Avionics Skyline

A Northern Perspective

Whitehorse
April 28-30, 2014

Norm Matheis - Regional Manager - Canada

UNIVERSAL AVIONICS SYSTEMS CORPORATION

Universal Avionics - Who We Are

- Privately-held Avionics OEM - Arizona Corporation
- Manufacturing, Sales/Marketing & Customer Support Headquartered In Tucson, Arizona
- R&D Groups Located In Redmond WA & Duluth GA
- Founded In 1982 By Hubert Naimer As A Navigation Company
- 482 Employees
- Sales Through Our Authorized Dealer Network

UNIVERSAL AVIONICS SYSTEMS CORPORATION

What We Build

- We Build the Only True Retrofittable SBAS Flight Management System
- Advanced Flat Panel Integrated Flight Displays
- Flight Recorders
- TAWS
- Vision-1® Synthetic Vision
- UniLink Datalink
- Application Server Unit
- Radio Control Unit & Radio Tuning Unit
- Peripherals

Today We'll Try To Cover…

- BEBS
- SBAS, WAAS, LPV And Changing Canadian Airspace
- TAWS Rule
- CVR Changes
- CPDLC, FANS AND ADS-B

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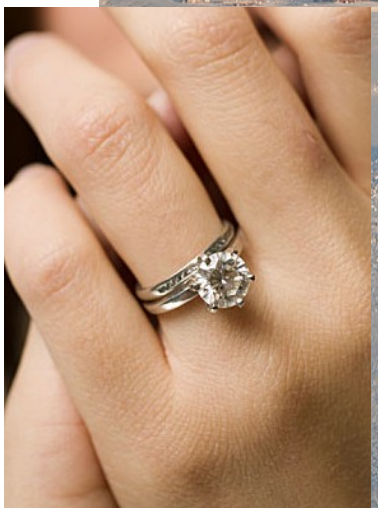
Aviation In The North



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The Way It Was

- Business And Commercial Aircraft Operators Haven't Wanted To Shell Out For Expensive Equipment Before They Can Get Benefits (Time And Fuel Savings)
- Tend To Hang Back
- Hoped That If They Are Among The Last To Equip For A Mandate They Will Benefit From Technology Improvements And Lower Unit Costs

Best Equipped, Best Served…

- BEBS Is Being Considered By Privatized ANSPs In A Growing Number Of Countries AND US FAA
- Controllers May Be Granted The Ability To Give Priority To Aircraft That Are Equipped With A Specified Level Of “NextGen” Equipment, Effectively Providing Their Operators With A Competitive Advantage
- E.g. WAAS-based ADS-B Allowed To Use The High-altitude Routes Over Hudson Bay That Provide Optimal Fuel Burn – Increasing Restrictions For Non-equipped Operators As More Aircraft Are ADS-B Equipped
- E.g. Many European States Have Placed Restrictions On Aircraft That Aren’t Fully Compliant With P-RNAV Standards
- Amsterdam Schiphol Airport Was The First Airport In Europe To Only Allow Such Aircraft

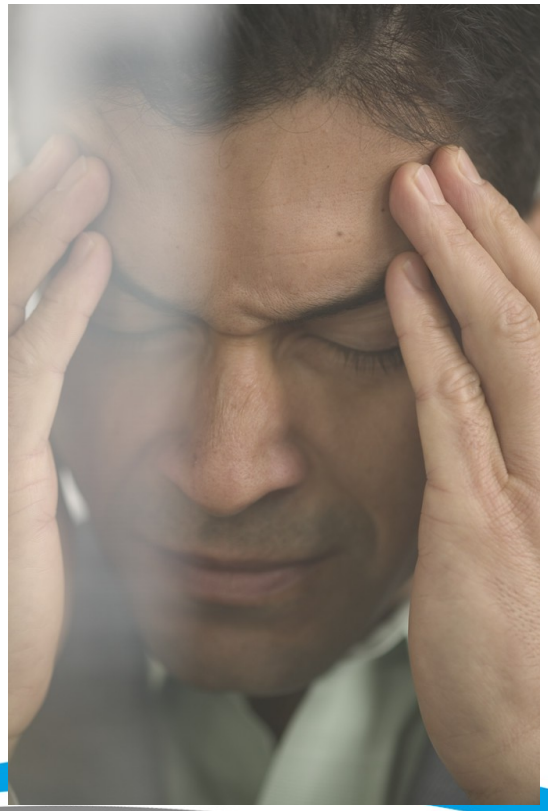
WHAT IS AN SBAS?

