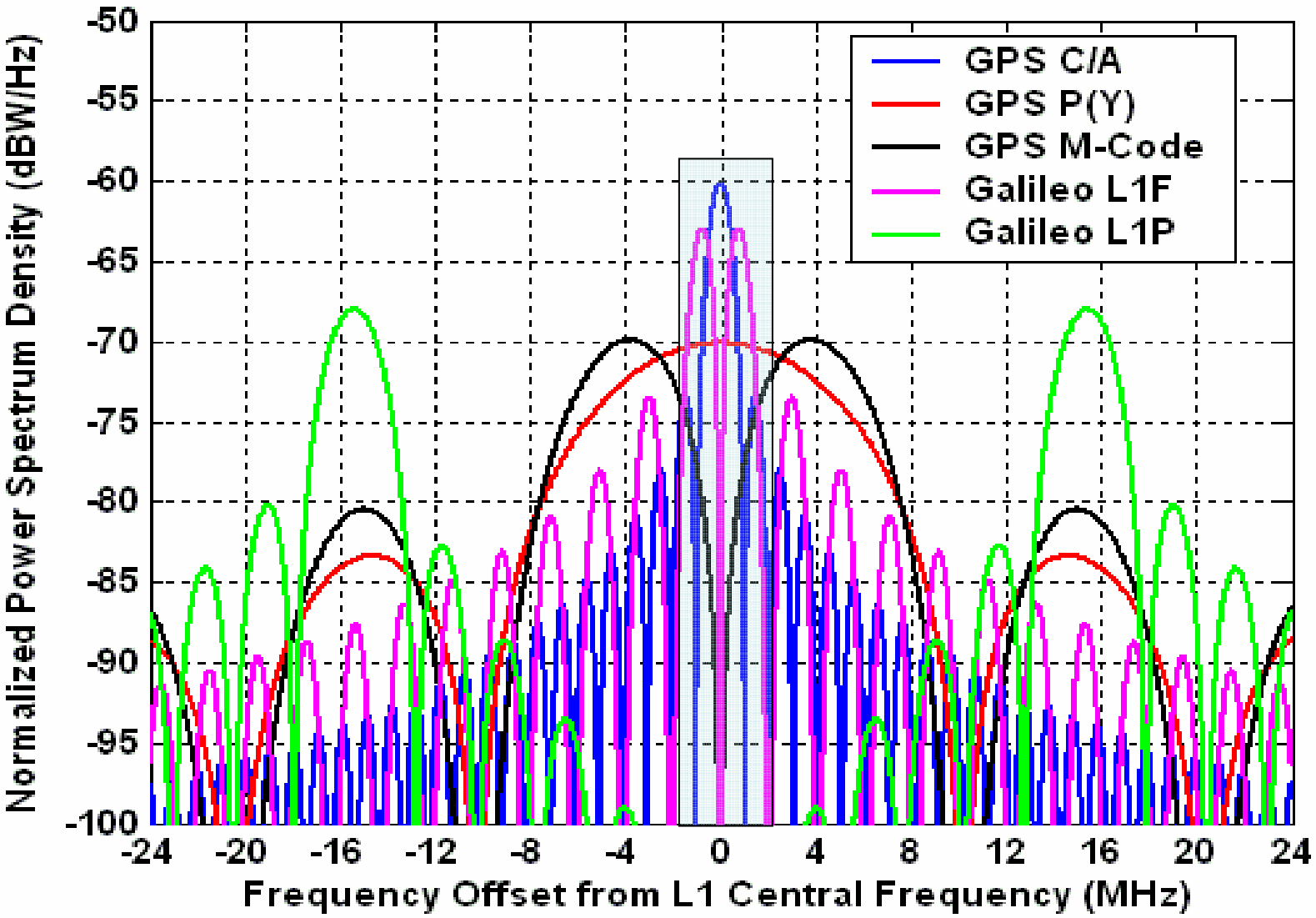


- SiRF used this chart to support our single frequency preference for L1
- Potential future support for 3 systems at L5

