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Article 6

Polar Air Traffic Control

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Air Traffic Control (ATC) operations over Continental US (CONUS) are becoming challenged due to increasing traffic loads vying for limited communications channels. Nevertheless, the CONUS situation is much better than what exists in the oceanic airspace.

In CONUS there are VHF radio communication nets and there also are tracking radar nets. With these, ATC can know where aircraft are and can readily communicate with them on a continuous basis. The VHF radios and the en-route radars provide the critical communications and surveillance that ATC must have to maintain order. Once aircraft fly beyond the radio and radar horizons those surveillance and communications capabilities are lost.

The historic approach that is used by oceanic ATC is to mandate large separations between ocean crossing aircraft and limit them to specific tracks. In addition, aircraft need to call ATC (by means of HF radio through the services of an operator) approximately once an hour, to report their position, altitude and speed. In this manner, ATC gains reassurance that aircraft are not impinging on one another.

That system has been workable, if not slow and cumbersome, but it is able to accommodate current traffic loadings. Were traffic to increase significantly, as is predicted, the existing system would fall short. However, separations cannot be reduced unless ATC can obtain more accurate and frequent position updates. If ATC can "know often and accurately enough" where aircraft are, they could reduce the separations and allow more aircraft onto each track.

NASA Glenn was studying a solution employing satellite communications to transmit Automatic Dependent Surveillance (ADS) messages from aircraft to oceanic ATC. ADS message incorporate GPS data as well as identity and future intent information. GPS provides the aircraft with accurate navigation information. In turn, the GPS content in ADS provides sufficient confidence for surveillance knowledge and the satellite link provides communications on a timely basis. It is the combination of GPS navigation, ADS surveillance, and satellite communications that can lead to reduced separations and higher traffic loads.

Air traffic to the Pacific Rim and India has been increasing and is expected to grow quickly as that economic powerhouse expands its influence. At the same time, the ATC situation in Polar oceanic regions is more demanding than in others. The vagaries of the ionosphere make HF communications even less

reliable then compared to other oceans. Additionally, the safety factor is even more severe because of cold fuel conditions, emergency landing sites facing snow storms, and ATC divided between several countries.

The sum of expected growth, limited communications reliability, multiple ATC entities, and heightened safety margins, call for a space-based solution. NASA Glenn, in addition to its overall Oceanic ATC efforts, was looking at a scheme for the Polar Region that would extend the GPS/ADS/SATCOM model to ameliorate those unique challenges.

Here again, the aircraft's flight computer would supply the GPS data, combined with other information (e.g., fuel temperature), the communications computer would generate an ADS message and transmit that to the Polar Oceanic Control Centers via a polar orbit satellite system.

The need for improved communications, navigation, and surveillance in oceanic regions is obvious and a space-based approach answers the need for accuracy, timeliness, and coverage as no terrestrial system can.

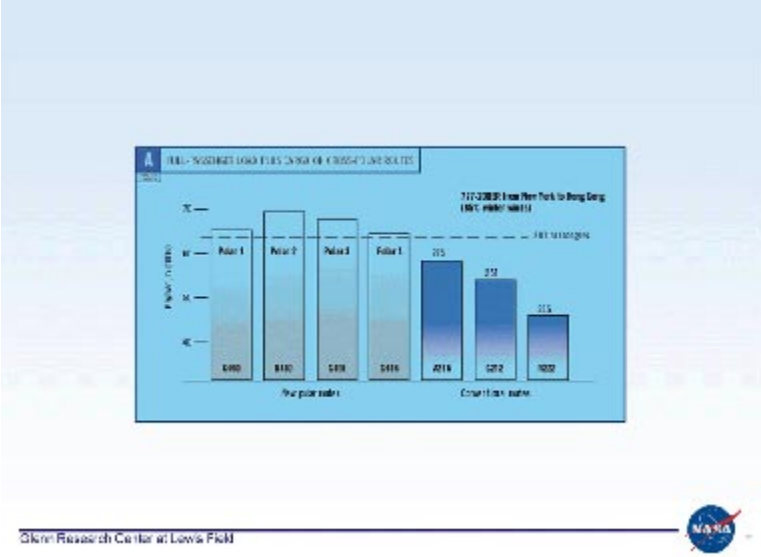

Fig. 1: Chart illustrating improved aircraft capacity provided by flying the polar routes. Figure produced by Boeing.
(click for larger image)