Satellite-**b**ased **A**ugmentation **S**ystem

Think Of It As “Corrected” or “Augmented” GPS – “Fixing” The Global Positioning System To a Quality Usable For Approaches

Through The Use of Additional Satellites’ Broadcast Messages

Better accuracy, integrity, continuity and availability



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WHAT IS WAAS?

Wide-area Augmentation System

WAAS is the North American SBAS

It's EGNOS In Europe

MSAS In Japan, GAGAN In India

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It's An SBAS/WAAS/LPV World

- Canadian Aircraft Need To Be SBAS Capable
- Legacy FMS Operators Subject to Increasing Limitations
- There Are Now Over 3000 LPVs in the US – More Than ILS
- A Building Block For All The Acronyms – FANS, ADS-B, CPDLC, PBN…

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Value Proposition – Universal SBAS FMS

- Provides RNAV (GNSS) LPV LOS Approach Capabilities
- True North Course Procedures, ETP/PNRs, And Gravel Runways in Database
- Trade-in Legacy Universal FMS For Credit
- Mitigate Database Limitations Of Legacy Equipment e.g. Multiple Approach Indicators
- Enhances Safety By Providing More Accurate Global Positioning Information To The Onboard TAWS/EGPWS, TCAS
- Required Accuracy And Integrity For ADS-B
- Allows Preferred Routings And To Alternate Airport In Adverse Weather Conditions – Think BEBS
- Pilot Entitlement Training

Four Base Models

LPV Approaches?

- **L**ocalizer **P**erformance with **V**ertical Guidance
- All WAAS/SBAS Approaches Are Types Of RNAV (GNSS) Non-precision Approaches
- When The Approach Is Coded In An FMS Database With Something Called A FAS Data Block, They Support Different Levels Of Service (Call This “Minimums” For The Moment) Including LNAV, LNAV/VNAV & LPV
- With “Near-CAT I” LPV, LOWEST 200-250 Foot Minimums Possible

Northern LPVs

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Ice Runways?

It's Possible For RNAV Procedures To Be Developed And Coded Into The True North Course Databases of Universal FMS For Temporary Ice Runways

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Aircraft Changes

- Trade-in Legacy FMS For SBAS-FMS For Credit
- Change Antennas
- Add Wiring For Cross-channel Monitoring
- Add LOS Annunciators
- Reconfigure And Test
- AFM Supplement And STC

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A Live Product - scn 1000.7

- Scn 1000.7 Was Approved On 15 November 2013
- Corrects The Erroneous VNAV Guidance That Can Occur On Some RF Leg Combinations
- It Fixes 26 Other Problem Reports And 4 Product Improvements

What Operators are Saying

"Unlike scheduled airlines which may cancel flights due to weather, we need to make every flight happen or workers are left in the camps away from their families, shortening their time at home, and extending overtime hours which can add substantially to our labour costs. Since we started operating our aircraft with Universal's WAAS/SBAS-FMSs, we reduce our flight delays and missed approaches by at least 20%."

- **Guylain Boutin, Chief Pilot, West Wind Aviation - Saskatoon**
- **Fleet of ATR-42s**
- **Dual UNS-1Lw FMS**

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The TAWS Rule

- On July 4 2012 Transport Canada Released The Changes To The CARs Affecting What Classes Of Aircraft Require A TAWS (Terrain Awareness & Warning System)
- Canada TAWS Regulation Applies To ALL COMMERCIAL Air Taxi, Commuter And/or Airline Operations Under CAR 703, 704 And 705, PLUS Private Turbine Aircraft With 6 Or More Passenger Seats

The CFIT Problem - GPWS Factors

- GPWS Has Been In Use Since 1974
- GPWS Has Significantly Reduced CFIT
- GPWS Has Evolved Over Many Years
- But GPWS Has Significant Limitations
  - **Cannot Look Ahead**
  - **Limited To Reaction To Radio Altitude**
  - **Provides Limited Reaction Time**
  - **Doesn't Enhance Situational Awareness**

GPWS Modes - Basic GPWS Modes

Mode 1	**Excessive Rates of Descent**
Mode 2	**Excessive Closure Rate to Terrain**
Mode 3	**Negative Climb Rate or Altitude Loss After Takeoff or Go-around**
Mode 4	**Flight Into Terrain When Not in Landing Configuration**
Mode 5	**Excessive Downward Glideslope Deviation**
Mode 6	**Altitude callouts**

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TAWS – What Is It?

