



# ***NTIA/FCC Spectrum Management Perspectives***

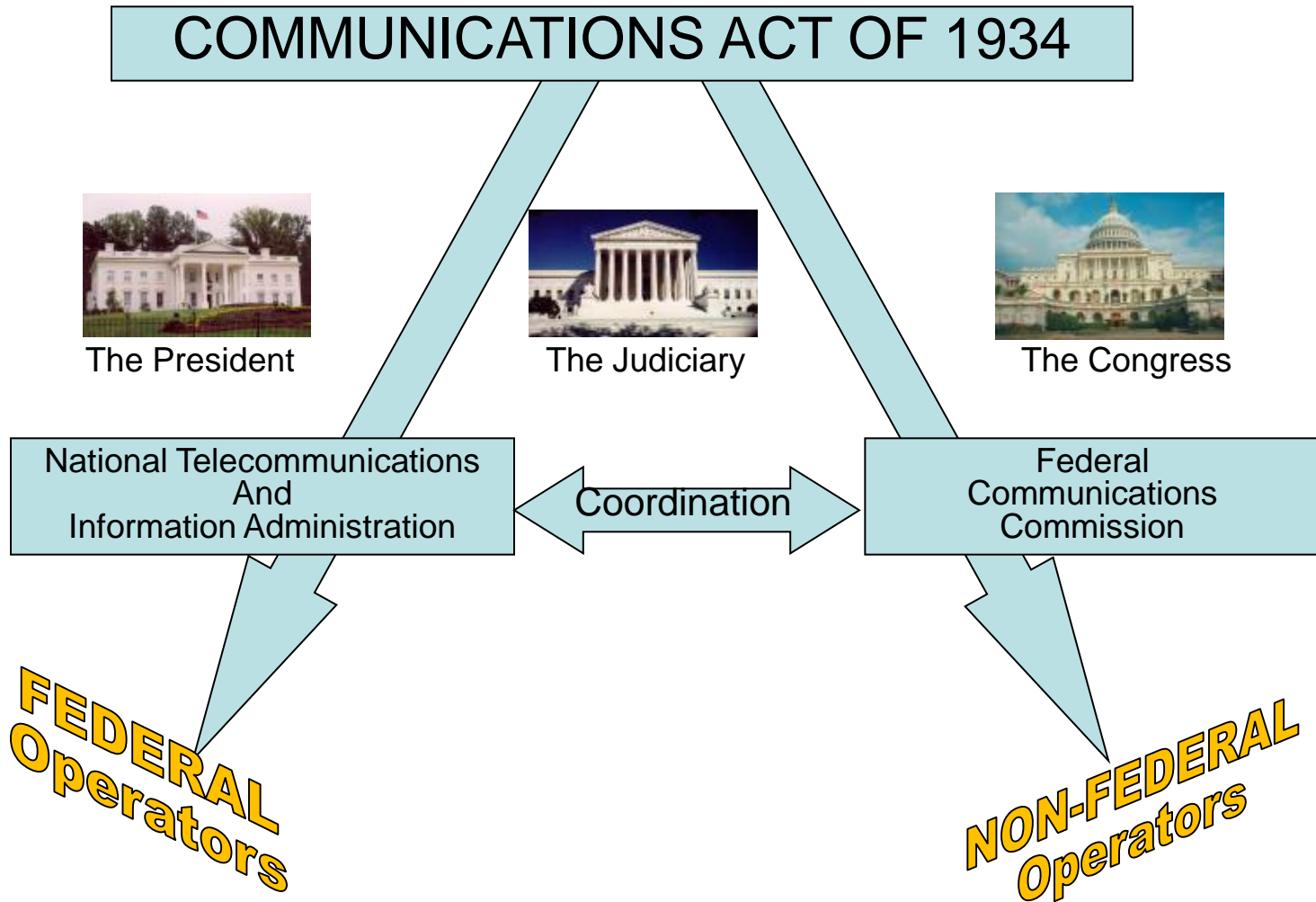
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## ***Presentation to the Fourteenth Meeting of the U.S. Space-based Positioning, Navigation and Timing (PNT) Advisory Board***

