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AERONAUTICAL TELECOMMUNICATION NETWORK PANEL

WORKING GROUP 2

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Policy-controlled Route Initiation over the Mode S Subnetwork

Working Paper

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SUMMARY

During the previous meeting of WG2, two proposals to amend the sections on route initiation were presented. The proposals were to add a balanced mode of route initiation, and to require ATN BIS's to establish subnetwork connection **in all cases** following join event reception by the subnetwork. For the Mode S subnetwork, this would be in contrast to the current situation where the ground router initiates Mode S subnetwork connection and IDRP connections based on the local knowledge as to whether this is appropriate or not. This paper provides justification material for the existing mode of operation for the Mode S subnetwork and proposes to maintain the current mobile routing initiation approach as specified in version 3.0 of the CNS/ATM-1 Package Internet SARPs.

References:

/1/ Routing Architecture: Considerations for the Update of ATN Internet SARPs Draft 2.1, ATNP-WG2 (Rome meeting), Flimsy 6, 21 July 1995

/2/ Balanced Mode Route Initiation, ATNP-WG2 (Rome meeting), Flimsy 9, 18 July 1995

/3/ Initial Mode S Interrogator Siting Plan, EATCHIP Mode S & GDLP Project, Draft 0.C, April 1994

/4/ Interrogator Coordination and II code allocation in Europe, EASIE study report, Eurocontrol, March 1993

1. Background

During the previous meeting of WG2, two proposals to amend the sections on route initiation were presented.

a) The first proposal (Ref. /2/) was to add a balanced mode of route initiation, where both, airborne as well as air/ground routers initiate a mobile subnetwork connection.

b) The second proposal (Ref. /1/) aimed at requiring an airborne and air/ground ATN BIS to establish mobile subnetwork connection **in all cases** following join event reception by the subnetwork. Main argument for the proposed modification was for increasing the network robustness by increasing the connectivity probability for the purpose of emergency or distress communication. For the Mode S subnetwork, this would be in contrast to the current situation where the air/ground router initiates routing based on the local knowledge as to whether this is appropriate or not.

The first proposal, although allowing such enhanced functionality in future subnetworks, puts no additional requirements on the subnetworks already standardized, and was thus accepted by the WG. The second proposal was rejected by the working group for a number of reasons, including

- potentially unnecessary increase of the amount of exchanged data (subnetwork connection management data, BIS-BIS connection management data, and routing information), since the aircraft may be not at all under actual or future control of the ATS provider operating the mobile subnetwork and the corresponding routing domain, to which the subnetwork is attached. Nevertheless, a subnetwork connection and potentially a BIS-BIS connection will be established and this routing information has to be distributed via the ground subnetworks of that particular ATS organisation. This has an impact on costs, potentially without possibility to recover these costs from the airspace users (since they are controlled via another ATS organisation);
- unavailability to distinguish between normal and emergency or distress communication, i.e. once the subnetwork connection and the route have been established, they cannot be reserved for particular types of communication; if a route is known as being available, the data traffic can only be separated based on service quality, traffic type and local policy.
- undetermined effect on the transponder availability and thus on the **surveillance quality**, and on the SSR RF environment, without having a clear requirement for this;

Nevertheless, it was agreed by the working group that inputs regarding the proposal in Ref. /1/ and its associated action may be prepared for consideration during next meetings, i.e. working group meetings or CCB. This paper provides such an input and explains in more detail why this proposal is not acceptable in the anticipated European Mode S environment.

2. Two-fold function of Mode S

Within the future ATC environment, Mode S will fulfill a twofold function:

- surveillance (or even enhanced surveillance), where aircraft positions are measured at, and aircraft data are extracted by the interrogator, and both are submitted to the controller in the form of target report messages;
- communication, where the Mode S subnetwork serves as air-ground-subnetwork, either stand-alone, or in an ATN environment;

At least for the next few years until the existing or planned/contracted radar stations have not exceeded their limit of life time, the surveillance function will have to stay the dominant

function of SSR Mode S for ATS purposes. In some regions, e.g. in central Europe, concepts for the use of Mode S for Enhanced Surveillance (with the view on full subnetwork funtionality) have been defined, and clearly support the use of Mode S as an ATN air-ground subnetwork.

Basic operational requirement for transitioning from conventional SSR to Mode S is that the surveillance quality (i.e. probability of detection [Pd], accuracy etc.) is not degraded, which implies that data link activity must not become the dominant factor for transponder occupancy. Unfortunately, in particular the Pd for SSR targets is directly dependent on the interrogation rate, i.e. the number of messages transferred within the Mode S subnetwork (uplink). Careful consideration of benefits as well as side effects of Mode S link utilization has to be taken when putting additional requirements on the subnetworks.

3. Probable Mode S Subnetwork Scenario in the European Environment

Although neither final implementation plans by the national administations nor ultimate results from studies are available yet, a probable scenario within the European environment shall be given to illustrate the problem. Within the former EASIE programme of Eurocontrol, a number of concepts concerning the future siting of Mode S interrogators in the European core area had been developed. Even aiming only at a global twofold coverage above FL 100 and in the major TMAs, more than a dozen interrogators having one particular target under coverage will not be untypical in the core area (see Fig. 1).