- GPWS + FLTA + PDA = TAWS (More On That In A Minute)
- Forward-looking Terrain Avoidance (FLTA) Produces Alerts From Things Ahead Of The Airplane Using A Terrain Database, GPS Position, Velocity, Etc.

Premature Descent Alerts

- TAWS Generates An Alert When The Aircraft Violates The Minimum Ground Clearance Boundary (MGCB) Floor Around A Runway
- Mode Is Designed To Fill The GPWS “Approach Hole”
  - Mode 1 & 2 Not Active At Typical Approach Descent Rates
  - Mode 3 Not Active
  - Flaps & Gear Extended Cancels Mode 4
  - Without An ILS Mode 5 Not Available
  - Mode 6 Calls May Be Ignored

TAWS Description - Classes of Installation

- The FLTA+PDA features in Class A and Class B are identical and represent the same level of safety
- The main difference is in the GPWS portion of the system
- Class A requires a "fully autonomous" GPWS while Class B does not. Practically this means:

Class A requires Radar Altitude and Class B does not
Class A requires Air Data and Class B does not
Class A requires both Gear/Flap inputs and Class B does not
Class A requires a terrain DISPLAY and Class B does not

Retrofit

- Affected Aircraft Manufactured Before July 4, 2012 Have Until July 4, 2014 To Have A TSO-C151**b**-compliant TAWS System Installed

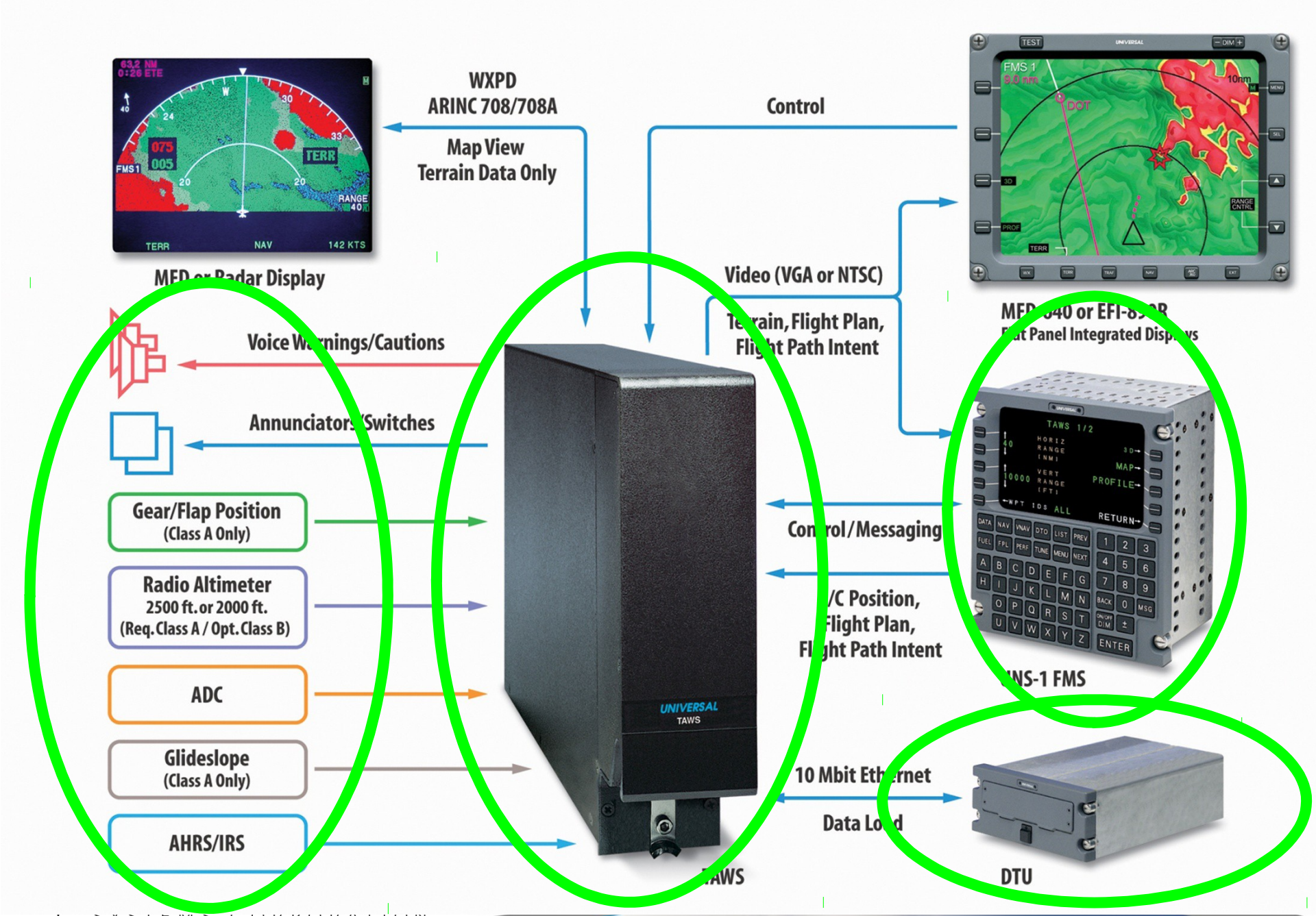
- All TAWS Systems Must Be Compliant With The EAA Requirement By July 4, 2017

