

Supporting
European
Aviation



Mode S Downlinked Aircraft Parameters WG 4th Meeting (ICAO APAC DAPs WG/4)

Agenda Item 3

Sharing of State's implementation on Mode S and related issues in APAC region

EUROCONTROL

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MICA (Mode S IC Allocation)

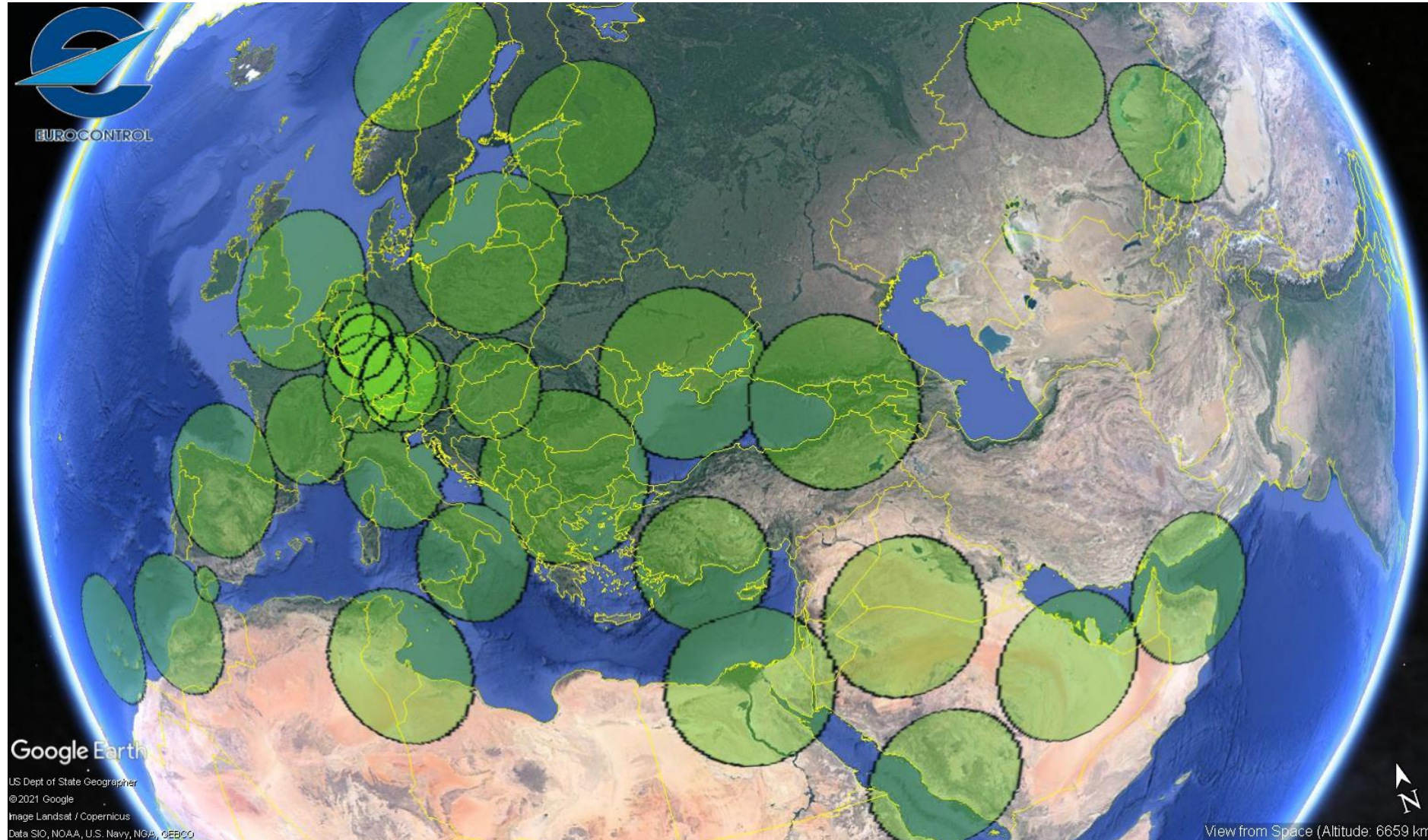
29 March 2021



Required IC Allocation Coordination

- For the safety of the air traffic surveillance system, the coverage of two Mode S radars operating on the same IC shall not overlap (except for radars operating in cluster).
 - Mode S radars with overlapping coverage shall operate on different ICs
 - A radar operating on a wrong IC can create an IC conflict and prevent one or several other Mode S radars to reliably detect incoming traffic
- ➔ **The allocation of Interrogator Code to Mode S radar needs to be coordinated**
- An Interrogator Code (IC) allocation grants a Mode S radar to operate
 - on a given **IC**
 - **within a given coverage** (surveillance and lockout coverage)
- ➔ Due to the limited number of Interrogator Codes (IC) and to avoid any IC conflict, it is necessary to have a **centralised Mode S IC allocation**