Given that a one-to-one or one-to-few relationship exists between the GDLP(s) and these interrogators, and given that subnetwork connectivity is established in all cases, as proposed in Ref. /1/, the aimed benefits of increased network robustness is achieved at the expenses of proliferation of subnetwork connections with the adverse effect of heavily increased (overhead) traffic in the Mode S subnetwork. Thus, if subnetwork connection being established in all cases, regardless of whether the aircraft is under control of the respective ATS authority or not, and BIS-BIS connections being established on an as-needed basis, judged by the aircraft, has a significant effect on the amount of additional link control and routing information.

4. Operational Aspects

First point with respect to the difficulties with the proposed method is as follows: From an operational point of view, the population of aircraft is divided into two categories: either the aircraft is under control, and the "own" center (resp. sector) has the responsibility for it, or it is outside the own responsibility, being controlled by another sector/centre/administration.

Of particular relevance here is the case where an aircraft is outside the control area of own administration, but flying in the coverage of own interrogators. For example, a flight from Brussels to Amsterdam is well inside the coverage of German radars, but of no particular interest. Within Europe, due to the close neighborhood of control sectors, several of such examples can be found.

Second point is the cost factor: Air Traffic Control is re-imbursed for its services; the users (i.e. the airlines) accept to be charged for control service actually performed by ATS during the transition through a particular control area. It appears difficult to impossible to request charges from non-users, as it would be the case for the example above.

Third point is finally, that up to now no strong requirements for such a revised mobile routing initiation approach has been given.

5. Conclusion

The Mode S Subnetwork has been designed to be ground initiated, and the establishment of subnetwork connections and BIS-BIS connections over this subnetwork to be controlled by local policy on the ground. The reasons for this decision has been again explained within this paper. The proposed revised mobile routing initiation approach has the risk for the case of the Mode S subnetwork to unnecessarily impact on the surveillance function of SSR Mode S and on the investment necessary for the ground subnetworks. In addition, from an operational point of view, it is not justifyable.

6. Recommendation

The working group is invited to note the material addressing the impact of the proposal contained in Ref. /1/. In light of the rationale presented within this working paper, the group is requested to confirm its decision from the previous meeting, i.e. not to accept the proposal of a revised routing initiation approch for the Mode S subnetwork.