What is EAA? Plain language

- Pilot Action Or Other Baro Air Data Error Whatever The Cause Must Not Affect Alerting Per TSO For That Class
- It Doesn't Mean You Can't Use Baro – Sometimes Its Better
- Universal TAWS Meets The EAA Requirement When Correctly Configured
- We Detect Unreasonable Baro Alt For TAWS Use

NATA QUESTION
TAWS NORTHERN PERFORMANCE

- Release Number 1202 Of The Universal TAWS Terrain Database Has Terrain Data For The Entire Northern Latitudes
- Universal TAWS can display its terrain images at latitudes between N87 and S85
- Terrain Alerts And GPWS Alerts Are Functional Above N87 And Below S85
- Depending On Whether The Orientation Of The TAWS Map Display Is Track Up Or Heading Up, Since TAWS Does Not Compute Magnetic Variance Above N73 Or Below S60, Operating TAWS Above N73 And Below S60 May Require A Source Of
  - true heading, or
  - magnetic heading and magnetic variance, or
  - drift angle and track


WXPD
ARINC 708/708A
Map View
Terrain Data Only
Control
MFD or Radar Display
Video (VGA or NTSC)
Terrain, Flight Plan,
Flight Path Intent
Voice Warnings/Cautions
Annunciators/Switches
Gear/Flap Position
(Class A Only)
Radio Altimeter
2500 ft. or 2000 ft.
(Req. Class A / Opt. Class B)
ADC
Glideslope
(Class A Only)
AHRS/IRS
Control/Messaging
/C Position,
Flight Plan,
Flight Path Intent
10 Mbit Ethernet
Data Load
UNIVERSAL
TAWS
TAWS
NS-1 FMS
DTU

UASC TAWS Continuous Improvement

- Scn 12.0 Introduced Man-made Obstacle Alerting And Display Function
- Currently Delivering scn 12.1
- Added GPWS Mode 5 Alert Function To The Flight Management System (FMS) UNS HS429-1 Bus For FMS Approaches With Vertical Guidance

CVR Changes

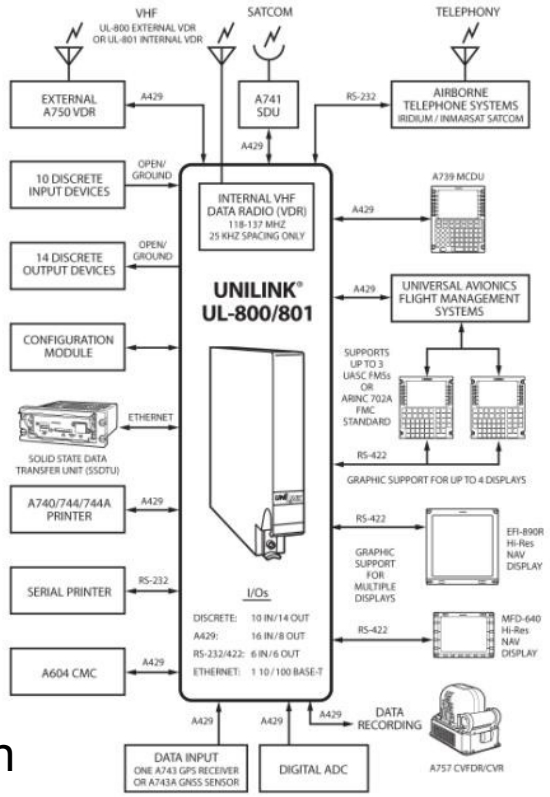
- Sync With FAA/ICAO – At NPA Stage
- 30-minute CVRs No Longer Acceptable
- 2-hour Recording Duration Will Effectively Require The Use Of Solid-state Memory Recording Technology In Lieu Of Tape
- Require The Use By Applicable Aircraft Of A CVR That Meets The Standards Of Technical Standard Order TSO-C123a, Or Later Revision
- Separate Container From FDR
- RIPS & Datalink Recording
- Universal CVRs Will Exceed The Minimum Rule

