

**AVIATION OPERATIONAL MEASURES**  
**FOR FUEL AND EMISSIONS**  
**REDUCTION WORKSHOP**


**Air Traffic Management  
Initiatives**

**Ross Bowie**  
**Director, ANS Service Design**  
**NAV CANADA**

**Air Traffic Management Panel**  
**Montreal, 20-21 September 2006**



# Introduction



NAV CANADA



Who We Are

Customers' Goals

Initiatives to Reduce Fuel Burn

The Way Ahead

How to Reach Us

# Who We Are



- Owner and operator of Canada's civil air navigation system (ANS) since Nov. 1, '96
- Private, non-share capital corporation; not for profit
- Revenue from aircraft operators; no government funding
- Stakeholder Board
- 4 founding "Members" have Board representation
  - Airlines
  - Business Aviation
  - Government
  - Employees

# Customers' Goals



- safety
  - schedule
  - **efficiency (fuel savings = reduced emissions)**
  - value
- 
- safety is expected and is our first priority
  - the price of fuel is a strong motivator to improve efficiency
  - we are working closely with our customers on ways to improve efficiency

# Efficiency



- optimum route
- optimum altitude
- continuous climb to cruise
- continuous idle descent to approach
- lowest possible approach minima
- minimum ground delay
- increased airspace capacity
- increased airport capacity

# Meeting goals via ...



- Air Traffic Control and Advisory Services
- Flight Information Services
- Aeronautical Information Service (AIS)
- Weather Services
- Navigation and Approach Aids
- Procedure and Airspace Design
- Traffic Flow Management
- Complementary Aircraft and ANS Technology

# Keys to efficiency



- performance-based communications, navigation and surveillance (CNS)
  - GPS, WAAS, ADS-C, ADS-B, CPDLC, SATCOM
  - **coordinated investments** by ANS providers and aircraft operators
- controller decision support tools
- improved weather forecasting strategies
- collaborative decision making
- increased airspace and airport capacity
- ATS procedures that ensure safety while increasing efficiency

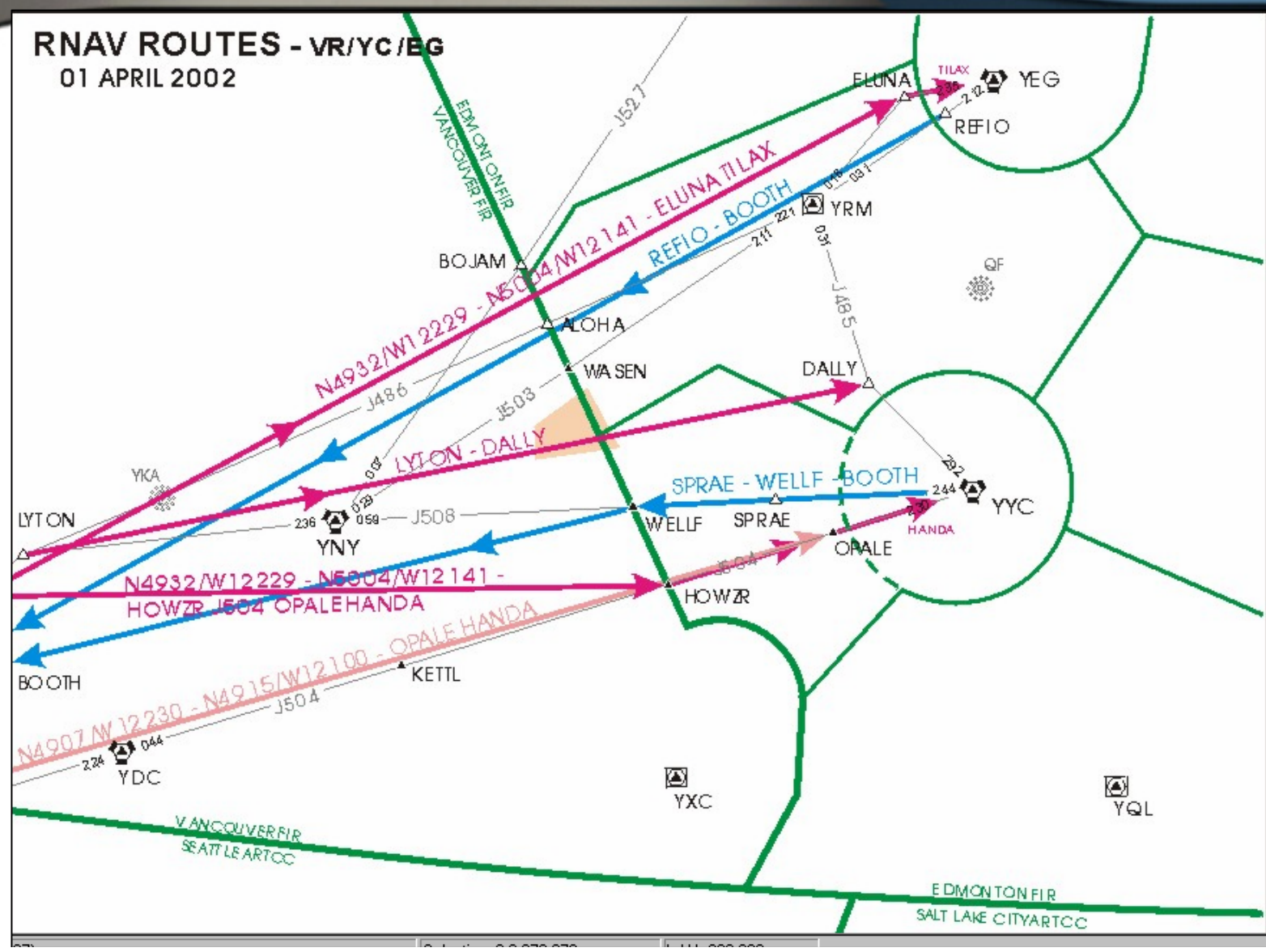
# Area Navigation (RNAV)



