Avionics Innovation for Safety

MECAS 2013

Raghd Talih, Regional Director
Business & General Aviation ME
Honeywell’s Businesses

- $38 - 39 billion* in revenue, 50% outside U.S.
- Nearly 130,000 employees operating in 100 countries
- Global corporate headquarters in Morristown, NJ, USA

*2012 revenue estimate
Honeywell Aerospace

Developing innovative safety products, driving the modernization of global air traffic management, revolutionizing combat technology and committed to improving operational efficiencies.

Business Units:

• Air Transport & Regional
• Business & General Aviation
• Defense & Space

• Phoenix, AZ, USA headquarters
• 40,000 employees at nearly 100 locations
• $12 billion revenues (2012 estimate)

Hi-End Global Technology Leadership
Business & General Aviation Customers and Products

Key Customers
- Airbus
- Boeing
- Bombardier
- Cessna
- Dassault Aviation
- Embraer
- Epic Aircraft
- Gulfstream
- Harbin Aircraft
- Hawker Beechcraft
- Pilatus
- Viking

Key Products
- Propulsion systems
- APU's and power generation
- Integrated avionics systems
- Advanced safety systems and applications
- Synthetic vision systems
- Flight management systems
- Cabin management systems and services
- Cockpit displays
- Satellite communications systems
- Digital flight guidance systems and controls
- Digital radio systems
- Environmental Control Systems
- On-Board Inerting Gas
- Generation Systems
- General Aviation panel mount and portable avionics
- Required Navigation
- Performance Special Aircraft and Aircrew Authorization Required
- (RNP SAAAR) Services
- Flight support services
- Maintenance service plans, avionics warranty plans, and remote diagnostic services
- Global Asset Rental Banks
- Electronic flight bags
Synthetic Vision System (SVS)
SmartView

Honeywell
SmartView™ SVS

Head Up Display
Accuracy/Symbology

Head Down Display
Color Graphics

Proven EGPWS
Terrain Database
Improved Primary Flight Display (PFD)
A significant improvement to the PFD, providing full scale HUD-like Attitude Display Indicators (ADI), including new navigation information.

Benefits:
-- Further increases the consistency of flight information displayed on head-up and head-down
-- Supports the intuitive conformal display of Smartview™ - Synthetic Vision System (SVS)
SmartView™ - SVS
Provides the pilot with a continuous and life-like display of where the aircraft is and where it is headed, relative to the surrounding terrain, at all times.

Benefits:
- SVS is a key asset to aircraft value
- Improved PFD symbology overlayed with the most advanced 3-D terrain representation allows crew to understand their flight path and the interaction with the surrounding terrain
- Increases flight crew situational awareness when flying in mountainous terrain or unfamiliar destinations.

Highlights:
-- Provides high resolution terrain along with obstacles
-- Highlights the runway and extended runway centerline helping the pilot locate the airport and facilitate his approach.
Combined Vision System

Out the Window Camera

Combined SVS/EVS Window

Seamless transition from head down to head out the window.
Future : EGPWS Integration Into SmartView
Future: SmartView™ – 3D Airport Moving Map

- Provides position on airport
- Comprehensive airport symbology
- Awareness of Ground Traffic
- Taxi Guidance
Business Aviation
Smart Runway® Smart Landing®

Honeywell
Underlying Causes of Runway Excursions

“Human Error has been documented as a primary contributor to more than 70 percent of commercial airplane hull-loss accidents.” – The Boeing Company

- Data analysis shows leading contributor to overruns is excessive energy on approach caused by:
  - Air Traffic Control Message Processing
  - Late Configuration by Pilots
  - Variable Pilot Technique
  - Landing Long
  - Floating on Landing Flare
  - Tailwinds
  - “Saving fuel” Policies

As Humans We are Fallible – Technology is our Backstop
Simple EGPWS Software Upgrade

- Optional Inhibit Switch
- Upgrade EGPWS Application S/W on-wing
- Install Reloadable Customer Definitions (RCD)
- Install Databus Wiring from FMGC/FMGE for “Too Fast” Advisory (Airbus Only)

Quick & Easy Upgrade Using Existing Hardware

SmartRunway & SmartLanding can potentially be installed across a fleet within a few days
How it works...