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***10 December 2014***

# Legal Framework



***NTIA and FCC Share Jurisdiction over Spectrum Matters***



# ***NTIA Background***

*(www.ntia.doc.gov)*



## ***Federal Government Frequency Uses Assigned by NTIA***

- NTIA is an Executive Branch Agency; performs spectrum management and assignment for all Federal spectrum use
  - Section 305 of the Act – Government Owned Stations
  - ...“All such Government stations shall use such frequencies as shall be assigned to each or to each class by the President.”
- NTIA Established by Reorg. Plan No.1 (1977), EO 12046, March 1978
  - Part of Department of Commerce (DoC) in the Executive Branch
  - Headed by the Assistant Secretary reporting to the President and the Secretary of the DoC
- Regulations published in Manual of Regulations and Procedures for Federal Radio Frequency Management (NTIA Manual)



# ***FCC Background***

*([www.fcc.gov](http://www.fcc.gov))*



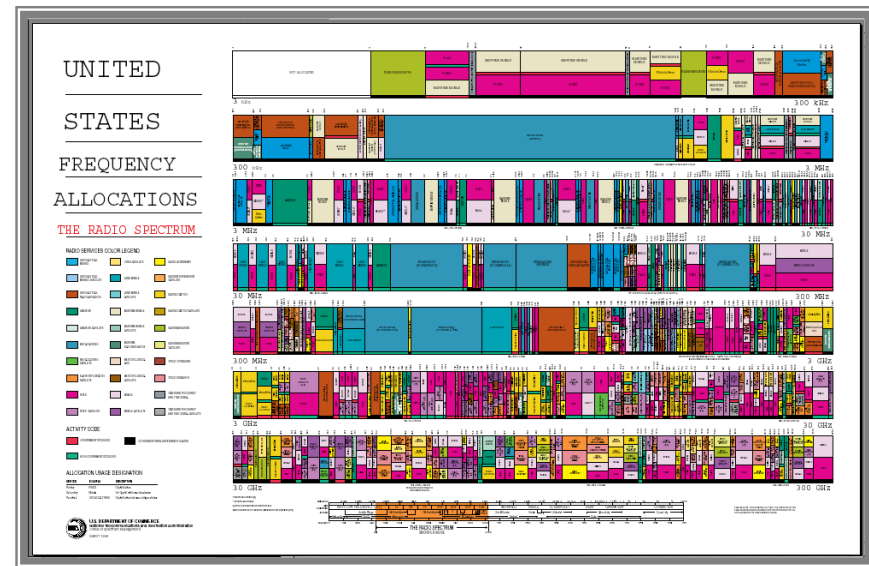
## ***Non-Federal Frequency Uses Assigned by FCC***

- FCC is an independent government agency, directly responsible to Congress; performs spectrum management and assignment for non-Federal spectrum use
- Communications Act Provisions Relating to Radio
  - Section 301 - "...No person shall use or operate any apparatus for the transmission of energy or communications or signals by radio...except under and in accordance with this Act and with a license in that behalf granted under the provision of this Act."
  - Section 303 contains the General Powers of the Commission
- FCC Rules contained in Title 47 Of the Code of Federal Regulations (47 CFR)
- Spectrum management decisions to promote:
  - harmonized spectrum use
  - efficient use of the spectrum
  - new technologies and services
  - interference protection among licensed stations

# Spectrum Management

## Four Major Spectrum Management Functions

- **Allocate Spectrum** to various radio services
- **Develop Service Rules** to provide administrative procedures, technical standards, and other operational requirements for shared intra- and inter-service use of the spectrum
- **Assign Frequencies** to individual systems or authorizes specific equipment use, assignments coordinated domestically and internationally
- **Enforce Rules** to ensure radio equipment and system compliance