- **signals from space (GPS & WAAS) and avionics deliver Required Navigation Performance (RNP)**
- **goal - RNAV everywhere, performance-based where required**
- **RNAV is key to efficient en route and terminal operations, and to better approaches to more runways**
  - **realizing full en route and terminal benefits requires 100% GPS equipage**



# RNAV Routes



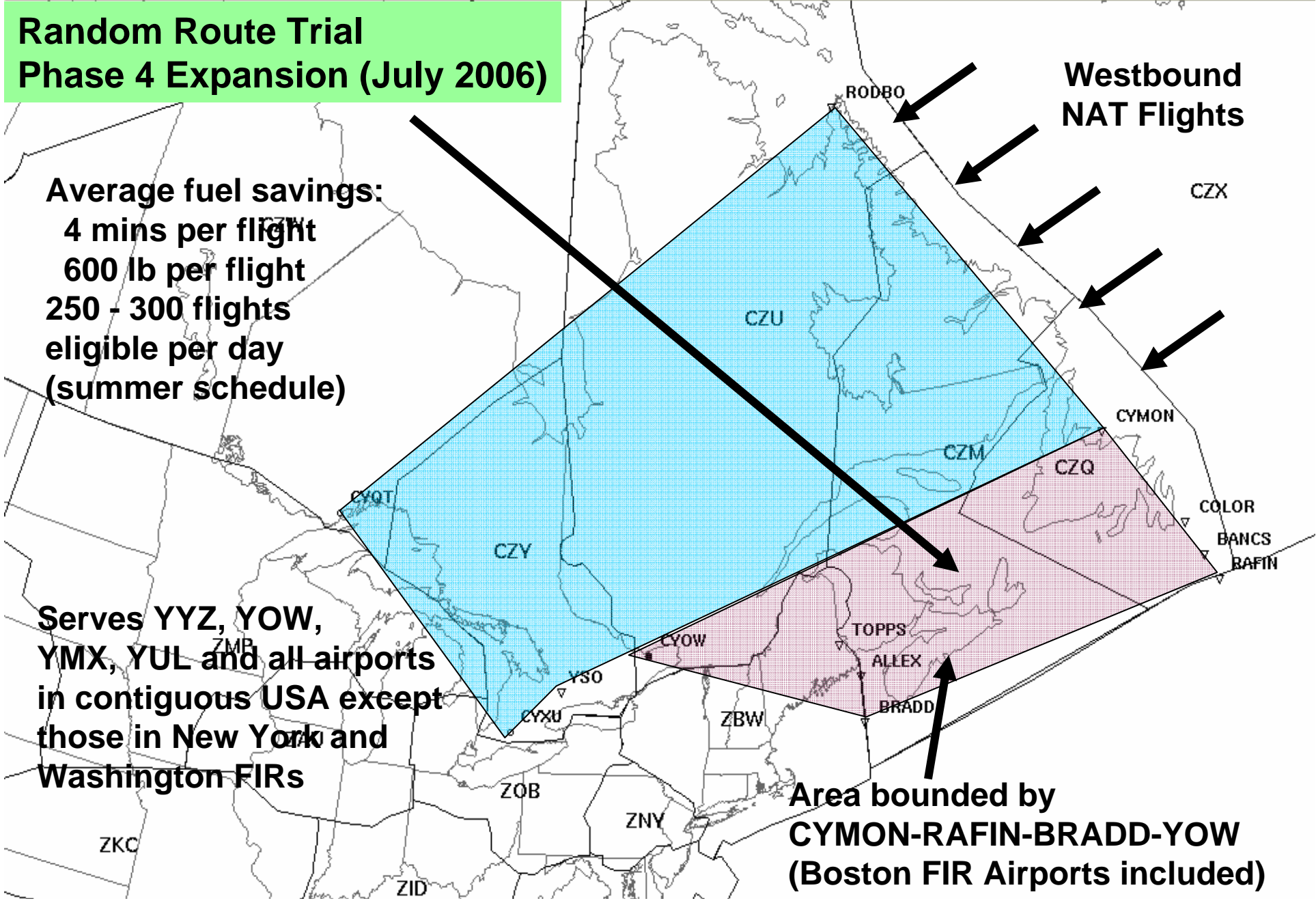
# Random Route Trial Phase 4 Expansion (July 2006)

**Average fuel savings:**  
4 mins per flight  
600 lb per flight  
250 - 300 flights  
eligible per day  
(summer schedule)

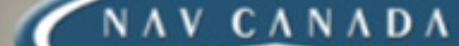
**Serves YYZ, YOW,  
YMX, YUL and all airports  
in contiguous USA except  
those in New York and  
Washington FIRs**

**Westbound  
NAT Flights**

**Area bounded by  
CYMON-RAFIN-BRADD-YOW  
(Boston FIR Airports included)**



# RNAV STARs

The NAV CANADA logo is an oval shape with a blue background and white text. It is positioned in the top right corner of the slide header.