• Taking advantage of GPS inputs, SmartRunway and SmartLanding identify the aircraft’s position at the specific airport, and its track and groundspeed

• Utilizing the EGPWS runway database
  – SmartRunway and SmartLanding implement a “virtual” box around runways
  – Uses voice advisories (13 SR/SL Advisories) and visual messages to provide positional awareness for the flight crew in order to help lower the probability of runway incursion/excursion incidents and accidents
Approaching Runway - On Ground

“Approaching One-One”

Advisory designed to typically annunciate when the nose of the aircraft is at a distance of twice the runway width

Conditions for Advisory:

- Function of aircraft groundspeed, track and nearest runway end
  - Earlier call-out at higher speeds
- Inhibited above 40 knots
  - No distraction during take-off/landing ground roll
- Does not ensure aircraft will or can be stopped before hold short line

Optional Routine Advisory
Insufficient Runway Length - On Ground

Example in Feet

“On Runway Three-Four Left, Two-Thousand Remaining”

Conditions for Advisory:

- Aircraft on runway
- Within 20° of runway heading
- Runway length available is marginal for normal take-off operations
- Operator can define nominal length in feet or meters

Optional Non-Routine Advisory
Taxiway Takeoff (Alert Level)

“Caution, On Taxiway! On Taxiway!”

Conditions for Advisory:

- Aircraft not on runway
- Groundspeed > 40 knots
Approaching Runway - Landing

“Approaching Three-Four Left”

Conditions for Advisory:
- Between 750 and 300 feet Above Field Elevation (AFE)
- Within approximately 3 nm of runway
- Track aligned within 20° of runway
- Within approximately 200 feet, plus runway width, of runway centerline
- Suppressed between 550 - 450 feet AFE to allow crew / radio altitude call-outs ... annunciated when descend below 450 feet
- Advisory not available below 300 feet AFE
- All EGPWS aurals have priority
Optional Non-Routine Advisory

Conditions for Advisory:
- Between 250 and 150 feet Above Ground Level (AGL)
- Not aligned with runway
- Advisory not available below 150 feet AGL
- All EGPWS aural have priority

Caution Taxiway, Caution Taxiway
Approach Angle Monitor (Too High)

• The aircraft must be (almost) lined up with runway
Approach Speed Monitor (Too Fast)

- **Too Fast - Too Fast**: Landing Gear is down and Landing Flap is set.
- **Unstable - Unstable**: Regardless of Gear or Flap setting if lined up with a runway.
- **If lined up with a runway**: When the aircraft is 5 NM from the destination runway.
Long Landing

**Long Landing conditions for advisory:**

Aircraft is airborne above 5 feet AGL, but below 100 feet AGL
Aircraft has passed a customer specified distance from the runway end
Summary: Reduced Workload & More Awareness

- Increases Pilot Heads Up Awareness
  - **An Affordable Easily Adoptable Safety Technology**
  - Increased Safety due Runway and Taxiway Enhanced Awareness
  - Audio and/or visual annunciations provide important keys without disrupting normal workflow -
  - Helps prevent disorientation at complex airports
  - Does not require any operational procedure changes
  - Always on and regularly heard by the crew
  - Early approach warnings can prevent go-arounds
  - Provides secondary confirmation without crew work

"Approaching Three Four Left"

"Improve Safety without Operating Procedure Changes"
Enhanced Navigation
FANS-1/A+, ATN-CPDLC, ADS-B & TCAS 7.1

