OTTAWA CITIZEN

Faster, cheaper, safer;

Made-in-Canada technology is ready for takeoff, and will take air traffic control to new heights. Ian MacLeod explains

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Senior software developer Daniel Charbonneau shows off Nav Canada's new trans-oceanic flight control system at the technical centre on Hunt Club Road in Ottawa.

Two years after a jumbo jet went missing over the mid-Atlantic for hours before a formal alarm was raised, Canada is set to announce a major advance in oceanic air traffic control.

The June 1, 2009 crash of Air France flight 447 into a desolate patch of ocean between Brazil and Senegal left many wondering how a huge airplane and 228 people could vanish with authorities taking little initial notice.

In an age of global positioning satellites and instant wireless communications, oceanic air traffic control remains a challenge, especially over the North Atlantic.

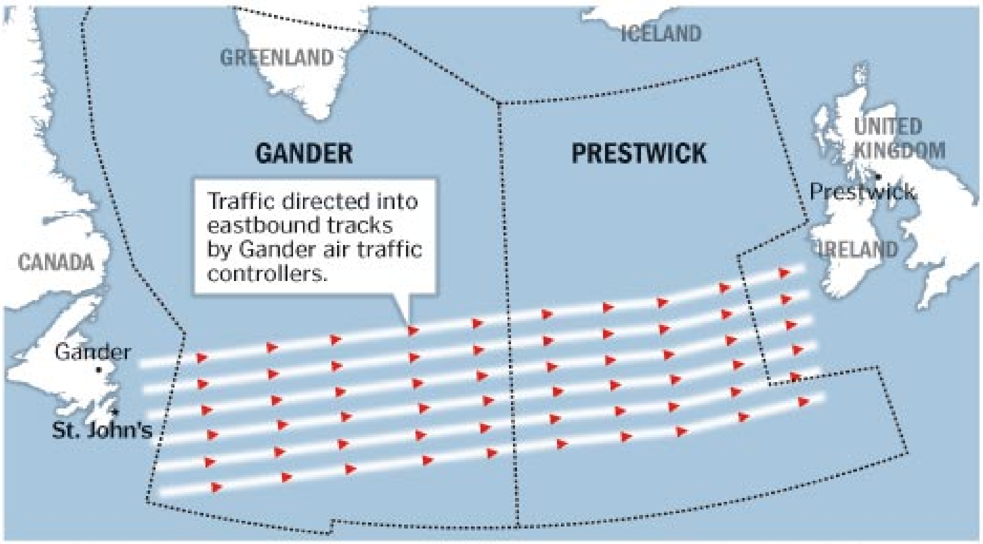
With more than 1,000 daily flights carrying hundreds of thousands of passengers, it is the busiest oceanic airspace on the planet. Traffic topped 367,000 flights last year and is running five-per-cent higher this year. Maximizing capacity is crucial to avoiding gridlock at 35,000 feet.

Yet because ground-based radar coverage is limited to coastal areas, tracking all those big jets and keeping them separated and on the most timeand fuel-efficient routes requires 61 specialized air traffic controllers stationed in Gander, Newfoundland and dozens more in Prestwick, Scotland with Britain's NATS (formerly the National Air Traffic Service).

On Monday, Nav Canada, the company that controls Canada's civilian airspace and the skies over the western half of the North Atlantic, is to announce a dazzling leap in technology that automates much of the job once done by controllers with grease pencils, paper flight data strips and analog-era plastic "wiz wheels" for speed, distance and time calculations.

A better way to fly

More than 1,000 flights a day carry hundreds of thousands of passengers over the North Atlantic, making it is the busiest oceanic airspace on the planet. Controllers compress the traffic into a handful of "tracks" mapped out daily, based primarily on the route of the jet stream. Here's how the eastbound tracks work:



Source: NavCanada DENNIS LEUNG, THE OTTAWA CITIZEN

Faster, safer, cheaper and cleaner trans-Atlantic travel is expected to follow.

Called the Gander Automated Air Traffic System Plus, or GAATS+, the system's high degree of automation and integration allows the current 10-minute longitudinal separation standard between same-speed planes in non-radar airspace to be cut in half, to five minutes. That's equivalent to a much closer 50-mile separation for eastbound planes 40 miles for westbound ones, opening the possibility for far more planes to exploit the most efficient routes. It also allows for earlier climbs to higher, more fuel-efficient altitudes and easier transitions from one flight level to another. The system was commissioned April 14.

About 60 per cent of trans-Atlantic jets are equipped with the latest GPS position-reporting and text-based communications avionics to take advantage of GAATS+.

Nav Canada estimates the technology will save client airlines $1 million in fuel costs in the first year and reduce engine emissions by 3,000 metric tonnes.

