WP/ASP 06-11
Agenda Item 4.4
20. – 24. April 2009

AERONAUTICAL SURVEILLANCE PANEL (ASP) WORKING GROUP MEETING

6th Meeting

Louisville, Kentucky, 20 – 24 April 2009

Military activities of Mode S implementation in Germany

(Prepared and presented by Franz-Josef Voißel)

Summary

This paper provides a survey of Mode S implementation activities in the German forces such as a new level of Mode S Cluster operations, established distance criteria's for mobile and maritime interrogators and an actual list of the German transponder equipage.

German Air Force Command

Section A 6 d

Military State Report Germany

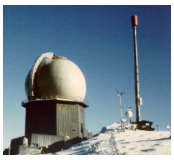
1st Lt. Franz-Josef Voißel

German Military Mode S Implementation Program

6 Stationary Air Defence Radars
(Cluster is operational)

2 Deployable Air Defence Radars

23 Military Airbase Surveillance Radars



Interrogator on Ships

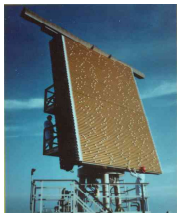
Transponder

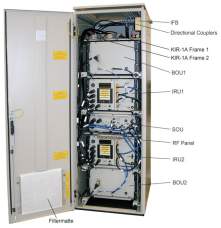
Stationary Air Defence Radars

Capability: **ELS and EHS**

Operating Mode: **Decentralized Clustering, Distributed Mode**

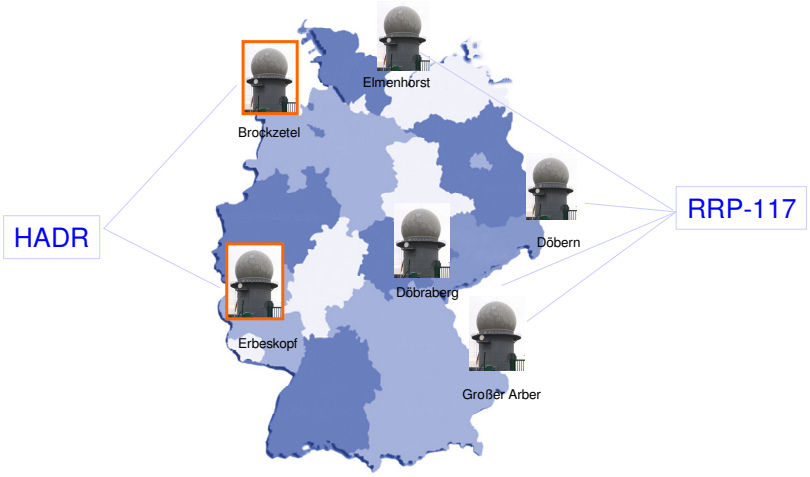
II-Code 13
SI-Code 13 (Fallback Code)



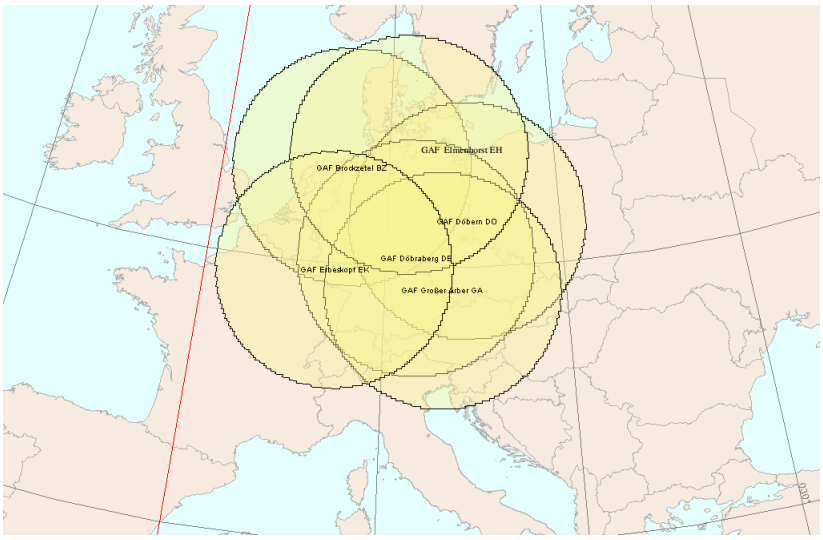


The stationary long range (about 250 nautical miles) air defence radars are part of the military air surveillance system in Germany. 18 radars are on service and 6 stations are modified to use Mode S. These 6 radars are operating with the same interrogator identification code in a decentralized Cluster.