Since then GPS improved significantly

- Satellite constellation now at 31 active vehicles
  - Improvement in TTFF and availability across the board
  - Next ground segment upgrade to support 64 SVs
- Significant navigation improvements
  - 95% Spec is 13m, actual performance is 3-4m
- Satellite upgrades underway
  - Block IIR-M vehicles on orbit and verified
  - First block IIF ready to go up
    - Begin L5 capability to assess market potential
  - Block III contract awarded
    - Sustainment of constellation and L1C interoprability
- Market perception of GPS is rock solid and continuing to improve with no impact on cost!
  - The bar has been set very high

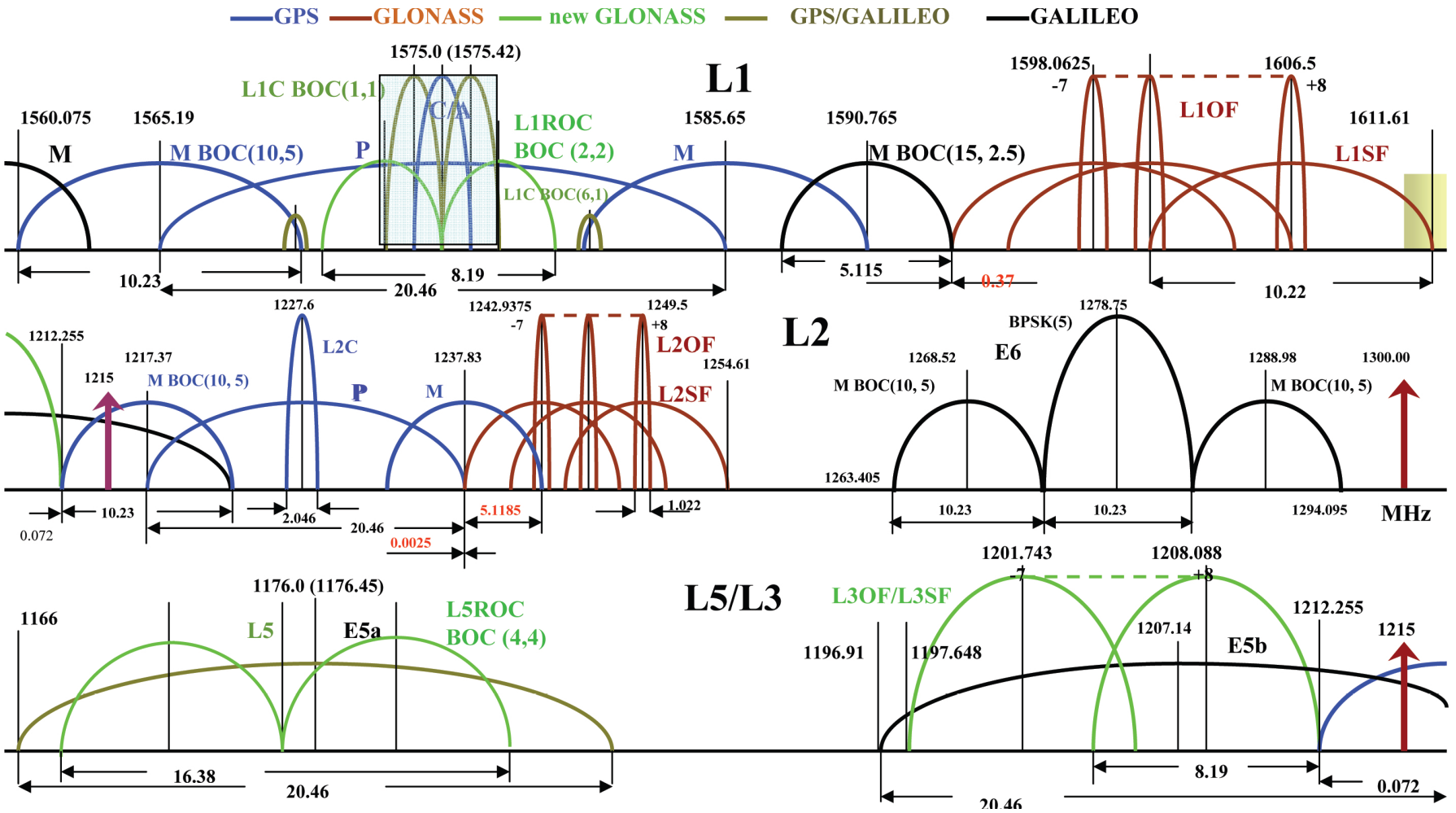
GPS & Galileo at L1



Galileo – Impact to customer design

- Major change in L1 signal structure for Baseband
  - Code is BOC(1,1) with ~4000 length memory code
    - Impact is extra gates for decimator and codes
  - Different message structure means new software for acquisition, tracking loops and navigation
- Acceptable cost/performance tradeoffs at modern (65nm) geometries
    - Licensing fees would be main open issue
- RF impact on bandwidth potentially more problematic
  - SiRF supports both 6 and 2 MHz bandwidth
    - Many customers prefer 2MHz for improved performance in unintentional interference from other internal sources
      - Transmitters, clocks, memory buses, display drivers, etc.
  - Wider bandwidth (6MHz) needed for full performance
- ICD process needs to be more transparent
  - Long time between revisions and little visibility as to which sections are under review