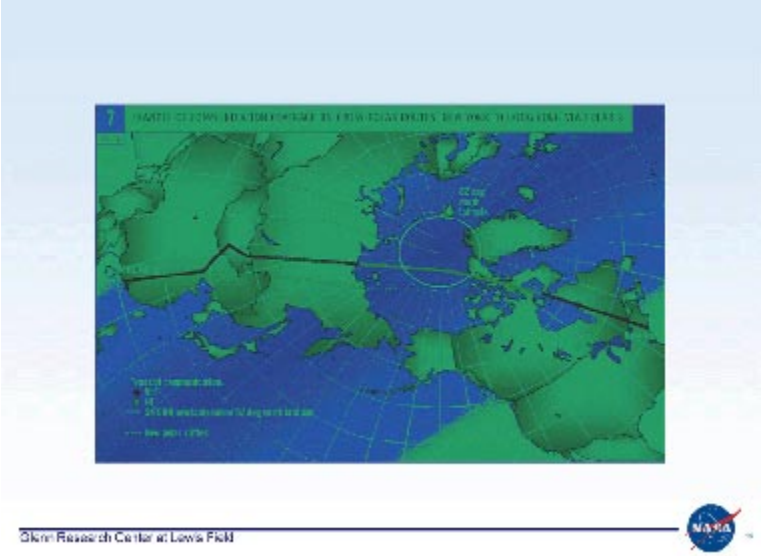

Fig. 2: Polar Route from New York to Hong Kong depicting VHF, HF and Satellite coverage areas. Figure produced by Boeing.
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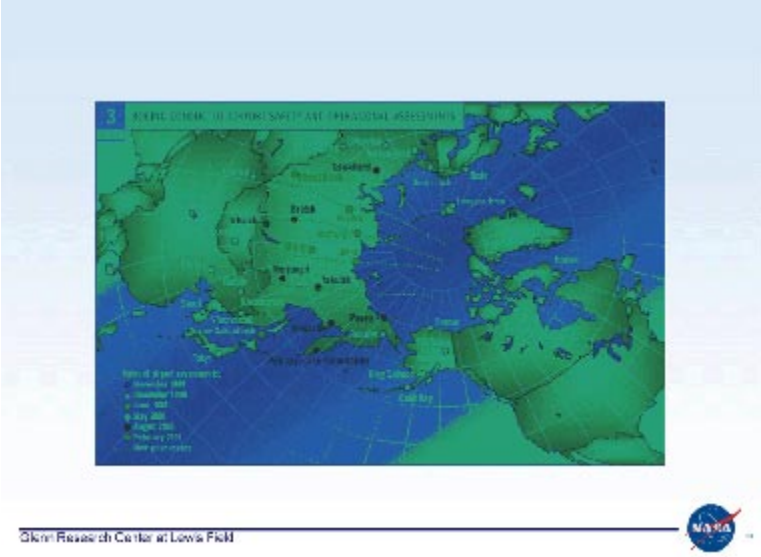

Fig. 3: Emergency landing sites in four different countries that benefit from global SATCOM connectivity. Figure produced by Boeing.
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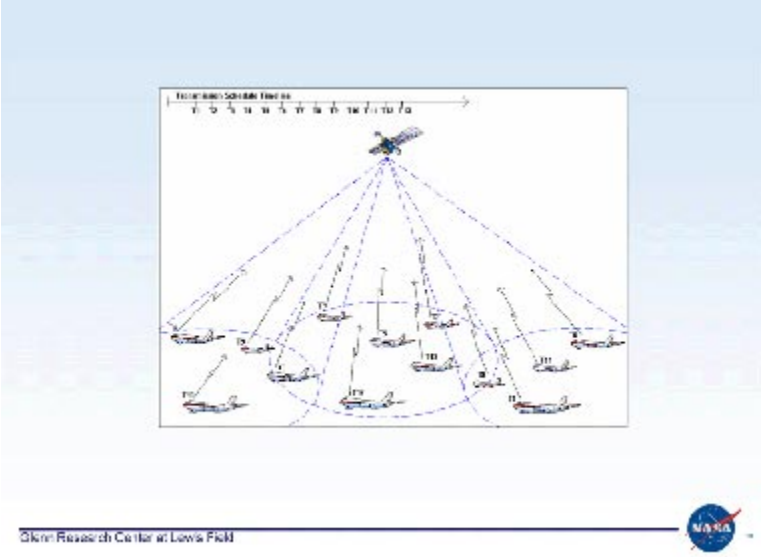

Fig. 4: NASA Glenn concept for transmitting ADS messages via SATCOM.
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