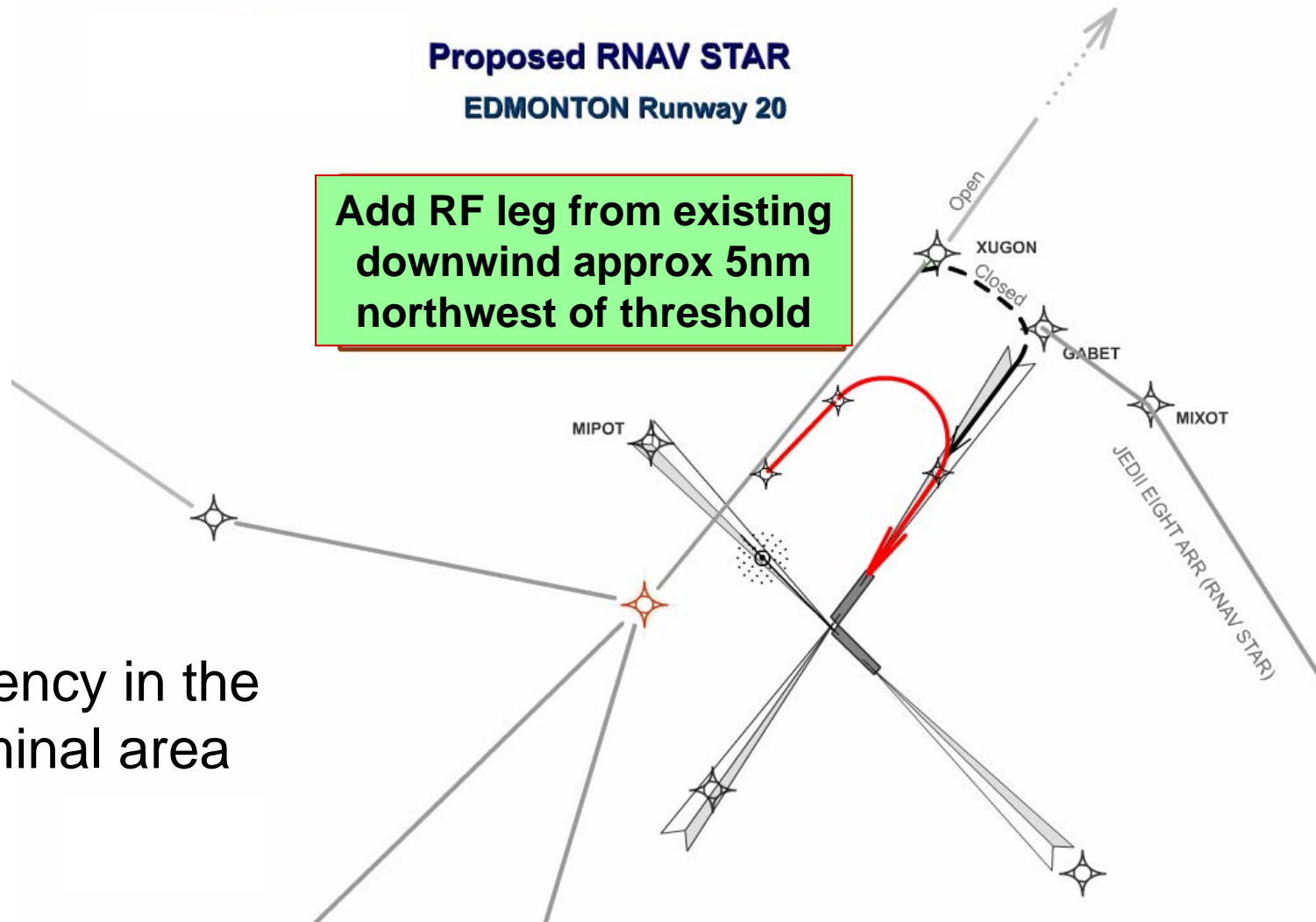
- RNAV STARs in use for over 10 years at major airports
  - idle descent saves fuel
  - no RNAV performance requirement; ATC monitors conformance and altitudes are at or above minimum altitudes; allows use of DME-DME
- emerging avionics capability (radius to fix (RF) leg) being incorporated to serve capable aircraft
- need to move to 100% GPS equipage
- near-term goal is to eliminate conventional STARs

# RF Leg Example - CYEG

## Proposed RNAV STAR EDMONTON Runway 20

Add RF leg from existing  
downwind approx 5nm  
northwest of threshold

efficiency in the  
terminal area



# RNAV SIDs



- “pilot-nav” SIDs result in a consistent, efficient, obstacle-free path to the en route structure and reduce ATC workload
- obstacle clearance is an issue, so navigation performance is a requirement
  - very difficult to impossible to meet performance requirements with DME-DME
  - GPS equipage is the answer
- aim is to eliminate conventional SIDs

# RNAV Approaches



- RNAV(GPS) approaches provide lower minima at over 400 runways in Canada
  - **fewer diversions, delays, overflights, cancellations**
  - **fuel savings due to no requirement for procedure turn**
  - **safety benefits via eliminating circling approaches, enhanced situational awareness**
- ILS-like WAAS approaches will support a 250 ft height above touchdown (HAT) minimum at over 90% of qualifying runways, 200 ft HAT at some with precision approach lighting
  - **WAAS signals available throughout southern Canada**
  - **vertical guidance provides significant safety benefit**