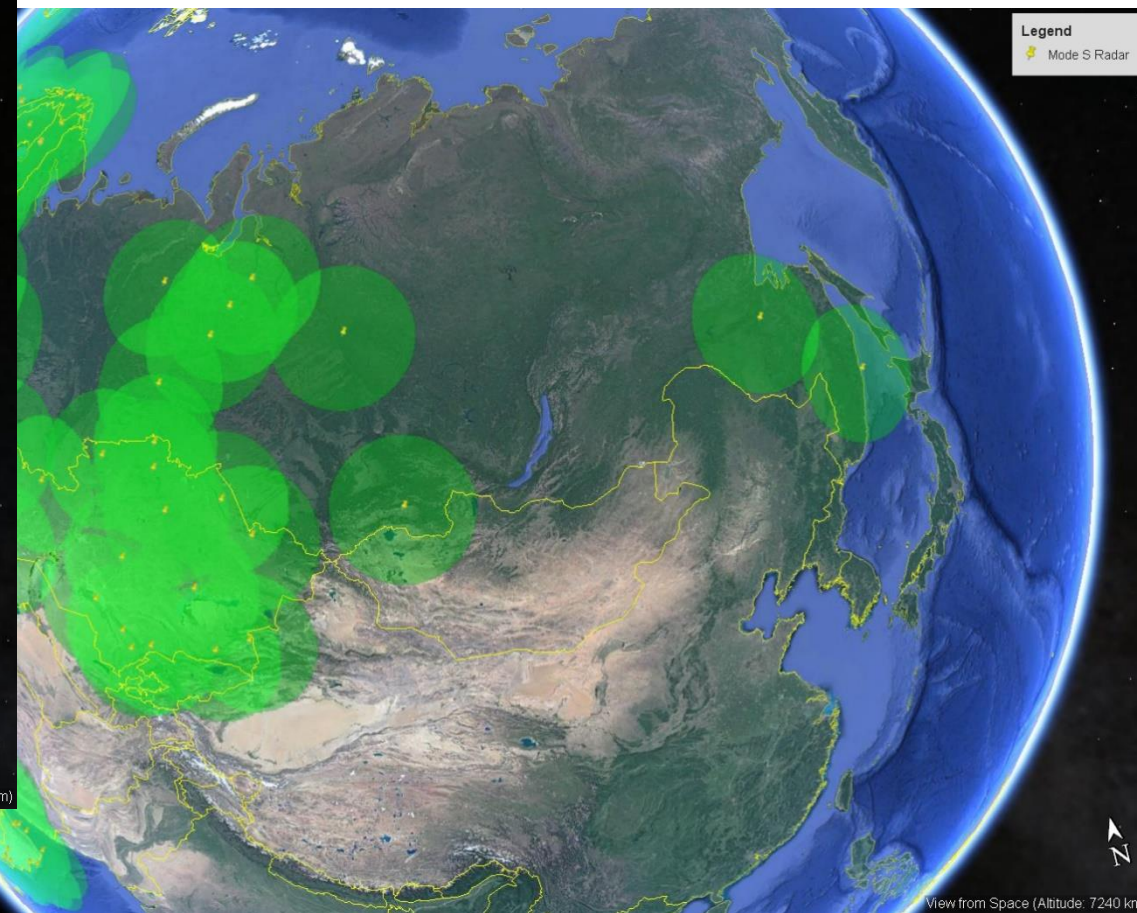
Example - IC allocations on II 11 (Surveillance coverage)



IC Allocation Coordination in ICAO EUR and ICAO MID

- **EUROCONTROL MICA (Mode S Interrogator Code Allocation) Cell** coordinates the allocation of Interrogator Code (IC) to civil and military Mode S radar, with a fixed position, in the **ICAO European region** on behalf of the **ICAO European Regional Office**.
- **EUROCONTROL MICA (Mode S Interrogator Code Allocation) Cell** supports the **ICAO Middle-East Regional Office** for Mode S Interrogator Code allocation in the **ICAO Middle-East region**.
- **EUROCONTROL MICA Cell:**
 - operates the centralised Mode S IC allocation system
 - provides the centralised Mode S IC allocation service through the MICA website:
 - For all fixed Mode S radars in ICAO EUR and ICAO MID region
 - Issued IC allocations contain the Interrogator Code (IC), the surveillance and the lockout coverage that have to be programmed in the Mode S radars.