Honeywell
Mandates and Their Impacts

- Controller Pilot Data Link Communication (CPDLC)
  - FANS-1/A+ (Future Air Navigation System)
    - SATCOM, Communication Management Function (CMF) & FMS
  - ATN-CPDLC (PM CPDLC - Protected Mode CPDLC)
    - VDL Mode 2 (VHF Data Link Mode 2), CMF & FMS
- Automatic Dependant Surveillance – Broadcast (ADS-B)
  - ADS-B Out
    - Transponder, GNSSU, Radio Management Unit
  - ADS-B In
    - TCAS (Traffic Computer)
- TCAS Change 7.1
  - TCAS
CPDLC and FANS-1/A+

CPDLC is simply “text messaging” between pilot and ATC for aircraft control instead of using voice communication. Pilot can request and/or acknowledge changes to aircraft speed, altitude and route using standard ATC phraseology.

- **FANS-1/A+ (Oceanic Airspace)**
  - ‘+’ indicates latest amendment to FANS which enables better FANS operation in the Pacific
  - Utilize SATCOM (FANS) and VHF Data Links
  - In service with airliners for over 15 years in oceanic regions
  - Encompasses two main parts: Automatic oceanic position reporting and CPDLC

- **Benefits to FANS-1/A+ CPDLC**
  - Reduction in Crew Workload, Operate More Efficiently
  - Increased Accuracy of Communications
  - Fewer delays on the ground while awaiting clearance
  - Preferred, more direct oceanic routing
  - Route clearances automatically made in flight plan
FANS 1/A+ Deployment

Graphic courtesy of The Boeing Company
ATN-CPDLC / PM CPDLC European Mandate

- ATN-CPDLC – (PM CPDLC) (Link 2000+) (European Airspace)
  - PM (protected mode) CPDLC is a higher speed data link service using newer ATN network & protocol with VDL Mode 2 VHF data link and is being tested in Europe today (Link 2000+ trials)
  - Improved data integrity with end-to-end message checksum vs. FANS
  - Ensures messages are delivered correctly to the intended aircraft

- Applicable Airspace
  - Above FL 285

- Published Dates
  - Jan 1, 2014 - End of FANS 1/A Exemption
  - Jan 1, 2015 - Retrofit Required
  - Jan 1, 2017 – A/C Retirement

- CPDLC will not completely replace voice communications
  - Initially will be used for non-critical communications
  - Will broaden in usage over time

Exemption Available For Aircraft That Upgrade to FANS-1/A+ Before 2014
ATN-CPDLC Regulatory Timeline

- Eurocontrol PM-CPDLC
  - Retrofit Required
  - February 5, 2015

- Eurocontrol PM-CPDLC
  - End of Exemption with FANS-1/A
  - January 1, 2014

- FAA CVR CPDLC Recording
  - Part 135 (CPDLC installed)
  - December 6, 2010

- FAA CVR CPDLC Recording
  - Part 91 (CPDLC installed)
  - April 6, 2012

- North Atlantic Tracks - FANS 1/A
  - Proposed Mandate
  - Tentative 2013-2015

= Preliminary Date

= Published Date

- Non-Compliant A/C can’t fly in Europe
  - January 1, 2017
ADS-B
Automatic Dependent Surveillance – Broadcast

**ADS-B Out**
- Transmission of accurate aircraft position / speed / direction data to enable radar-like coverage without ground-based radar
- Continuous transmission from the aircraft, without interrogation from ATC
- No capability to receive transmissions from other aircraft (ADS-B In)
- Basis of all published mandates

**ADS-B In**
- Adds to ADS-B Out capability to receive and display info from other aircraft
- Provides situational awareness, combined with TCAS data
- Enables future self-separation
- Requires significant system upgrade to display other aircraft positions
ADS-B Out Timeline