# Wide Area Augmentation System (WAAS)

SERVICE - 99%+ WAAS Approach Availability

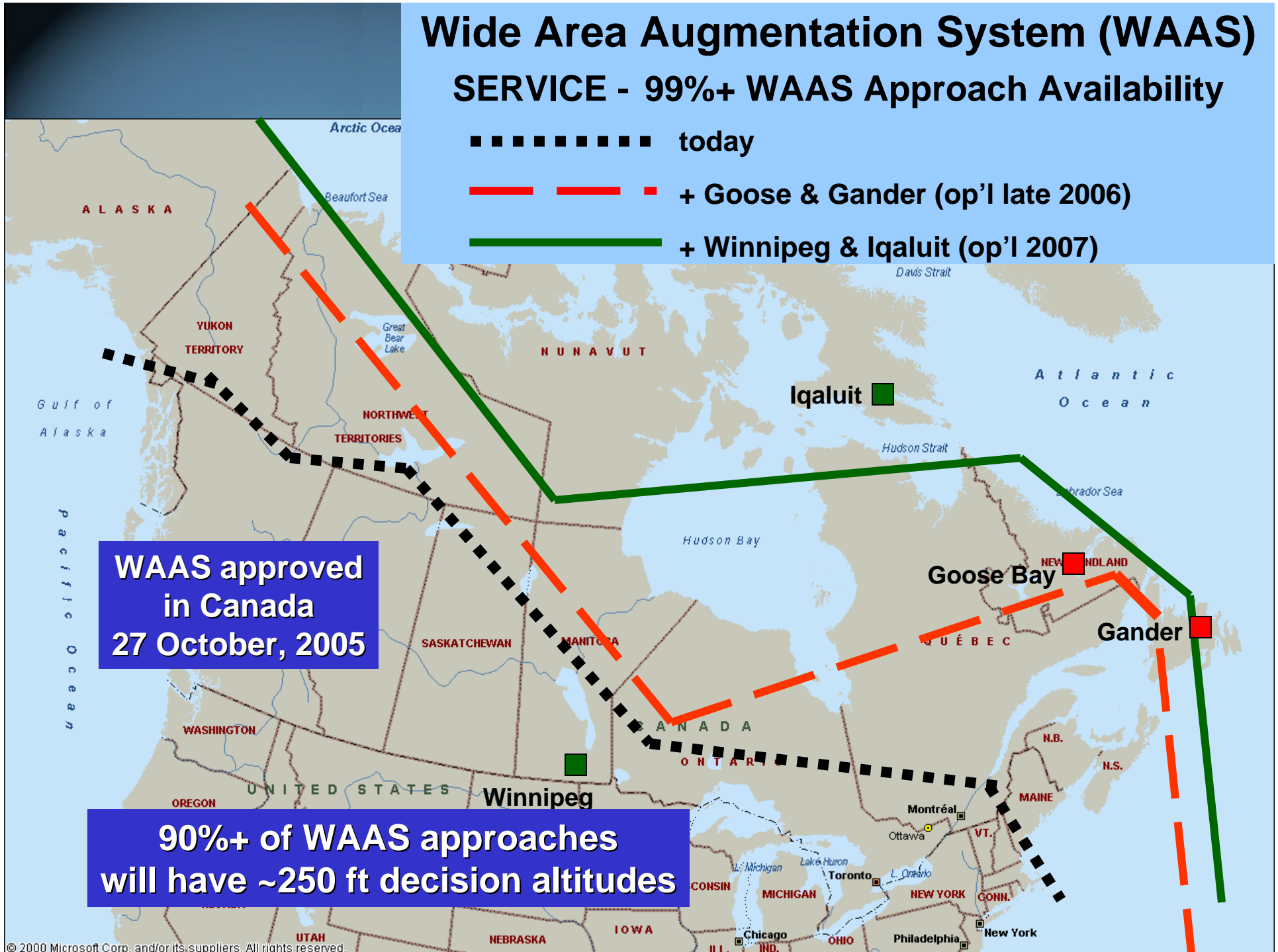
■■■■■■■■■■ today

— — — — — + Goose & Gander (op'l late 2006)

————— + Winnipeg & Iqaluit (op'l 2007)