Air traffic control has, "come a long ways," says Chris Mouland, general manager of Nav Canada's Gander Flight Information Region. "We know within 30 seconds where that aircraft is going to be in an hour."

While the industry has little trouble commissioning or purchasing off-the-shelf equipment such as radar and landing systems for its navigation and surveillance needs, building software to interact with the highly complex and real-time demands of controllers has always been a problem.

"You can write a specification," and contract out the development work, says Sid Koslow, Nav Canada's vice-president and chief technology officer. "But it's very difficult to get all the details straight and you often end up with systems where it takes longer and costs more than you would expect."

A decade ago, Nav Canada decided to start building its own air traffic management (ATM) gear by putting computer specialists on staff and teaming them up with controllers.

The daily flow of trans-Atlantic traffic begins at night in North America as planes, up to 120 an hour, move up the eastern seaboard and from points southwest and funnel into a narrow band of airspace off Newfoundland's east coast.

Routing for each plane has already been assigned, based on flight plans filed earlier by the airlines. The routing "profile" for each must ensure "conflict free" separation from the Newfoundland-Labrador coast to landfall in Europe.

By the time they reach the oceanic entry point, "we know exactly where they need to be, what speed they need to be at, the flight level that they need to be at and the track that they need to be on," says Mouland.

Controllers compress the traffic into a handful of eastbound "tracks" mapped out daily in Gander and based primarily on the route of the jet stream and its fuel-saving tail winds. The planes return the next morning and afternoon, this time on routes mapped by Prestwick that minimize the jet stream's headwinds.

Air traffic control, meanwhile, relies on two types of navigation: positive and procedural. Positive control tracks a plane on a radar scope. When radar is not available, procedural control is used, with pilots reporting their positions to the oceanic centres every several minutes, typically via High Frequency (HF) radio.

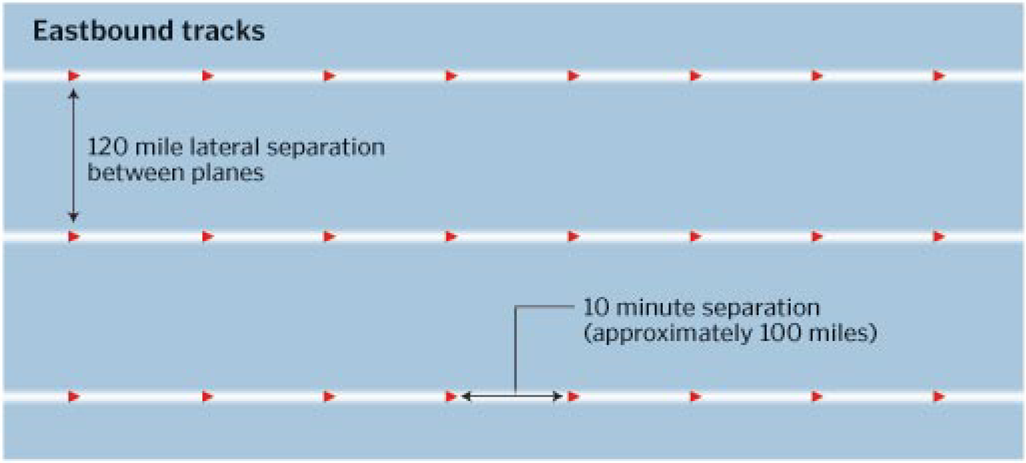
But procedural control means controllers have had to put bigger "safety bubbles" -lateral and vertical separation -around planes, since their exact, real-time position can't be tracked until it reaches radar-controlled airspace.

GAATS+ lessens reliance solely on procedural control - therefore allowing reduced separation - by extending positive control using traditional radar feeds from the Department of National Defence's North Warning System along the northeast coast.

It also exploits newer GPS surveillance technologies, such as Automatic Dependent Surveillance-Broadcast (ADS-B), which allows ADS-B-equipped planes to automatically broadcast their GPS positions every second. In place over Hudson Bay since 2009, Nav Canada plans to open more ADS-B stations in southern Greenland this fall and shrink the oceanic separation standard in that area even further, from five minutes to five nautical miles.