CPDLC
FANS
ADS-B

CPDLC

Controller-Pilot Data Link Communications

- Air Traffic Controllers Communicate With Pilots Over A Datalink System – “TEXTING TO ATC”
- CPDLC By Itself Is Up And Running In Canada And We Are A Leader
- One Of The 3 Legs Of A FANS Solution
- Mandatory (LINK 2000+) In Europe Above FL285 In 2015
- Coming To US As NextGen Data Comm
- Solutions Via SB And STC
- Need A Datalink, Terminal And New CVR
- Nav Canada Controllers Now Use CPDLC to Additionally issue Altitude, Speed, and route clearances – Phase 3 (Complete) - Winnipeg - Edmonton - Moncton - Montreal - Gander - Vancouver



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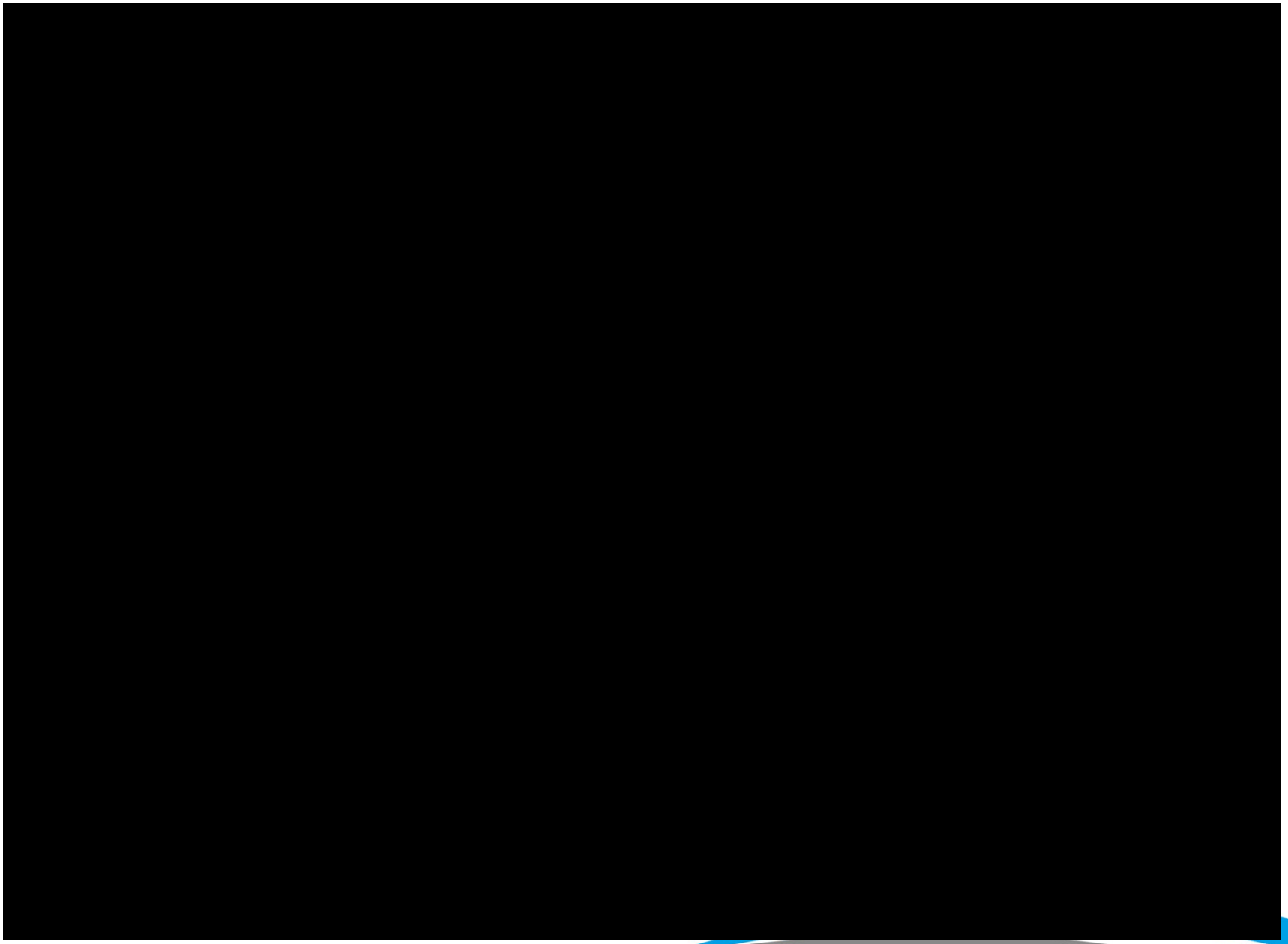