WAAS approved  
in Canada  
27 October, 2005

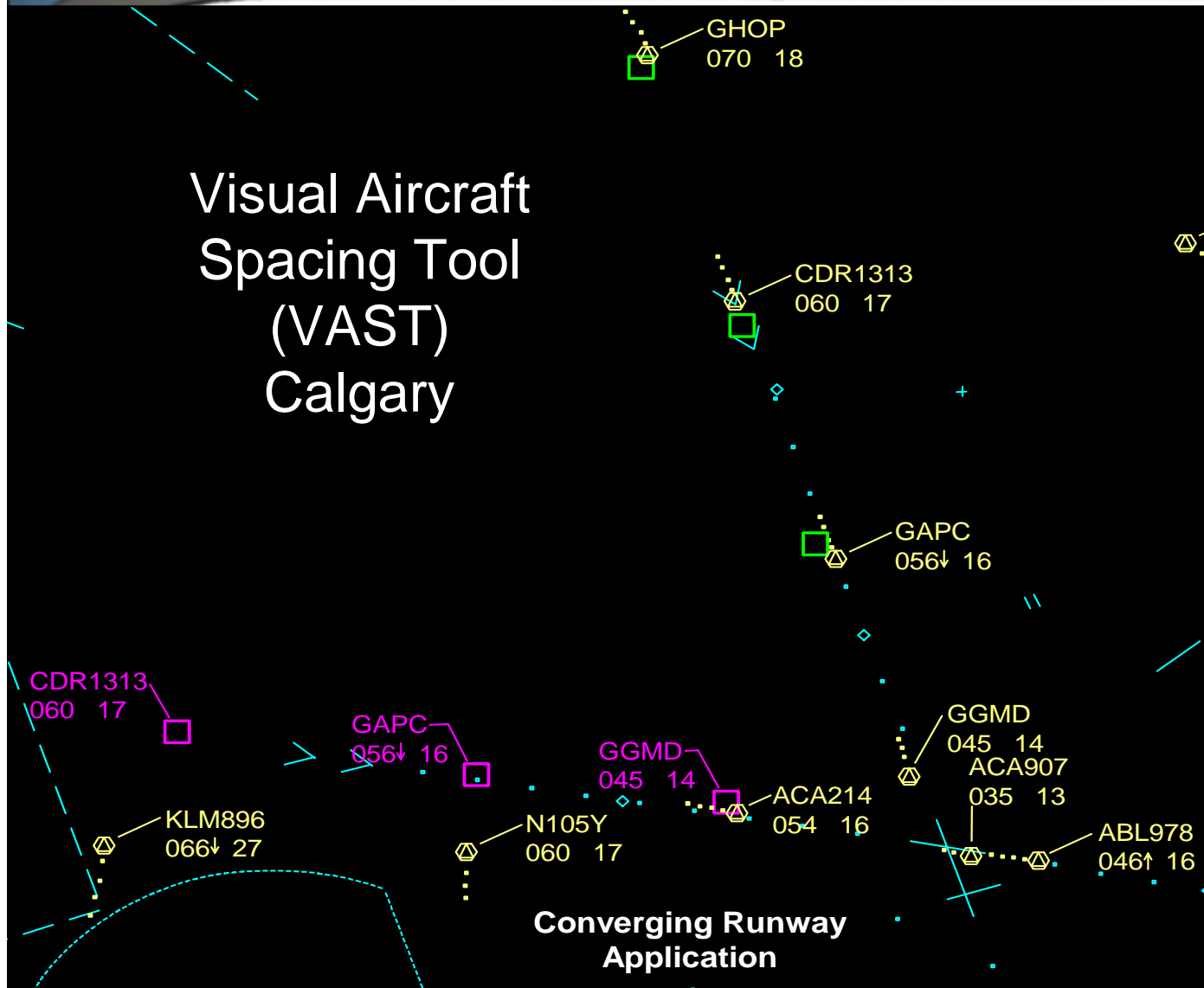
90%+ of WAAS approaches  
will have ~250 ft decision altitudes



# Airport Capacity



## Visual Aircraft Spacing Tool (VAST) Calgary



- maximum capacity on intersecting runways
- eliminates conflicts at intersection
- eliminates need for land and hold short (LAHSO) instructions



# Airport Performance Monitor



- APM provides airlines and airport personnel with up-to-the-minute analysis of airport performance, including such events as time on the ground taxiing, de-icing, holds for departure separation etc.
- The analysis of APM data allows airline personnel to better plan for the scheduled departure times of their aircraft. Additionally it allows NAV CANADA to recognize the potential for gridlock early, reducing airline operating costs and undue travel delays

### Advisories

( CYYZ ) - 2002/01/15 11:30z  [Report](#)

Switch to this airport:  [Go](#)

001 CYYZ/CZY OPERATIONS FORECAST 1200Z-2000Z

ARRIVALS: 23/24R / DEPARTURES: 23/24R AIR DELAYS: UP TO 10 MINS FOR ETAS 1840Z-1920Z

02/01/15 11:30 TORONTO.Infs/Avkstrn02 905-676-3528. CAN 800-268-4831 / U.S. 800-387-3801

[View past advisories](#)


### AAPM Status

Zulu: 2002/1/15 13:56:07z Local Time: 2002/1/15 8:56:08z

Last Status Message Updated: 2002/01/10 16:37z

**The Manuals and Release notes can be found in the documents section of the portal.**

### Gridlock Monitor


( CYYZ ) - 2002/01/15 13:46z  [Report](#) [Edit](#)

Ground Count [History](#) Threshold setting

**65** **100**

Departure Rate: **90** 60 Arrival Rate: **42** 60

### Ground Monitor

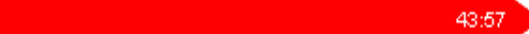
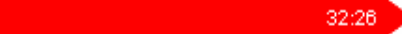
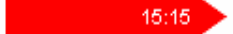
( CYYZ ) - 2002/01/15 13:46z  Departures [Show Legend](#) [Report](#) [Edit](#)

Departure Rolling median: Based on

Runway 23	22 ✈	4:25 ▼	7:26 ▲	0:00	4:01 ▲	● ▼	11:42
Runway 24R	18 ✈	5:34 ▲	8:38 ▲	9:11 ▲	5:28 ▼	● ▲	14:35

Departure Ground status: In Process **22** Departed **18** Line Up Count **5**


**Aircraft above threshold: 6**

<a href="#">JEL105</a>	UNDF	0:01					43:57
<a href="#">ACA600</a>	208	7:43	1:32	12:36	14:19		
<a href="#">COA1673</a>	UNDF	0:01					32:26
<a href="#">GGN984</a>	296						15:15
<a href="#">ACA702</a>	237	10:00	1:24	9:05	3:14	8:47 ●	32:30
<a href="#">ACA440</a>	225	6:48	1:21	9:17	3:38	5:49 ●	26:53