Old

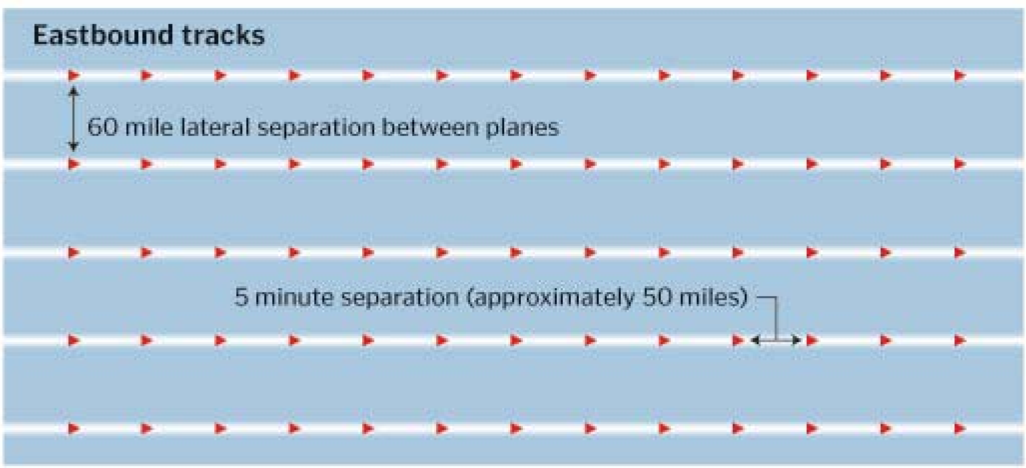
Before GAATS+, controllers had to put bigger 'safety bubbles' around planes, since their exact position couldn't be tracked in air space not covered by radar.



Source: NavCanada DENNIS LEUNG, THE OTTAWA CITIZEN

New

The made-in-Canada system allows planes to travel more closely together — more safely — and allows more planes to exploit the most efficient routes.



Source: NavCanada DENNIS LEUNG, THE OTTAWA CITIZEN

Meanwhile, in mid-ocean where ADS-B is not available, most planes use a surveillance aid called ADS-C, which automatically transmits the plane's position every 18 minutes, in addition to voice and datalink communications.

When Mouland began as a controller 33 years ago, the backbone of the system was paper flight data strips containing crucial flight details.

"You had all of these strips and as a new strip came out of the printer, you may get four or five at a time, (you) would put them physically in the flight data board to try and get them to fit, it was a very manual process."

Over the same period, an initial GAATS system was evolving that gave controllers some automated tools to monitor and direct aircraft. As recently as 2006, Britain's NATS adapted GAATS for its oceanic needs and is now looking at GAATS+.

But the older system still required many manual inputs via keyboards and HF voice communications, which could be time-consuming and open to potential keystroke and "read-back" errors.

"What the system allows (now) is to very quickly look at what profiles are available to this aircraft (and) tell right away, I can give this guy exactly what he wants, I can give him 1,000 feet higher with a slight speed adjustment and I can do it very, very quickly," says Mouland.

Key GAATS+ features include: ??Colour-coded electronic flight strips on a touch screen replace conventional paper strips and any flight changes are automatically updated, meaning less typing for controllers. If something in the flight profile does not conform to the controller's clearances or the original flight plan, the "strip" is highlighted in bright yellow, signalling a "conflict," and an icon representing the plane on the controller's main situational display also turns yellow.

The paperless strips were first introduced into Nav Canada's domestic air traffic control towers and the system has been sold and licensed internationally to a handful of other air navigation services.

To resolve a conflict or determine whether, for example, a pilot's request to climb to a higher altitude or change speed will put him in conflict with nearby craft, controllers activate the "BORG" function.

The Bilateral Option Resolution Grid is a simple graphical display offering up to 25 combinations of speeds and altitudes available to a particular flight. Options that would put the flight in conflict or some other nonconformance are highlighted in yellow. Allowable options are displayed in green.

The controller simply touches the preferred green option and the instructions to the flight crew can be issued automatically by a datalink text message or, if the controller prefers, by issuing an HF radio clearance.

Before BORG, the controller would have to manually calculate all the possibilities while handling all the other traffic in his sector.

If a pilot's request to change a flight profile can't be immediately fulfilled, GAATS+ stores the request and continually monitors traffic. When the requested clearance becomes available, it alerts the controller, who has final say before issuing a clearance.

Another time-saver is a "click-and-drag" function that allows controllers to move onscreen icons representing real flights to different tracks and instantly see whether there's a conflict anywhere along the potential new route.

The system also is capable of sending electronic oceanic clearances to aircraft, with electronic readbacks.

"All of these things are huge in terms of time-savers and service delivery," says Mouland. "We're very proud of what we've accomplished."

VIDEO TRANSCRIPT

The following video accompanied the story on the Ottawa Citizen web site:

http://www.ottawacitizen.com/business/Faster+cheaper+safer/4891167/story.html?tab=VID

KIM TROUTMAN (VP Engineering, NAV Canada): NAV Canada provides air traffic control and other services in Canada and the North Atlantic. We just completed our enhanced oceanic system called GATS-plus. This system was developed internally by NAV Canada, and we consider GAATS-plus to be the most advanced oceanic system in operation. The system has advanced pictures and tools to assist our air traffic controllers as they manage traffic in the North Atlantic, the busiest oceanic airspace in the world. GAATS-plus provides the foundation that will allow us to add additional functionality in the future for the benefits of our controllers and our customers.