- **Gulf of Mexico**
  - ADS-B Out
  - DO-260A or later

- **Hudson Bay**
  - ADS-B Out
  - FL 350-400
  - DO-260 or later

- **Australia**
  - Forward Fit (FL 290+)
  - DO-260 or later, SA Aware GPS

- **Singapore**
  - Retrofit (FL 290+)
  - DO-260 or later

- **Indonesia**
  - Retrofit (FL 290+)
  - DO-260 or later

- **Hong Kong**
  - PBN Routes FL290+
  - DO-260 or DO-260A

- **HKG FIR FL290+**
  - DO-260 or DO-260A

- **EASA**
  - Forward Fit
  - DO-260B or later

- **EASA ADS-B Out**
  - Retrof it
  - DO-260B or later

- **FAA ADS-B Out**
  - Forward Fit and Retrof it
  - DO-260B or later

Symbols:
- ★ = Improved Access (Helo)
- ★★ = Preliminary Dates
- ★★★ = Firm Dates
TCAS II v7.1 – Adjust Vertical Speed

Change 7.1 includes many updates but primarily addresses two safety issues

1. “Adjust Vertical Speed, Adjust” Resolution Advisory (RA) changed to “Level Off, Level Off” - was determined to be confusing, and there is a history of some pilots not responding as intended - solution in Change 7.1 is to replace the four AVSA RAs with a single “Level Off, Level Off” RA.
2. Correct missed and/or late TCAS reversals
   - TCAS reversals were introduced in 7.0 to adapt to changing situations where the original guidance became the wrong thing to do if one of the pilots did not follow the RA or was instructed by ATC to perform a particular maneuver.
   - Change 7.1 improves this reversal logic to address late issuance of reversal RAs and potential failures to initiate reversal RAs.
TCAS II v7.1 Regulatory Timeline

- **Eurocontrol C7.1**
  - Forward Fit – March 1, 2012
  - May push out toward ICAO dates

- **Eurocontrol C7.1**
  - Retrofit – December 1, 2015
  - May push out toward ICAO dates

- **ICAO TCAS C7.1**
  - Forward Fit – January 1, 2014
  - Forward Fit – March 1, 2012
  - Retrofit – January 1, 2017

- **FAA TCAS C7.1**
  - No proposed regulation

★ = Preliminary Dates
## Mandate Retrofit Schedule

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### NAT FANS 1/A Mandate Timeline:
- Phased Implementation
- Required from Feb 7, 2013, on center tracks, from FL360 to FL390
- Required from Feb 5, 2015, proposed all tracks to FL410
- ICAO has submitted final version to States to implement first phase
- No exemption process in final version

### ADS-B Out Mandate Timeline:
- Indonesia / Australia (RF FL290+) DO-260 Q4 2013
- Hong Kong (PNB Rte FL290+) DO-260/A Q1 2014
- Hong Kong (HKG FIR FL290+) DO-260/A Q1 2015
- EASA (FF) DO-260B Q2 2015
- EASA (RF) DO-260B Q4 2017
- FAA (FF and RF) DO-260B Jan 1, 2020

### ADS-B Out – Operational but Not Mandated:
- Gulf of Mexico DO-260A End 2008
- Hudson Bay (FL 350-400) DO-260 Q3 2010

### TCAS C7.1 Mandate Timeline:
- Eurocontrol C7.1 FF Mar 1, 2012
- Eurocontrol C7.1 RF Dec 1, 2015
- ICAO TCAS C7.1 FF Jan 1, 2014
- ICAO TCAS C7.1 RF Jan 1, 2017
- FAA TCAS C7.1 No proposed regulation
Summary

• New technologies all have industry mandates and operational benefits coming over the next decade (2010 – 2020)
  – FANS 1/A+
  – ATN-CPDLC
  – ADS-B
  – TCAS II C7.1

• Honeywell has planned software and hardware solutions for all of our customers
  – Classic aircraft retrofit include:
    • Gulfstream IV and V, Hawker 800, Bombardier Challenger 601, Global Express / 5000 / XRS, Dassault Falcon 900 / B / C / EX, Embraer Legacy 600 / 650, Cessna Citation X, and others
  – Primus Epic aircraft include:
    • Gulfstream 350/450/500/550 PlaneView, Dassault Falcon F900 EX / DX / LX EASy, F2000 / LX EASy and F7X, Cessna Sovereign, Hawker 4000, others
Questions and Answers

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