**Aircraft below threshold: 34**

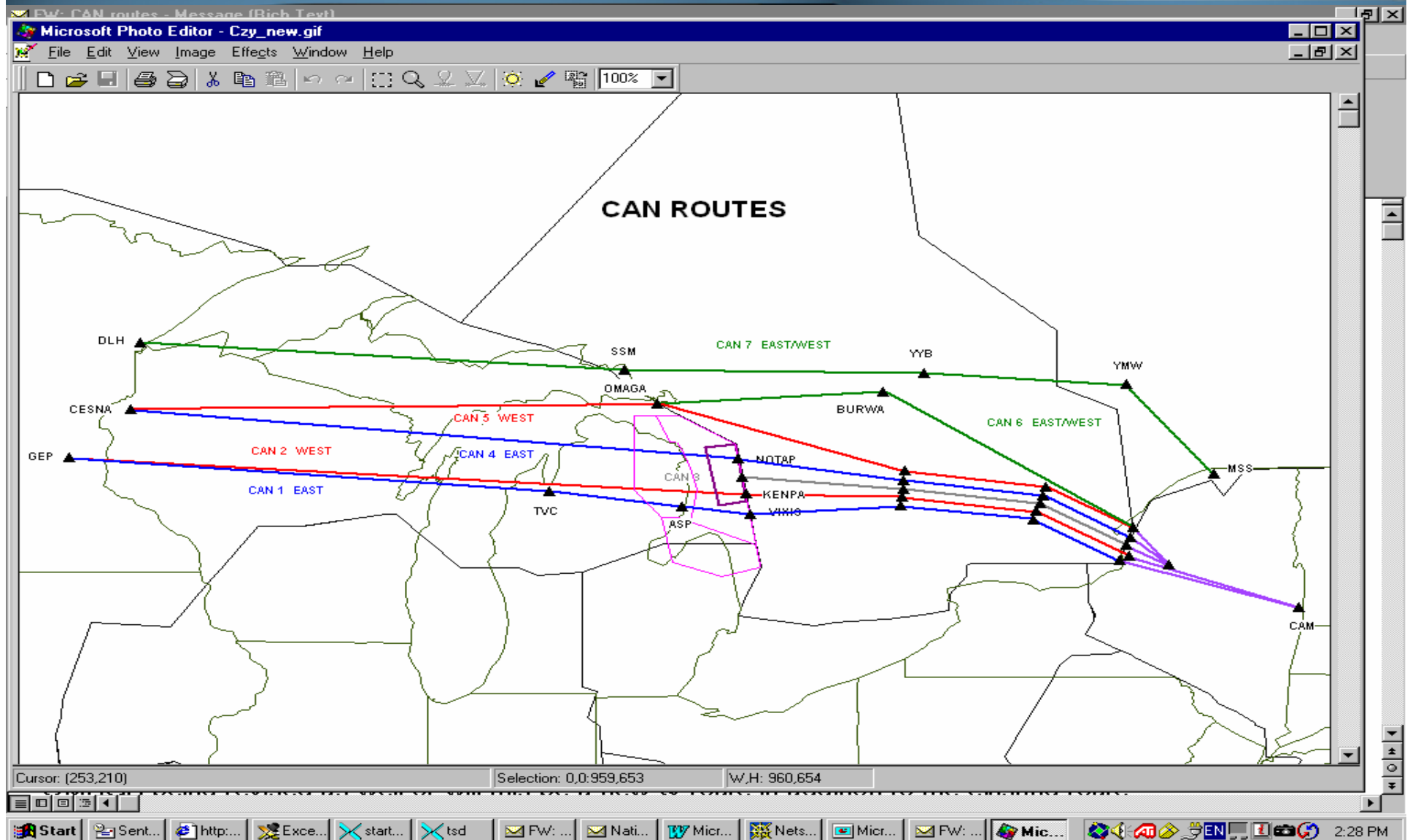
In Process	18 ✈	5:44	10:32	7:56	9:11
Departed	16 ✈	4:18	6:48	0:00	4:00

### Daily Summary

( CYYZ ) - 2002/01/15 13:46z  [Report](#)

Interval	Runway	Arr	Dep	BDP	EPS
13:05z - 14:05z	23	8	20	93%	+17
	24R	14	17	71%	+20
12:05z - 13:05z	23	8	12	36%	+9
	06L	0	1	6%	-10
11:05z - 12:05z	24R	13	12	50%	+14
	15L	6	0	50%	-5
	23	4	20	64%	+13
	24R	0	6	14%	-5

# U.S. Offloads



# Weather & Flow Management



- NAV CANADA's National Operations Centre (NOC) currently uses:
  - the Collaborative Convective Forecast Product (CCFP)
    - a seasonal thunderstorm forecast product tailored to the specific requirements of air traffic flow management
  - the Canadian and North Atlantic Turbulence Forecast
- We are evaluating the contribution that aviation meteorologists could make to efficient air traffic flow management; two forecasters worked with NOC staff during August 2006
  - exploring the value-added services that could be provided by a direct consultation service

# Aerodrome Forecast (TAF) Accuracy and Efficiency



- the TAF is the principal tool for deciding how much fuel to upload for an IFR flight
  - but users cannot assess the meteorologist's degree of confidence in a TAF because formatting rules do not allow such flexibility
  - a higher than necessary fuel load means more fuel burn and less payload/revenue
  - the same fuel upload decision is taken even though the forecaster's level of confidence could be anywhere from 50% to 100%
  - would probabilistic forecasts provide benefits?