Air Surveillance Mode S Radarstations

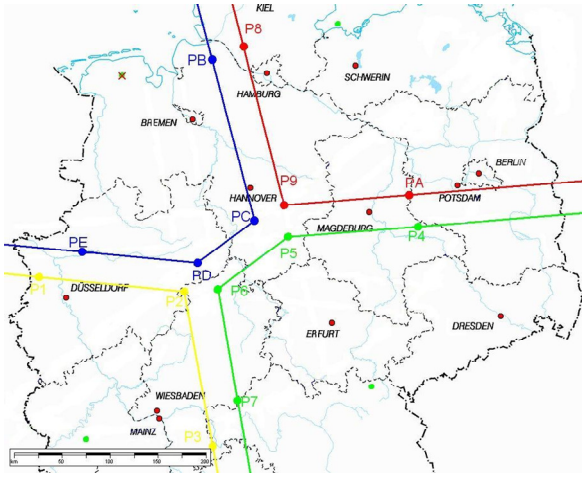


Mode S Radar Coverage II 13



Quite 1/3 of Germany is covered 6 times. So we need additional measurements to reduce the high frequency load produced by multiple interrogation processes.

Detection Deconfliction by Mapping

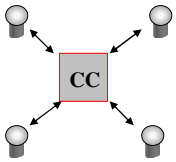


For the intermediate time without cluster controller we established a special mapping to solve the problem of locking out targets of neighbours.

Within the surveillance maps we reduced the lock out map and established lock out free zones - the space between the colour lines on this slide. This feature was suitable for 3 to four interrogators, but not feasible for 6 interrogators.

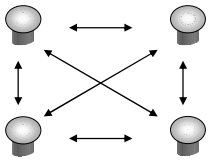
The ability of 6 SSR Radars working together with overlapping coverage and the same II Code required Clustering.

Principals of Clustering



Centralised Cluster (Central Mode)

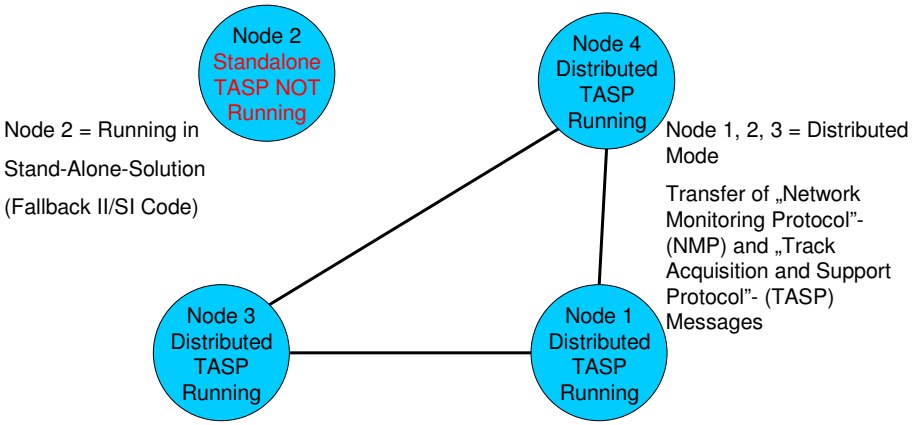
- High data rate to and inside Cluster Controler (CC)
- Arrangements for CC outages
- Less expensive



Decentralised Cluster (Distributed Mode)

- Moderate data load
- Outage Resistance

Mode S Clustering – Distributed Mode



The basic idea of „distributed mode" is a mutual support of each node (or radar) within the coverage and acquisition of aircraft by handing over tracks on in-flight of neighbour-node-coverages.