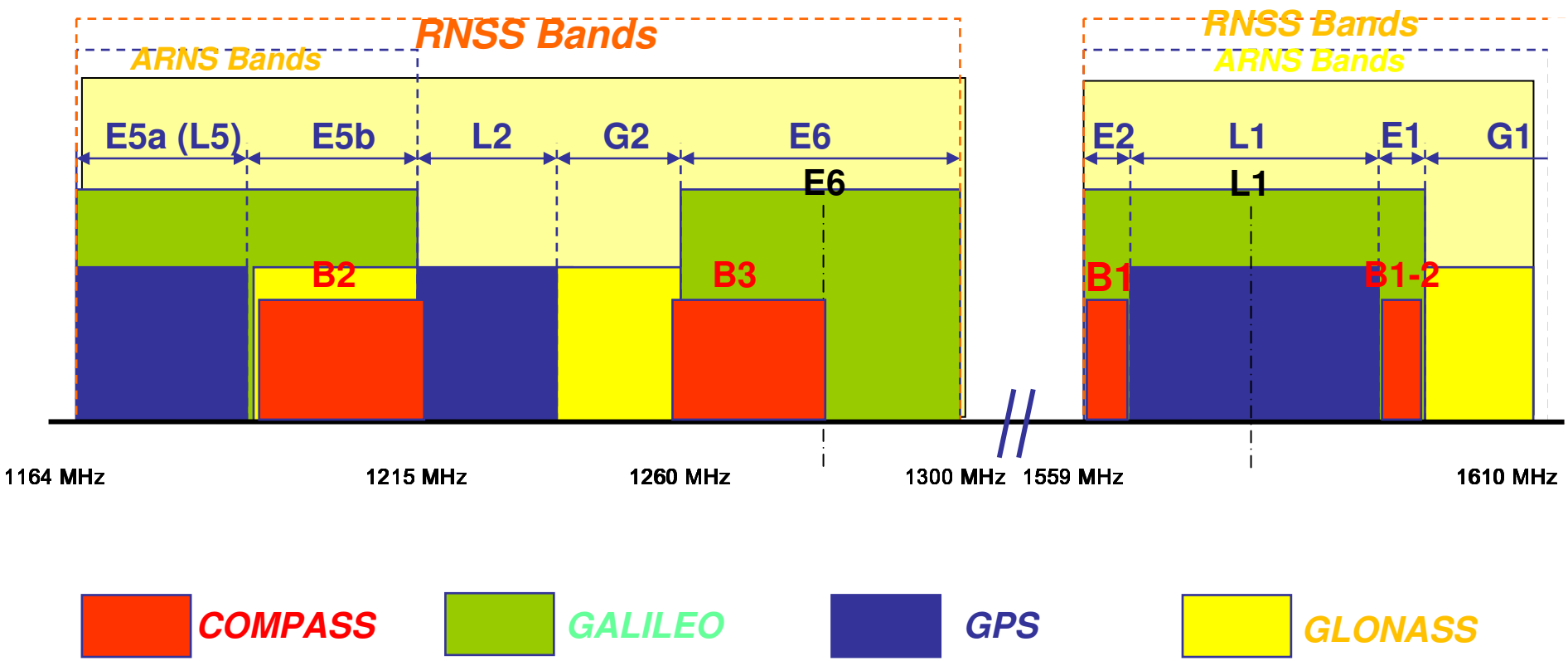
GLONASS makes 3 systems



GLONASS on the rise

- Constellation "replenishment" moving to schedule
  - New revision satellites (Glonass-M) have much better performance and on-oribt life than previous ones
- GLONASS gaining market traction
  - Some customers requesting for it, starting to appear in standards
  - Internal Russian market growing
- Significant silicon integration issues on current signals
  - Wide bandwidth and different center frequency at L1
    - Requires two front end paths
    - RF silicon is not as area efficient as digital
  - FDMA methodology and new tracking loops needed
- Longer term future is more code compatible
  - Next generation (Glonass-K) will have CDMA at L1 & L5
  - Similar issues to Galileo baseband
  - Really need ICDs to understand hardware impact
- Main concern is RF due to signal bandwidth
  - 8MHz at L1 is problematic
  - 20MHz at L5 would require major redesign

COMPASS Frequency Design Plan



COMPASS Integration

- Chinese COMPASS system is evolving in a positive way
  - Proposed MEO constellation is complimentary
  - Combination of Geo and iGEO for regional augmentation is also positive
  - Initial testing on signals shows positive results
- Code compatibility is good
  - Limited impact on digital design
  - Software modifications for message structure
  - Need to understand ICD release timeframe
- RF impact is uncertain
  - Bandwidth is relatively narrow but not centered
    - Compatible but not very interoperable
  - Potential impact on filter design as well

Overall Result

- There is a definite benefit from multi-MEO constellation integration