# Probabilistic Forecasts



- 14-month American Airlines study of “No Alternate IFR” fuel decisions for 18 different flights:
  - for one daily flight LAX to JFK:
    - cost using standard TAF: \$88,743
    - cost if probabilistic forecast used : \$78,272
    - savings for daily flight for 14 months: \$10,501
  - average savings for the 18 selected flights: \$23,000
- there are ~8,000 flights/day in USA: ~US\$160M/yr
- we have started working with our partners towards probabilistic forecasts
- we are also putting more emphasis on hubs



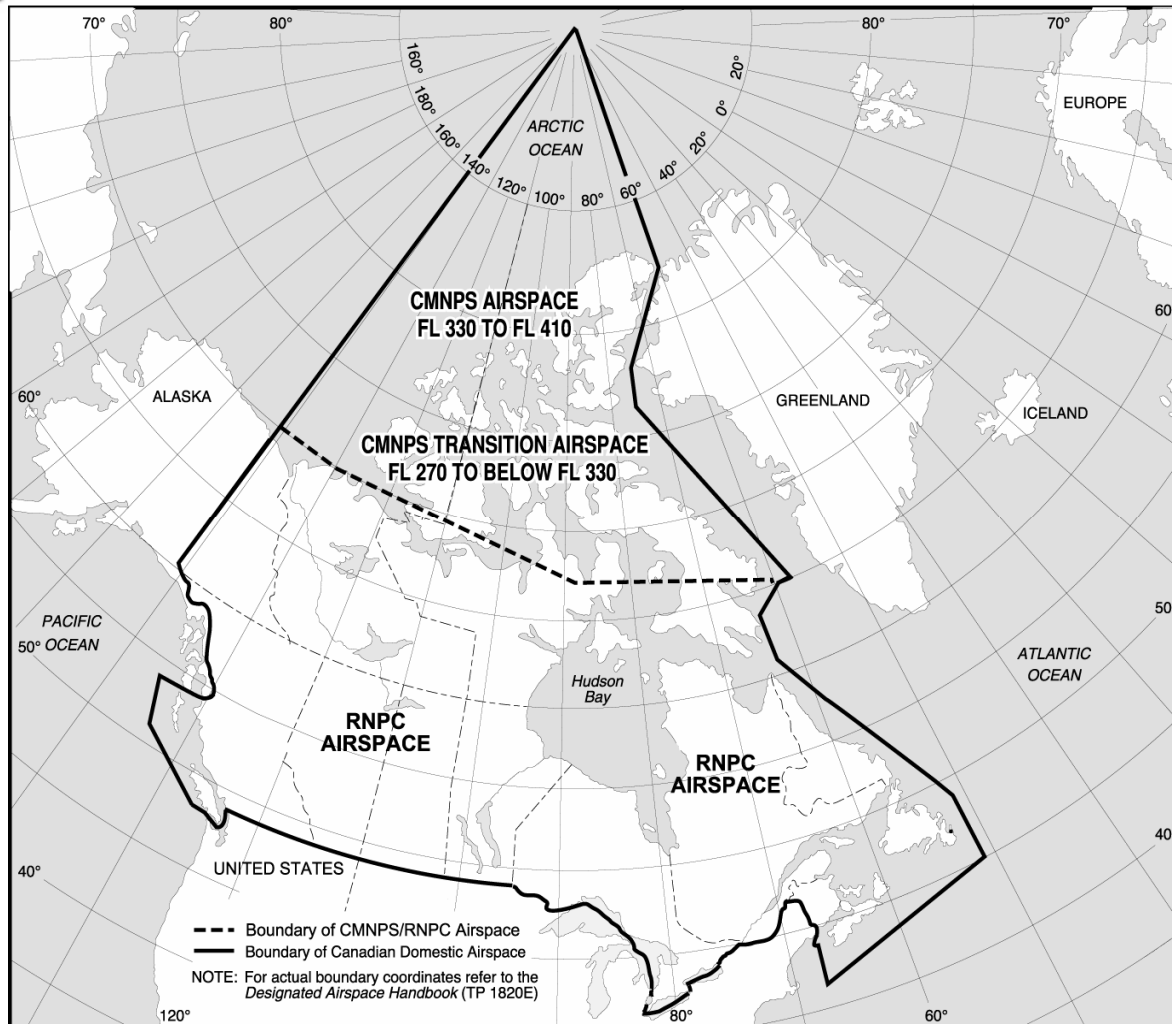
# NAT Concept of Operations



- current operations
  - lateral separation: 1 deg of latitude = 50.5 to 60nm
  - longitudinal separation: 10 minutes
  - NAV CANADA and UK NATS develop eastbound and westbound OTS (Organized Track System) centered on the MTT every day in collaboration with customers
- proposed separation
  - lateral:  $\frac{1}{2}$  degree of latitude (25.25 to 30nm), based on GPS
  - longitudinal: reduced time-based (7, 6, 5 minutes?), based on GPS-time-stamped ADS-C position reports
- benefits
  - more aircraft on or near most efficient track
  - more flexibility to allow climbs to efficient altitudes



# Northern Airspace



- polar traffic increasing and expected to be significant leading to the Beijing Olympics
- Eastern NA - Pacific & Western NA - Atlantic traffic significant
- traffic flows now cross where communications and surveillance are not common

# Separation - Capacity



Airspace	Separation (Lateral/Longitudinal)
<b>CMNPS</b>  (If all aircraft were equipped with GPS, all CMNPS airspace could be converted to RNPC)	<b>60nm or 1 degree</b>
	<b>15 minutes or 10 minutes using Mach or 20nm with <b>DCPC*</b> and <b>GPS</b></b>
<b>RNPC</b>	<b>20nm (10 miles either side)</b>
	<b>10 minutes or 30 nm with <b>DCPC</b> or 20nm with <b>DCPC and GPS</b></b>
<b>Radar or <b>ADS-B**</b></b>	<b>5 miles (requires <b>DCPC</b>)</b>