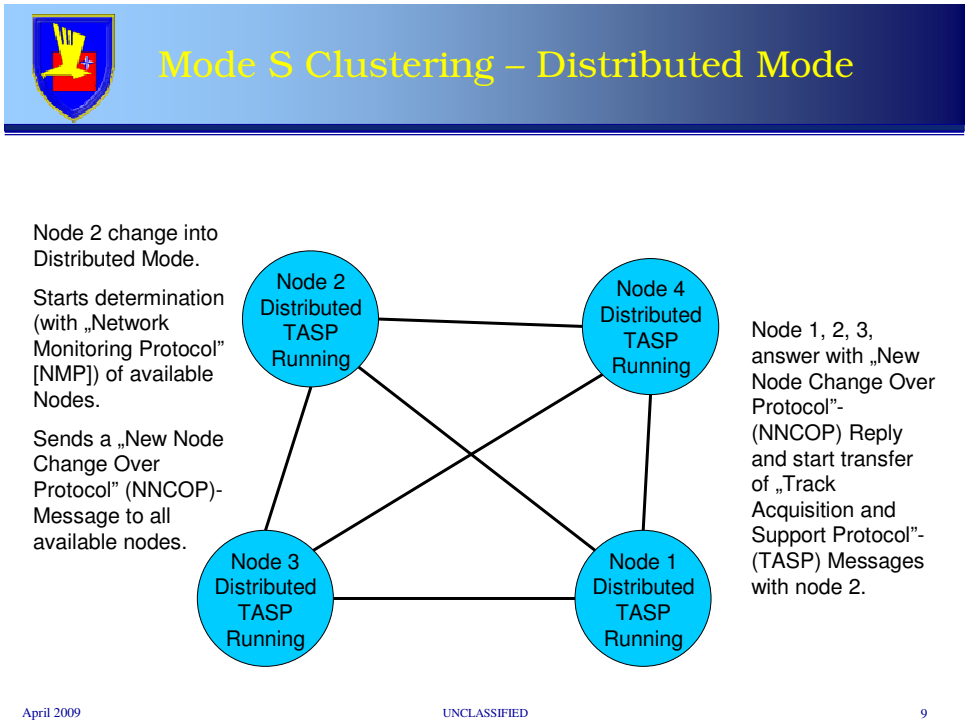
→ So there is no further need of Lockout free-Zones

The cluster-network-communication (SCF ASTERIX Cat 017) consists essentially of three Messages:

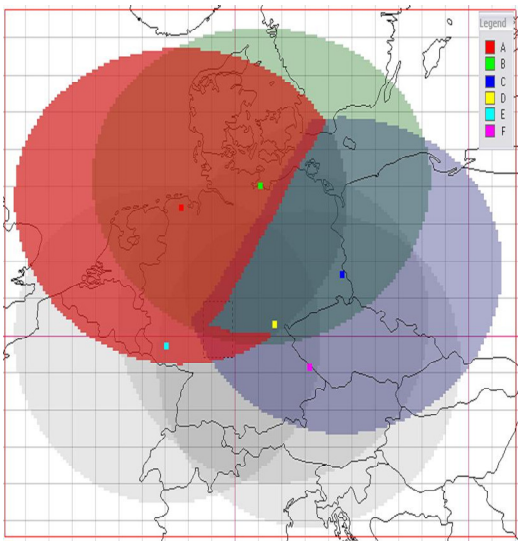
1. NMP - Network Monitoring Protocol: network- and node-observation with map-solution-management

2. TASP – Track Acquisition and Support Protocol: which compare track-lists in overlapping areas including conflict-management (detection of double- or fail-tracks and support by other overlapping node) and guarantee a safe track-handover.