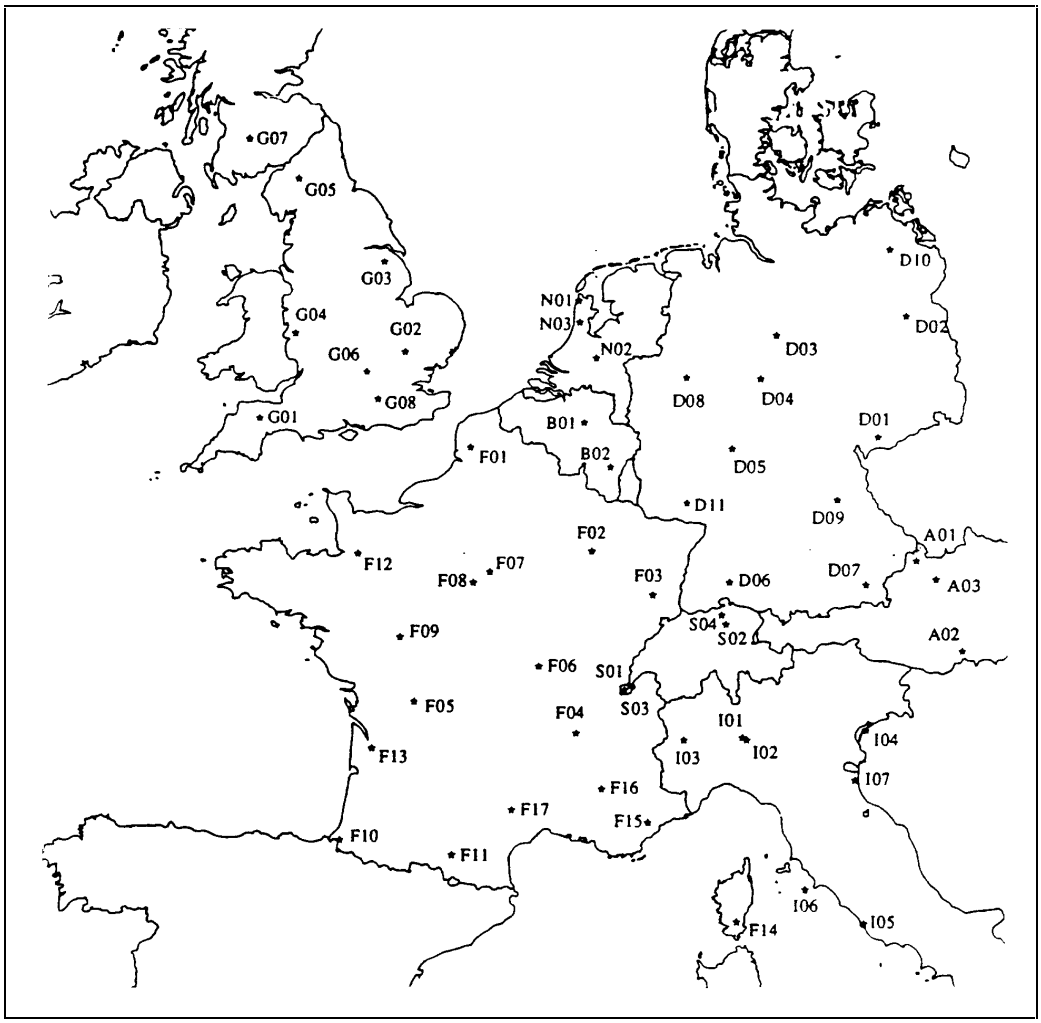

Fig. 1 Proposed Mode S Interrogator Siting in core Europe for at least double coverage above FL 100 and in major TMA's (from Ref. /3/)

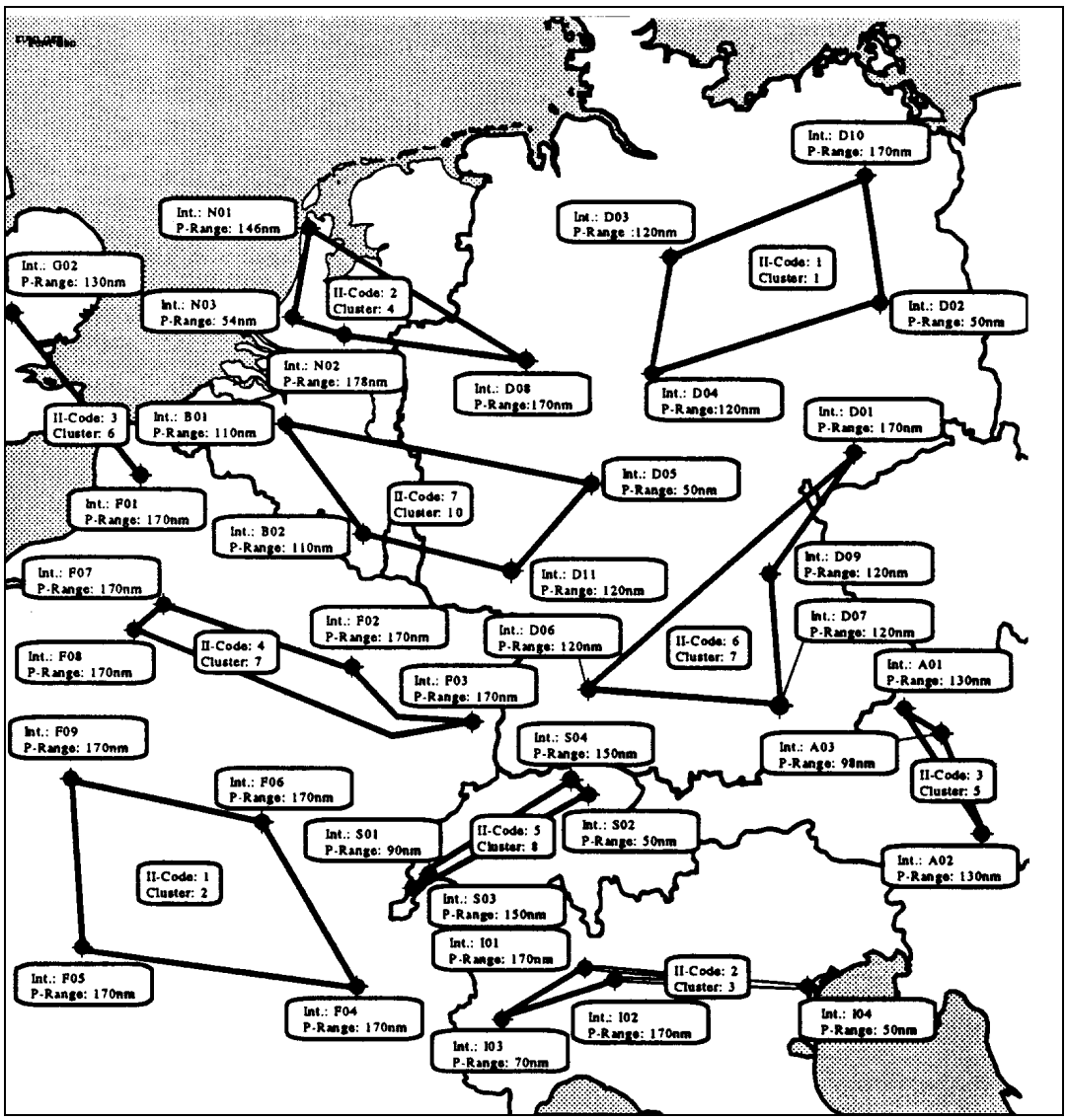

Fig. 2 Proposal for Mode S Interrogator Clustering (4 interrogators per cluster) in the central area of Europe (from Ref. /4/)