# Spectrum Allocations



## International Allocations

## Federal Allocations

## Non-Federal Allocations

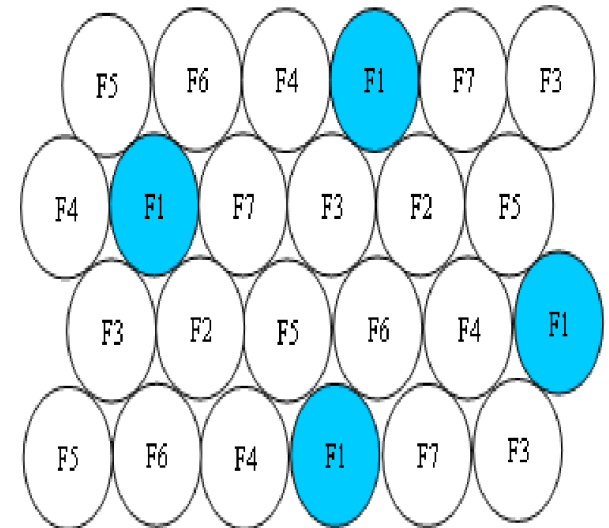
941-1430 MHz (JHF)					Page 41
International Table			United States Table		FCC Rule Part(s)
Region 1	Region 2	Region 3	Federal Government	Non-Federal Government	
See previous page for 890-942 MHz			941-944 FIXED US268 US301 US302 G2	941-944 FIXED US268 US301 US302 NG120	Public Mobile (22) Fixed Microwave (101)
942-960 FIXED MOBILE except aeronautical mobile 5.317A BROADCASTING 5.322 5.323	942-960 FIXED MOBILE 5.317A	942-960 FIXED MOBILE 5.317A BROADCASTING 5.320	944-960	944-960 FIXED NG120	Public Mobile (22) Auxiliary Broadcast (74) Fixed Microwave (101)
960-1215 AERONAUTICAL RADIONAVIGATION 5.328 5.328A			960-1215 AERONAUTICAL RADIONAVIGATION 5.328 US224		Aviation (87)
1215-1240 EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.329A 5.329A SPACE RESEARCH (active) 5.330 5.331 5.332			1215-1240 RADIOLOCATION 5.333 G56 RADIONAVIGATION-SATELLITE (space-to-Earth)	1215-1240 5.333	Rule References
1300-1350 AERONAUTICAL RADIONAVIGATION 5.337 RADIOLOCATION RADIONAVIGATION-SATELLITE (Earth-to-space) 5.149 5.337A			1300-1350 AERONAUTICAL RADIO- NAVIGATION 5.337 Radiolocation G2 5.149	1300-1350 AERONAUTICAL RADIO- NAVIGATION 5.337 5.149	

**Promote New Technologies and Services**

# Service Rules

## Promote Spectrum Efficiency

- Promote Intra-service and inter-service spectrum sharing
  - Minimize interference risk; compatible or coordinated use
  - Tradeoffs between flexibility and complexity; costs and benefits of spectrum sharing
    - Frequency Separation and emission limits
    - Geographic Separation and coordination
    - Power Overlays in non-Restricted Bands
    - Time Sharing - database access and management to track authorized emitters





# *Frequency Assignments (FCC)*



- **First-received, First-licensed approach**
- **Market oriented approach to licensing**
  - Exclusive use licensees receive interference protection and flexibility to offer new applications
- **Licensed-exempt use in non-restricted bands**
  - Authorized but no interference protection
- **Equipment Authorizations**
- **Experimental Authorizations**
  - to test and demonstrate equipment and applications
- **Special Temporary Authority (STA)**
- **Waivers**

***Interference Protection Among Authorized Stations***





# *FCC Rulemaking Process*

- **Communications Act, Administrative Procedures Act govern FCC's interactions with the public**
- **Notice to Public**
  - **Public Notices (PN), Notice of Inquiry (NOI), Notice of Proposed Rulemaking (NPRM or Further NPRM)**
- **Decision based on Public Comment**
  - **Report and Order (R&O), Memorandum Opinion and Order (MO&O)**
- **Authorizations (e.g. Orders, conditional authorizations)**
- **Federal Input**
  - NTIA
- **Industry Input**





