GNSS Aviation Applications

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Alice Wong
Senior Advisor
US State Department
Aviation Navigation Evolution


• Components Of GNSS:
  – Satellite Position, Velocity, and Time Constellation(s)
    • Global Positioning Systems (GPS), U.S. - Operational
    • GLONASS, Russian Federation - Not Operationally Usable
    • Galileo, European Union - Not Operational
  – Augmentation Systems
    • Aircraft Based Augmentation Systems (ABAS)
    • Satellite Based Augmentation Systems (SBAS)
    • Ground Based Augmentation Systems (GBAS)
    • GNSS Regional Augmentation Systems (GRAS)
GNSS

• Using GPS Today, Immediate Implementation Of GNSS In Aviation Is Possible
  – Performance Based Operations: Utilizing All GNSS Capabilities Of The Aircraft To The Fullest Extent Possible
  – Area Navigation (RNAV): Flying Efficient Direct Routings
  – Instrument Approaches To All Runway Ends Without The Need For Most the Ground Navigation Equipment
    • Non-precision Only. No Vertical Guidance
    • High End Aircraft Can Provide Vertical Guidance Through Aircraft Based Barometric-Vertical Navigation (VNAV)
  – GNSS Based Required Navigation Performance (RNP)
    • Precise Navigation Capability
    • Permits Efficient Operations In Terrain Constrained Or Congested Airspace
GNSS In United States

• U.S. Has Approved Use of GPS For Aircraft Navigation For Over A Decade
• FAA GNSS Activities
  – Participates In Management Of GPS To Insure Aviation Requirements Are Sustained
  – Working With Other U.S. Federal Government Agencies To Insure Modernization of GPS Improves Aviation Capabilities
  – Implementing RNP
  – Commissioned the FAA’s GNSS SBAS
    • Wide Area Augmentation System (WAAS)
  – Continuing Development Of the GNSS GBAS
    • Local Area Augmentation System (LAAS)
  – Committed To Performance Based National Airspace System
Moving To a Performance Based NAS

• FAA’s Goal Is To Design An Integrated, Performance Based National Airspace System That Can Meet The Needs Of Tomorrow And Satisfy ICAO’s Vision Of A Safe, Secure, And Seamless International Air Transportation System
What Is “Performance-Based” Navigation?

• An End-to-End Air Transportation System Based On Performance Standards Rather Than Specific Technologies Or Equipment
  – Area Navigation (RNAV)
  – Required Navigation Performance (RNP)

• Recognizes The Ability Of Modern Aircraft To Operate Safely And Efficiently Using A Variety Of On-Board Systems and External Signals
FAA Roadmap for Performance-Based Navigation

- Divided into three planning periods
  - Near-term 2003 to 2006
    - Implementation of public RNAV and RNP procedures in all phases of flight
    - Development of enabling criteria and guidance for more advanced RNAV and RNP operations
  - Mid-term 2007 to 2012
    - RNAV becomes the predominant means of navigation in the NAS
    - Removal of some ground-based navaids as a result of increasing number of RNP procedures
    - Advanced navigation capability enables improvements in airspace design based on applicable route spacing, separation minima, new sectors and terminal airspace structures
  - Far-term 2013 to 2020
    - Application of RNP becomes mandatory in some airspace
    - Significant capacity and efficiency gains through airspace restructuring
    - Minimal operational network of ground-based navaids used as a backup
FAA Satellite Navigation Programs

• Stand-alone Global Positioning System (GPS) with Certified Avionics

• Augmented GPS
  – FAA’s Wide Area Augmentation System (WAAS)
  – FAA’s Local Area Augmentation System (LAAS)
Automatic Dependent Surveillance (ADS-B)

- **Safety Benefits**
  - Improved situational awareness both in the aircraft and ATC
  - Reduced runway incursions through the use of surface surveillance and navigation
  - Search and rescue
  - New services in non-radar airspace enabling access to airports

- **Operational Efficiency/Capacity Benefits**
  - Higher air traffic throughput due to reduced separation
  - Optimized flight levels and routes
  - More efficient airline dispatch and control
Int’l Cooperation… A Necessity

- U.S. Assigned Airspace Equals 77 million Square Kilometers
GPS Aviation Ops Approvals

42 Nations; many others pending
International SBAS Coverage

GAGAN  MSAS  WAAS  EGNOS
Backup Slides

Additional GNSS-Based Applications
GNSS Location Based Services

- **Cargo Fleet Tracking**
  - Improves safety and security
- **Fleet Control/Dispatch**
  - Fuel savings
  - Improves asset management
- **Emergency Operations**
  - Reduces response times
  - Reduces injury & property loss
- **Road Maintenance**
- **In Vehicle Navigation**
  - Accurate position determination
  - Reduces air pollution
GNSS Positive Train Control

- Situational Awareness
- Enhances safety
  - Reduces accidents
- Increases capacity and efficiency
  - Closer train spacing reduces investments
  - Reduces fuel consumption
- Rapid rail structure and condition mapping
  - Improves maintenance capability
GNSS Maritime Applications

• Large ships, fishing & recreation boats
• Harbor entrance and approach
  – Regardless of visibility
• Hydrographic Survey
• Buoy Positioning, etc.
GNSS Recreation Applications

• Explore anywhere in the world
  – Without getting lost or eaten!
• Your favorite fishing spot
  – Every time
• Try Geocaching
  – GPS treasure hunting