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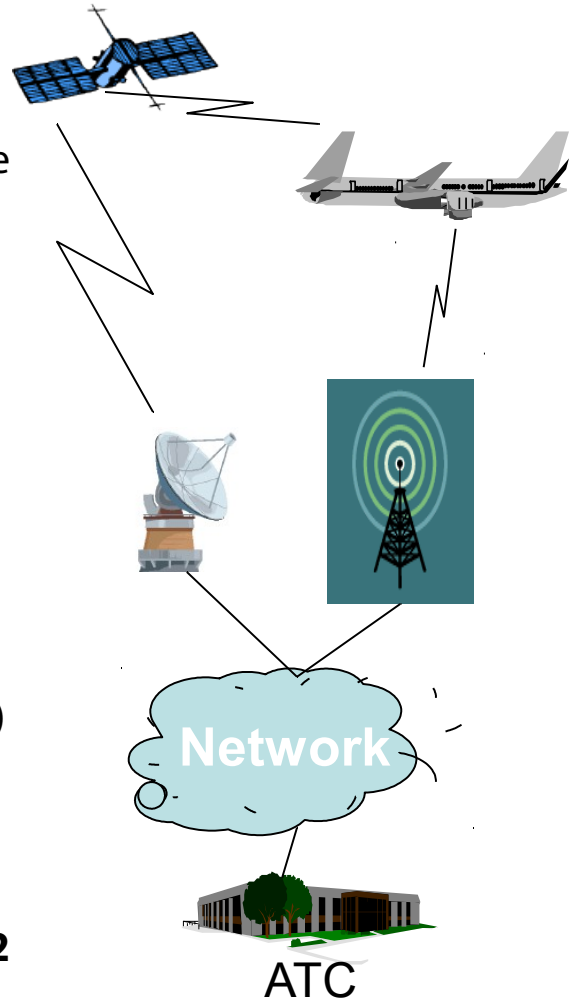
Future Air Navigation System 1/A+

What is "FANS"?

- Provides an improvement to HF Radio Communications in remote and/or oceanic areas
- Provides a data link communication to ATC through Satcom (Inmarsat or Iridium) or VHF
- Three elements
  - **ADS-C: Automatic Dependent Surveillance - Contract**
  - Provides digital **automatic position reports** to ATC
  - **CPDLC: Controller-Pilot Data Link Communications**
  - Provides digital communication for **requests and intervention**
  - **AFN Logon**
- Iridium Satcom recently approved for FANS 1/A operations by the FAA, check with state AIPs (aeronautical information publications) for other areas
- Provides a higher level of performance, which will lead towards reduced separation initiatives
- **Proven Solution for Communication**
- **Also planned for use in US NextGen System using VDL Mode 2 as early as 2015**