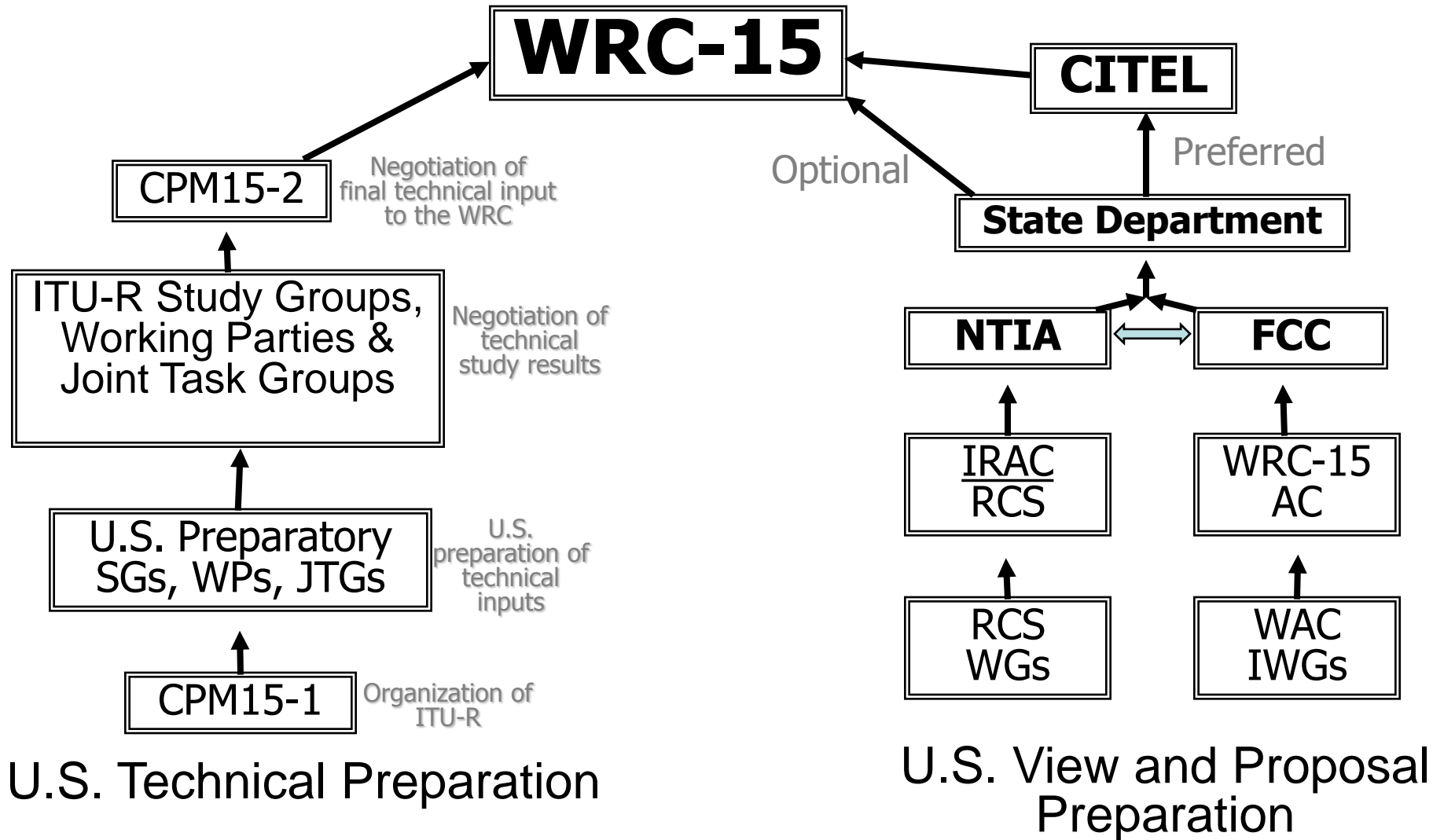
# *NTIA and FCC Coordination*



## ***Spectrum Decisions Coordinated Between FCC and NTIA***

- Agreement between FCC and NTIA (last updated January 2003)
  - Parties shall give notice of all proposed actions that could effect one another with sufficient time for the other agency to comment prior to final action
  - FCC and NTIA will maintain up-to-date lists of their respective authorized transmitting frequency assignments
- Federal Input
  - Policy and Plans Steering Group (PPSG)
  - Interdepartment Radio Advisory Council (IRAC)
- Industry Input
  - Commerce Spectrum Management Advisory Committee (CSMAC)
  - FCC Technological Advisory Council (TAC)

# WRC Proposal Process





# *National Space Policy*



- **2010 National Space Policy – directive’s goals guidelines to be executed by “all departments and agencies”**
- **Guidance to all departments and agencies – “maintain and enhance” space-based PNT systems. To this end, the US shall (among other things) –**
  - invest in domestic capabilities and support international activities to detect, mitigate, and increase resiliency to harmful interference to GPS, and “identify and implement, as necessary and appropriate, redundant and back-up systems or approaches for critical infrastructure, key resources, and mission-essential functions”
  - Foreign PNT services “may be used to augment and strengthen the resiliency of GPS”
- **“RF spectrum and interference protection” – the US government shall –**
  - “[s]eek to protect US global access to, and operation in, the radiofrequency spectrum