IC allocations in ICAO EUR and ICAO MID regions (720 Mode S radars in February 2021)



European Governance

- Development of MICA Process
 - Development needs identified in December 2002 during the 44th meeting of European Air Navigation Planning Group (EANPG 44)
 - In 2011, “European Principles and Procedures for the allocation of SSR Mode S Interrogator Codes (IC)” transferred from the ICAO EUR ANP (Doc 7754) to ICAO EUR DOC 024.
 - EUROCONTROL Specification for the Mode IC Allocation Coordination and IC Conflict Management
- Commitment of participants to facilitate cooperation between countries
 - ICAO EUR process
 - Regulation in the European Union (EC No 262/2009)
 - requirements for the coordinated allocation and use of Mode S IC for the single European sky
- Collaborative Decision Making
 - EUROCONTROL MICA Cell operates the centralised Mode S IC allocation system
 - Dedicated group to review and manage the allocations → MICoG (Mode S Interrogator Codes Co-ordination group)

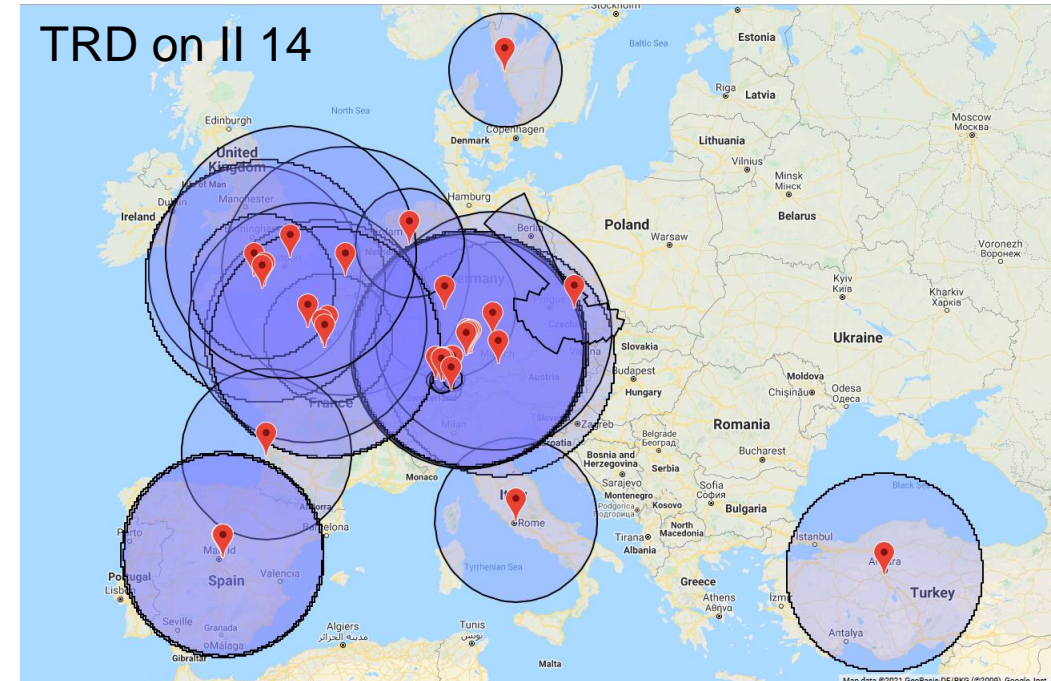
Agreement with ICAO MID regional office

- In 2011, the ICAO MID Regional Office requested EUROCONTROL to formally provide support for Mode S Interrogator Code allocation in ICAO MID region.
 - MICA Cell will support the ICAO MID Regional Office, with the same standard bi-annual MICA cycle as that for Mode S radars within EUR region.
 - IC allocations in ICAO EUR region and in ICAO MID region are processed together
 - ICAO MID Regional Officer CNS will coordinate directly with the MICA Cell for all countries in MID region.

Which Mode S interrogators?