  - Not dramatic, but sufficient to pursue
  - Impact to digital and software is a good cost/benefit ratio
    - future-proofing receivers requires ICDs years in advance
  - Investigate impact to cross-correlation and noise floor from multiple systems in same band
- Biggest impact is RF bandwidth/center frequency
  - Vast majority of fielded systems today are narrow band
  - Bandwidth directly impacts cost and size
    - 2MHz->6MHz creates potential jamming problems
    - 8-12 MHz starts to impact external filters
    - > 12 MHz leads to multiple RF paths
    - >50 MHz leads to multiple antennas
  - This is the key to moving from compatibility to interoperability to interchangeability
- Our goal is to increase availability while minimizing impact
  - Small benefit can justify small impact
  - Competition is not just other satellite systems
    - Its ground based infrastructure and MEMS sensors

Recommendations to providers

- Additional systems have to integrate easily
  - Maintain narrow bandwidth option for maximum consumer penetration
  - ICDs should be out 3-5 years ahead of deployment
    - Met by L5, L1C, QZSS, Galileo OS
- Use business models that are successful in the consumer market
  - GPS is a good example
    - License free operation
    - Early and open publication of ICDs
    - Establishment of user forums for ICD changes
      - Allows all users to comment on other users requests
  - Wireless standards groups
    - IEEE 802.11, BT
    - Provides proven structure for standards, ICDs and interactions between Infrastructure and user equipment providers
- Involve everyone, maintain independent decision making authority