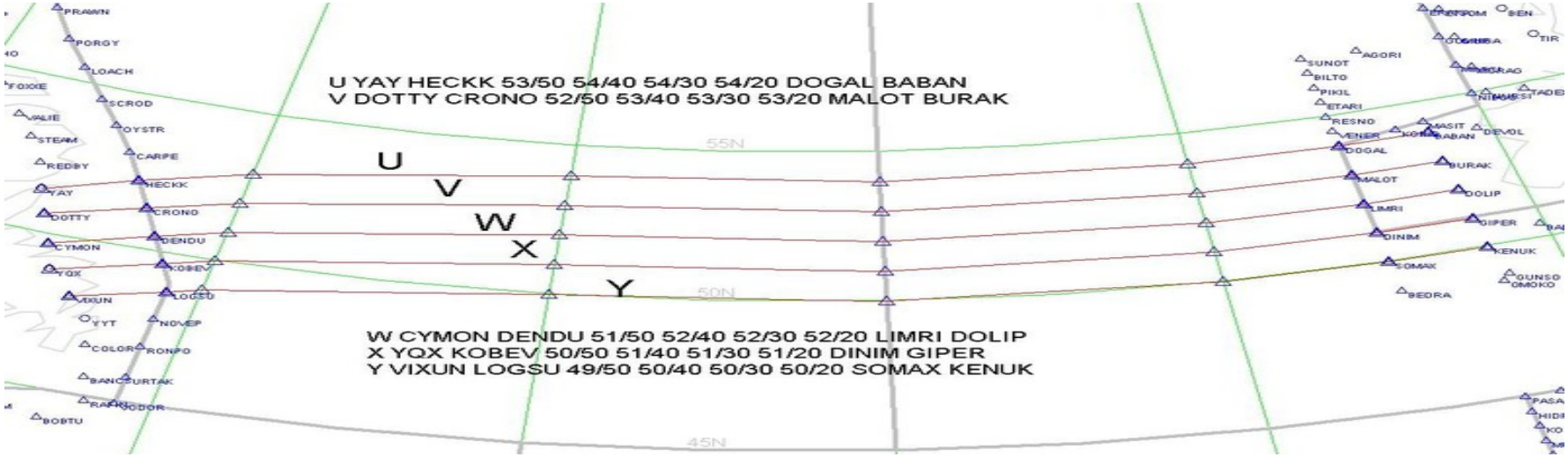
FANS 1/A

Typical HF Communication

FANS 1/A

North Atlantic

- Approximately 1400 North Atlantic Track Crossings per Day and increasing (6% Corporate)
- Approximately **60%** of all North Atlantic Track Crossings are FANS 1/A Equipped and increasing
- Current Separation 10 minutes in trail, 60 nm (1 degree) lateral and 1000ft vertical
- Two Most Desirable Tracks FL370-390 Are Now **FANS-ONLY**



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FANS 1/A

Cost of Non-Compliance – North Atlantic

- **Many Long-Range Aircraft Optimum Altitudes are FL370-FL390**
  - FL400 is not achievable if temps are too hot (ISA +10) at full gross weight
  - FL420 is not available due to non-RVSM airspace above (2k separation)
  - At FL340 or FL350, aircraft will burn at least 10% more fuel
    - Higher cruise speed to keep up with airliners
    - In the weather/turbulence
- ***Result:***
  - By 2015, aircraft not FANS 1/A equipped will have to fly around the OTS, and transitioning through the OTS on a "random route" will be unlikely
  - By 2017, aircraft not FANS 1/A equipped will have to fly the "Blue Spruce Routes" or above/below FANS 1/A airspace FL350-FL390, inclusive
  - By 2020, aircraft not FANS 1/A equipped will have to fly the "Blue Spruce Routes" or below FL290

FANS In Canada

- Use Of ADS-C In Canadian Domestic Airspace Has Been Limited To The Edmonton FIR To Date
- Basic Functions Only
- Additional Functionality Will Be Introduced In Stages Per The Global Operational Data Link Document (GOLD), Which Is Used By NAV CANADA As Guidance Material For Its FANS 1/A Data Link Implementations
- At The Current Time, It Is Planned To Implement ADS-C Functionality Only In The Edmonton And Vancouver FIRs

FANS 1/A

How Do I Get It?

- Install FANS 1/A equipment under STC or OEM Service Bulletin (AC 20-140B)
  - FMS Update (Universal SBAS FMS FMS)
  - Communications Management Unit
  - Annunciator “cube” or integrated into displays
  - Aural Alert
  - Data-Capable CVR Required (AC 20-160)
  - RTCA/DO-178B **Level D** (software) Satcom system

- At This Time Letter of Authorization Not Required For C-registered Aircraft

FANS 1/A

Universal Avionics' Solution

UniLink® UL-800/801

- Airborne Data Link System
- Two-way Digital Data Communication
- Multiple Communications Transmission Media
    - VHF & Satcom (Iridium & Inmarsat)
- Built-in VDL Mode 2 VDR (UL-801)
- CPDLC & ADS-C Functionality For FANS
- ARINC And SITA Network Compatible
- Classic VHF "ACARS" Text Data Link
- 1 MCU LRU, Less Than 5 Lbs.
- **Provisioned For Link 2000+ And Atn**

FANS 1/A

Universal Avionics' Solution

UniLink® UL-800/801

- Works with WAAS/SBAS-FMS
  - SBAS accuracy needed for ADS-B
- Trade-in credits available for non-WAAS FMS and legacy UniLink
- Data-recording CVR required for FANS operations

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FANS 1/A

Basic Functionality

- AFN (ATS Facilities Notification) LOG-ON
- Log-on to North Pacific
- Log-on to KZAK (Oakland)