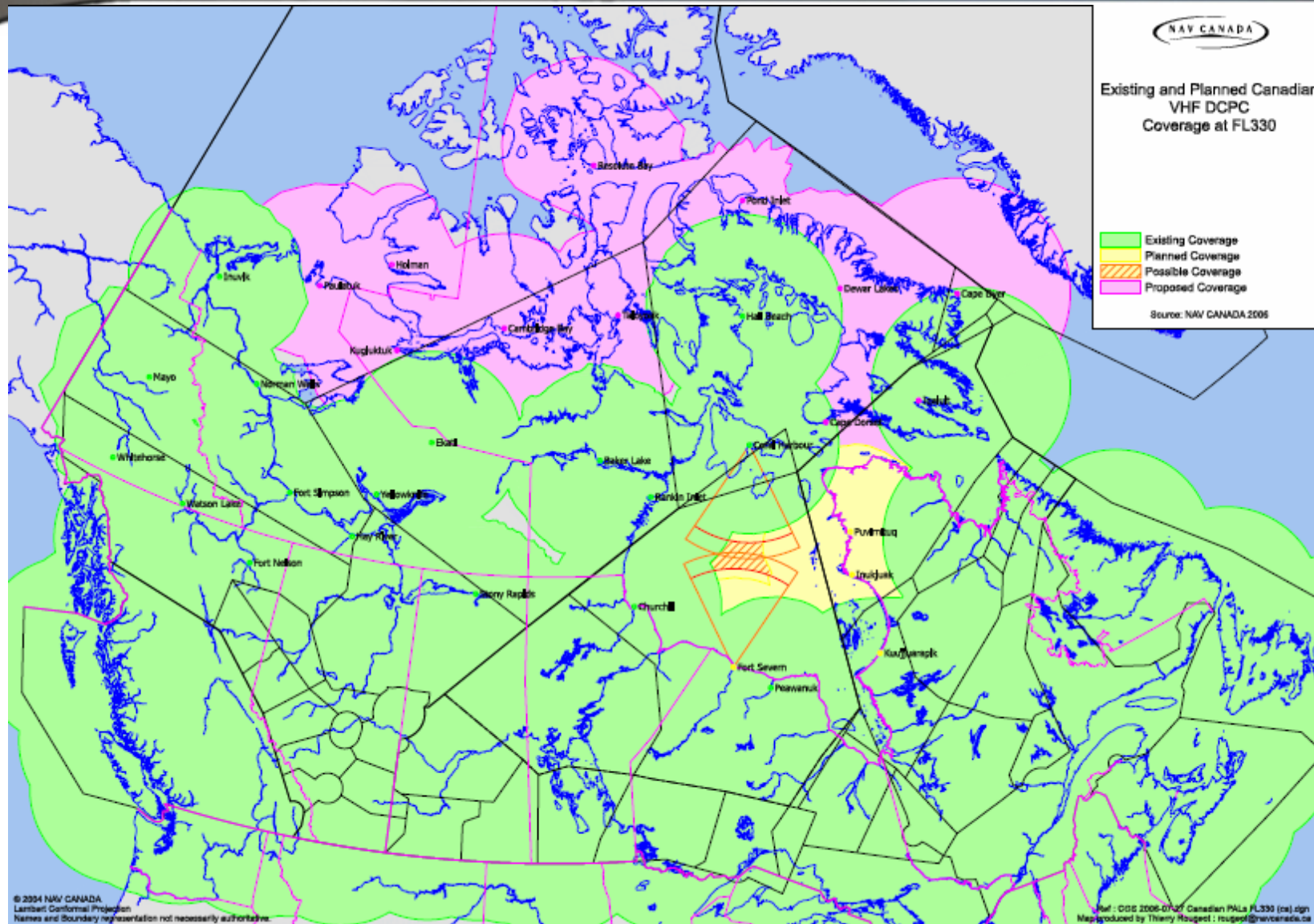
\* DCPC = Direct Controller Pilot Communications

\*\* ADS-B = Automatic Dependent Surveillance - Broadcast

# ADS-B (- out) Hudson Bay



# VHF Direct Controller Pilot Communications (DCPC)

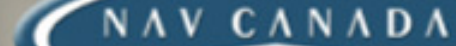


# Northern Concept of Operations



- near term CONOPS (2006 – 2008)
  - expanded flow management capability
  - Northern Organized Track System (NOR OTS)
    - IATA estimates US\$6M/yr savings for NAT traffic alone
  - expanded VHF COM (DCPC); 15 new ground stations
  - Hudson Bay ADS-B (ADS-B (out))
    - 60% aircraft equipage; segregate airspace vertically; decide with customers on appropriate level and timing of eventual FL290 lower limit
- medium term CONOPS (2009 – 2011)
  - expand ADS-B and DCPC throughout north
  - SATCOM voice to augment and possibly replace HF
  - enhanced ADS-C and CPDLC for the far north

# The Way Ahead

The logo for NAV CANADA, featuring the text "NAV CANADA" in white capital letters inside a blue oval with a white border.

- we can increase efficiency via:
  - emerging CNS, ATM and weather technology
  - collaborative decision making
- more and more, ANS providers and aircraft operators have to coordinate investments, so we have to work closely together
- aircraft equipage is an issue that requires segregating airspace to provide benefits to equipped aircraft while encouraging others to equip; there will be an eventual requirement for a mandate

# How to Contact Us



- [www.navcanada.ca](http://www.navcanada.ca)
- Customer Service:  
1-800-876-4693-4  
[service@navcanada.ca](mailto:service@navcanada.ca)



**AVIATION OPERATIONAL MEASURES FOR FUEL AND  
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**Thank You**



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