# *PNT Policy*



- **2004 US Space-based PNT policy** – the US government shall (among other things) (p.3):
  - “improve performance” of space-based PNT, including “more robust resistance to interference” for national security purposes, homeland security, and civil, commercial, and scientific users worldwide
  - the Secretary of Commerce shall (among other things) (p.9) –
    - in coordination with State, Defense, DOT and NASA seek to “protect the radio frequency spectrum” used by GPS and its augmentations through “appropriate domestic and international spectrum management and regulatory practices” and
    - in coordination with Defense and DOT and NASA facilitate cooperation between US government and US industry to “identify mutually acceptable solutions that will preserve existing and evolving uses” of space-based PNT “while allowing for the development of other technologies and services that depend on the use of the radio frequency spectrum”

***Build on Core Strengths in Spectrum Management and Technological Expertise to Protect and Enhance GPS***



# *NTIA and FCC Common Goals*



- Promoting harmonized spectrum use (including internationally)
  - ITU-R Study Groups; CPM-15; WRC-15
- Spectrum efficiency to include increased sharing in federal and non-federal spectrum allocations
  - AWS-3; 3.5 GHz; UNII;
- Promoting new technologies and services
  - Investigating Model City concept to develop innovative spectrum-sharing technologies
- Interference protection among licensed/authorized and incumbent users
  - 600 MHz (Incentive Auction); AWS-3; 3.5 GHz; UNII;
  - Receiver flexibility, RF adaptability, and interference resilience



# *Questions ?*





# *Backup Slides*





## Global GNSS Market Summary

### Unit Shipments (000s)

GNSS Market	2014	2020
Survey	200	320
Agriculture	220	610
Aviation	260	340
Rail	15	57
Maritime	117	158
Road	58,000	102,000
LBS	1,200,000	2,200,000