- After an AFN log-on, ATC **may** establish an ADS Contract

- Ready to accept ADS Contract

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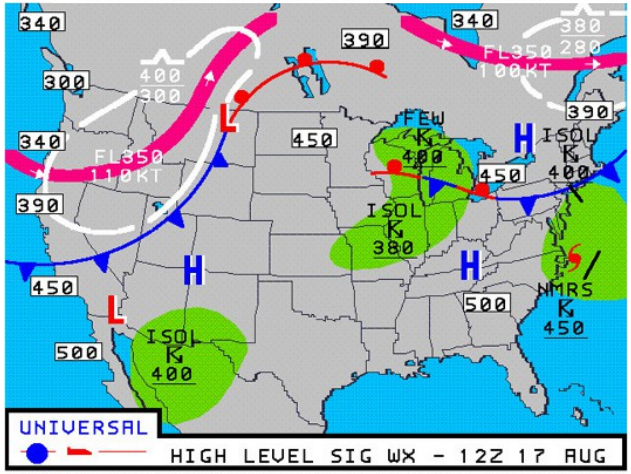
FANS 1/A

Additional Capabilities with *UniLink*®

(after subscribing to AOC services)

- Hi-res Weather Graphics
- Textual Based Data – e.g. Weather, Change In Flight Status etc. (Based On Service Offering)
- Aircraft Tracking And Ground-to-air Messaging From Any Internet Connection
- Flight Plan Uploading (AOC)



Weather graphic is the property of Universal Weather and Aviation, Inc., Houston, TX

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FANS 1/A

Additional Capabilities with *UniLink*®

(after subscribing to AOC services)

- Flight information services (airport dependent)
  - D-ATIS
  - Pre-Departure Clearance
  - Expected Taxi Clearance
  - Push Back and Oceanic Clearances
  - TWIP (Terminal Weather Information for Pilots)
- Capable of Iridium or Inmarsat ACARS Data Link

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What Is ADS-B-Out?

- **A**utomatic Dependent **S**urveillance – **B**roadcast
- ADS-B Out - Surveillance Technology That Transmits GPS-based Position And Other Aircraft Or Vehicle Information Via “Extended Squitter” Mode S Transponder:
  - Identification
  - GPS Position
  - Altitude (Baro & Geometric)
  - Velocity
  - Quality And Integrity Data, Etc.
- Instead Of SSR
- It Is Not ADS-C

Why ADS-B Out?

ATC Providers (Nav Canada) and Regulators are Interested Because:

- Potentially Allows Them To Decommission Expensive SSR Radars
- Not Possible To Have New SSR In Remote Regions
- Much Faster Update Rate – Once Per Second
- Position Accuracy
- Aircraft State And Intent Information
- Ultimately Will Allow More Aircraft To Use Existing Airspace With Equivalent Or Better Safety And Efficiency

- **Estimated Savings Through 2016 In Hudson Bay**
- **$158 Million In Fuel**
- **436,000 Metric Tons Of CO^2 Emissions**

Hudson Bay/Minto ADS-B Out

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ADS-B – Canada Summary of Requirements

Eligibility for ADS-B separation service is based on satisfying two conditions:

- The aircraft meets a minimum performance specification to transmit ADS B messages and,
- The flight crew is qualified in the operation of the equipment and the operational practices of the ADS B airspace.
- Condition 1 is satisfied if the Aircraft Flight Manual (AFM) or AFM Supplement contains a statement indicating compliance with the European Aviation Safety Agency (EASA) Acceptable Means of Compliance (AMC) 20 – 24 for ADS-B, or Transport Canada Advisory Circular (AC) No. 700-009 Issue 2.
- Condition 2 is satisfied if flight crews know, understand and apply the contents of NAV CANADA's ADS-B Hudson Bay Implementation information pamphlet.

ADS-B Recommended Equipage

Equip for DO-260**B**!

Do It Early To Reap The Benefits Soonest

Equipment

- Transponders TSO-C166**b** compliant
- Universal TSO-C146 SBAS/WAAS Flight Management System
  - Most TSO-C129a approved FMS or GPS systems do not meet the accuracy, latency and integrity requirements per AC 20-165A (or EASA AMC 20-24)
- Update UASC Radio Control Unit to alert the pilot of any loss of ADS-B output parameter

4th Dash 8 EFI-890R Customer

Delivered April 7 2014

Getting Ready…Upgrades

- Have a Trusted Broker of Information As An Adviser
- Make Use Of The Information Sources Available
- Have A Clear Objective (Mandate, Enhanced Safety…)
- Aircraft Survey
- Demand A Clear Proper Proposal Covering Technical, Operations and Commercial
- Be Realistic About Downtime
- Break With Tradition And Consider Not Waiting Until The Integrators Are Swamped

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Thank You

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