3. NNCOP – New Node Change Over Protocol: hands over all new tracks, when a stand-alone-node change into distributed mode



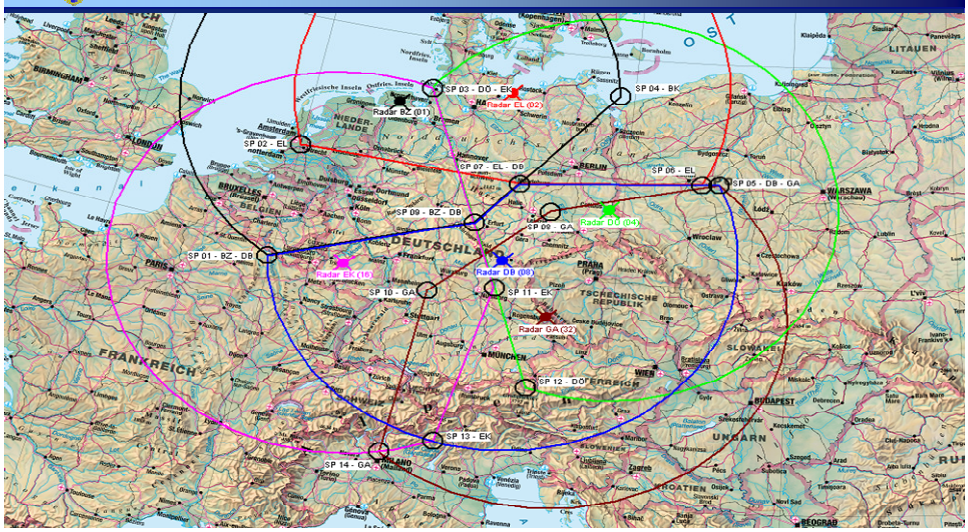
Cluster Mapping



- Cluster capability is described by Maps
- Outages of radar lead automatically to map-change
- Each possible combination is one Solution
- 6 Radar = 2^6 Solutions
  = 64 Solutions

Decentralized Clustering is based on dynamic Coverage Maps. Outages of a radar leads automatically to a map-change, so all possible solutions and maps have to be defined before. Without Clustering quite 1/3 of Germany is covered 6 times, which means a very high transponder utilisation. To reduce the high frequency load produced by multiple interrogation processes, we had to define new cluster maps which are not correspond to the origin surveillance maps. These maps establish maximum interrogation by normally two, but never more than three radar stations. Further you have to guarantee a redundant acquisition in all flight levels, so you have to take the geographical conditions into account.

Full-Operational Cluster-Map



Capability: ELS

Operating Mode: Stand Alone

II-Code 0

2 Radars scheduled operational in 2009

This sensor is designed for out of area operations, but it is also usable as gab filler when we have planed outages of radars in Germany. This mobile sensors will operate in II Code = 0. Regarding to II Code = 0 we investigate the impact of mobile military Mode S interrogators on the performance of civil SSR sites.
We analysed frequency-compatibility and system-capability of civil SSR-Systems and military IFF-Systems under consideration of mutual interaction in dense Scenarios.
The study found out, that significant problem's occur in those areas, where we have overlapping of side loops of interrogators.

Therefore we have to establish distance criteria's for mobile interrogators, to minimise multiple side loop overlapping.

These criteria's are going to be regulations in the “Order for Electronic Identification”

German NAVY Interrogator on Ships

Capability: ELS and EHS

Operating Mode: Stand Alone

II-Code 0

7 Fast Patrol Boats (10 planed)
5 Frigates (15 planed)
2 Corvettes (5 planed)
(3 Supply Vessels planed)
1 Training Facility

The German navy has build up a Mode S capability by installing interrogators on 6 fast patrol boats and 3 frigates. 5 further corvettes are planed to by equipped in the near future. For the time being these ships are operating in the Mediterranean area.

For foreseen operation on the German shore we have to establish adequate distance criteria's in the “Order for Electronic Identification” as for mobile land-interrogators.

Military Airbase Surveillance Radars (ASR-S)

Capability: ELS and EHS
Operating Mode: Stand Alone
(in future: Decentralised Clustering)

SI-Codes with Lockout-Maps

1 Radar under testing

23 Radars scheduled from 2010-2015

Mode S - German Military Aircraft

Type	Mode S Equiped (31.03.2009)	Not Equiped (31.03.2009)
Fighter (without EF 2000)	60,5 %	39,5 %
Helicopter	57,6 %	42,4 %
Transporter	15,0 %	85,0 %

For the use of military aircraft with non-conform transponders in Germany we have special arrangements with the ministry of transport. For missions outside Germany we need an exchange of transponders or the permission of the states we fly in.

Radar Site Großer Arber

Questions?

Thank's for your attention!