Source: GSA, GNSS Market Report issue 3, 2013

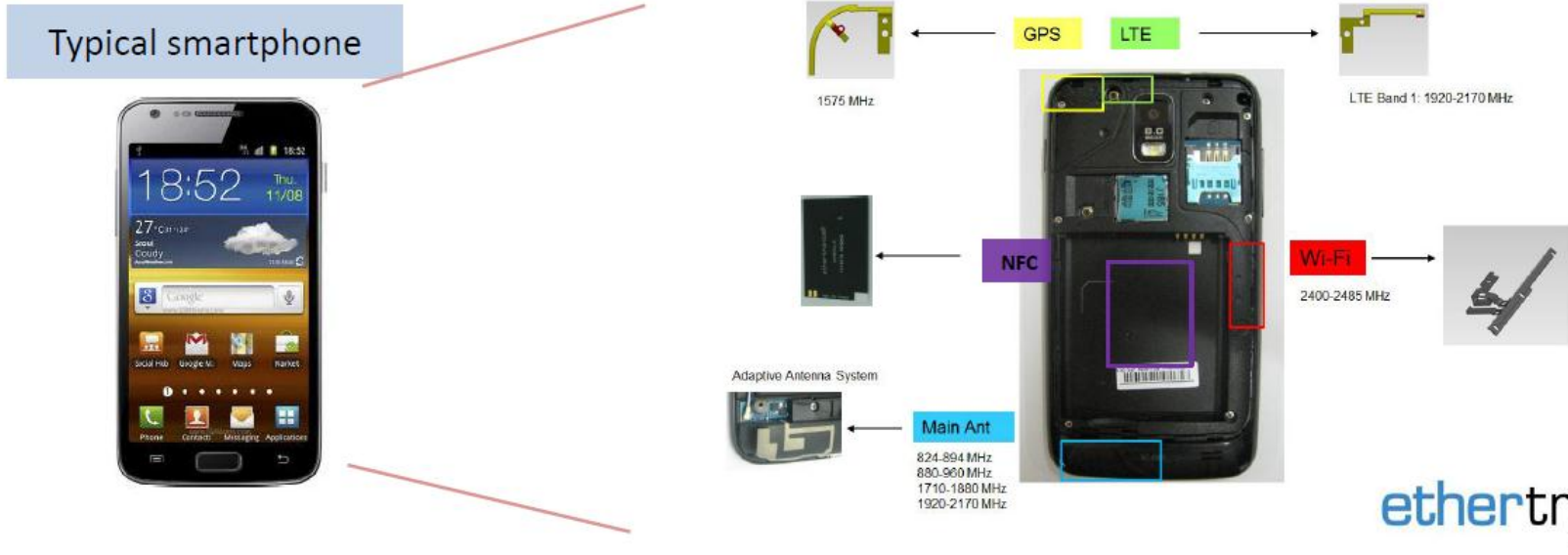


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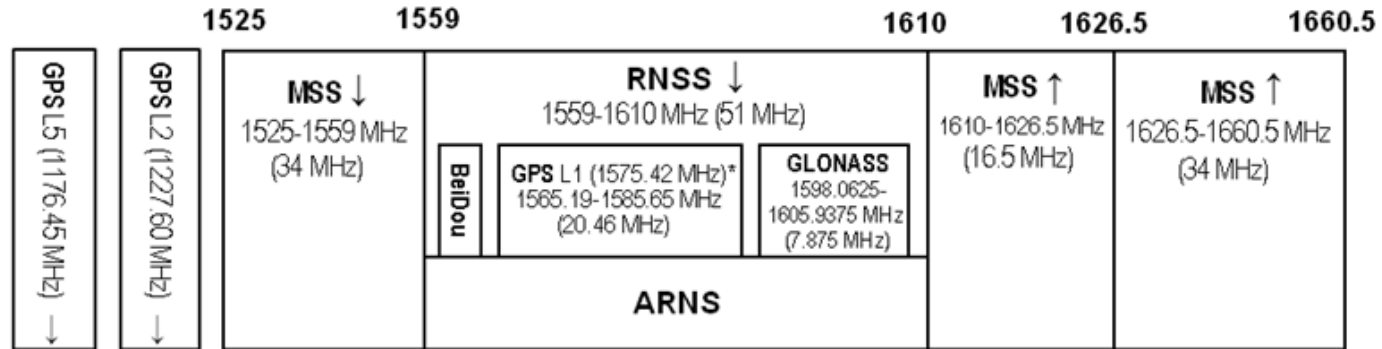
- CEA presentation at June 20<sup>th</sup> GPS Workshop indicates LBS devices (e.g. smart phones, tablets, laptops) are expected to be over 95% of global GNSS shipments by volume in 2020



- A typical smart phone has 5+ antennas in the current design and it's becoming more complex as more bands are added
- Wireless phones are designed to support simultaneous operation of GPS service and 3G/4G transmission
  - 3G/4G transmitters OOB is designed to protect GPS receiver
  - GPS Receiver is designed to overcome the potential overload interference while the 3G/4G transmitters are at the maximum power

# RF Front-End Bandwidth

GPS/GNSS Systems and Neighboring Bands Allocations  
(not to scale – for illustration purposes only)



L5: 1164.45-1188.45 MHz (24 MHz)    BeiDou (COMPASS) (1559.052-1563.144 MHz)

L2: 1212.25-1242.95 MHz (30.7 MHz)    \*U.S. GPS and Galileo (Europe's proposed GNSS system)

GPS/GNSS Mode	Minimum RF Front-End BW
Narrowband GPS Only	2 MHz
Wideband GPS Only	20 MHz
Wideband GPS + GLONASS	41MHz
Wideband GPS + GLONASS + BeiDou + Galileo	47 MHz
L1 + L2 + L5	Single or Multiple RF Front-Ends?

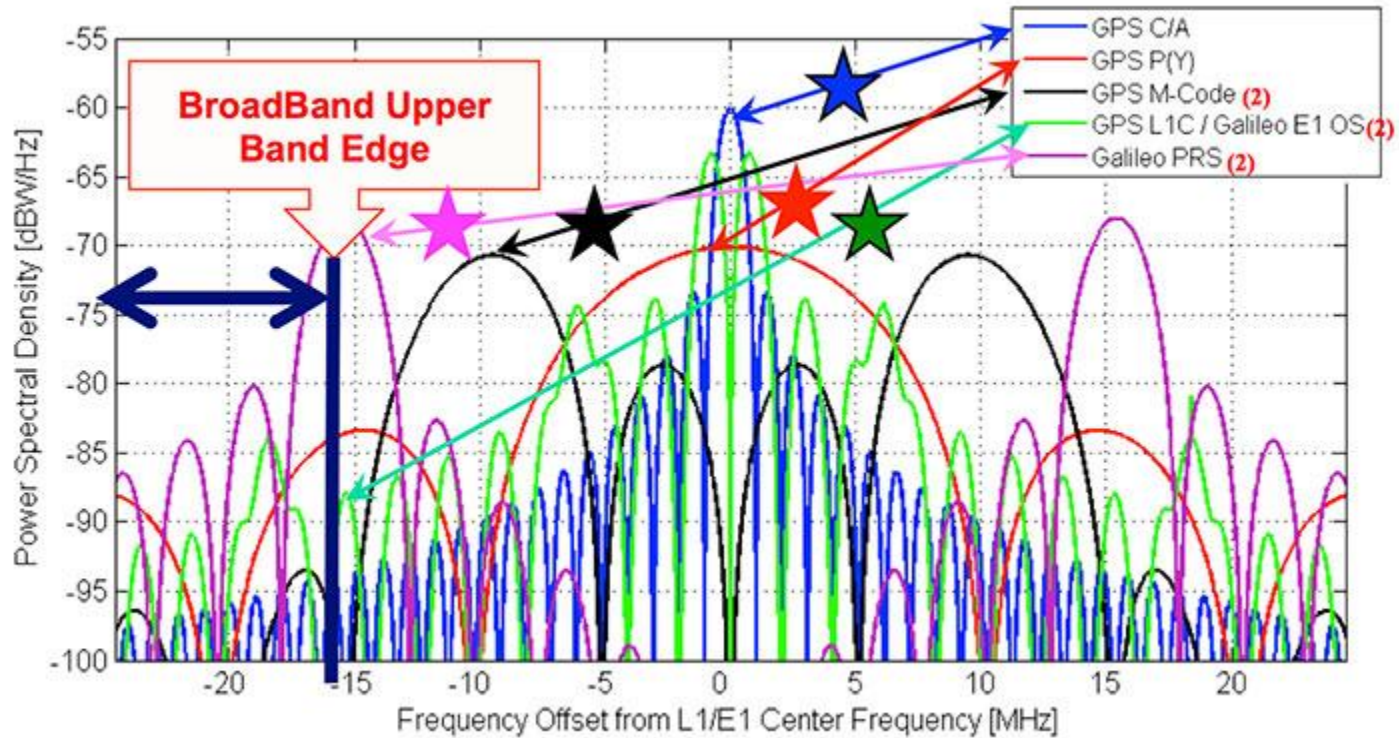
# Big LEO and L-band MSS Terminals

1525	1559	1610	1626.5	1660.5	1675	1695	1710
<b>L-Band MSS ↓</b> 1525-1559 MHz (34 MHz)	<b>RNSS ↓ (i.e. GPS)</b> <b>ARNS</b> 1559-1610 MHz (51 MHz) GPS L1 = 1575.42 MHz	<b>Big LEO MSS</b> 1610-1626.5 MHz		<b>L-Band MSS ↑</b> 1626.5-1660.5 MHz (34 MHz)	RAS 1660.5-1670 MHz SRS (passive) 1660.5-1668.4	<b>MetSat MetAids ↓</b> 1675-1695 MHz (20 MHz)	<b>Gov't Transfer</b> 1695-1710 MHz (15 MHz)
		Globalstar ↑	shared Iridium ↓		<b>Fixed &amp; Mobile</b> (except aeronautical) (5)		



Terminal Types	MAX EIRP	Notes
Satellite Phones (Sat Mode)	26-29.5dBm EIRP	29.5dBm with car kit
Broadband Data Terminals MET/MES	40-55dBm EIRP 37-46dBm EIRP	Based on the Inmarsat product catalog and FCC Authorization

# GNSS Signal Interoperability



Ref: "Assured PNT for Our Future:", Brad Parkinson, Special Supplement, GPS World,, September 2014