- Fixed Mode S civil radar
- Fixed Mode S military radar
- Test, Research & Development radar (TRD) operated by industry/research institutes

- No IC allocation (= operation on II Code 0) to:
 - mobile Mode S radars
 - WAM/MLAT
 - IC allocation not needed for operation as no All-Call interrogations, no lockout and no multisite datalink
 - However operation on II<>0 is accepted for monitoring

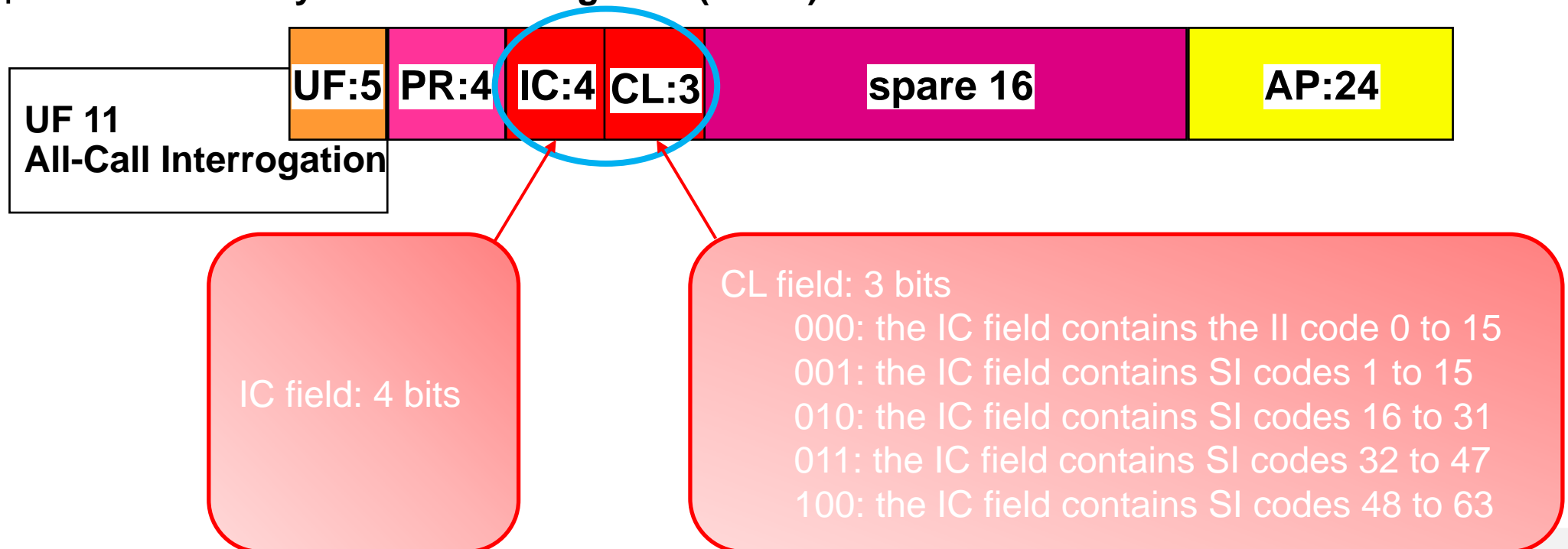


Which Interrogator Codes?

- An Interrogator Code (IC) is either:
 - Interrogator Identifier code (16 II codes: II code 0 to II code 15)
 - Surveillance Identifier code (63 SI codes : SI code 1 to SI code 63)
- II 0 reserved for mobile interrogators
 - II 0 and SI codes matching II 0 (SI 16, SI 32, SI 48) not allocated by MICA Cell
- II 14 and SI codes matching II 14 (SI 14, SI 30, SI 46 and SI 62) allocated to Test, Research and Development (TRD) Mode S radar in ICAO EUR and ICAO MID region
- II 15 and SI codes matching II 15 (SI 15, SI 31, SI 47 and SI 63) reserved for military operations in ICAO EUR region (managed by military) → recommend for worldwide use
- 13 II codes (II 1 to II 13) and 52 SI codes (matching II codes 1 to 13) allocated to operational Mode S radars by MICA Cell

II Code / SI Code Encoding

- Mode S interrogations:
 - II code encoded in **IC field** (4 bits – 0 to 15)
 - SI codes encoded in **IC field** (4 bits) + **CL field** (3 bits)
- Example - **Mode S Only All-Call Interrogation (UF 11)**



II and SI Codes Allocation Strategy

- SI code capable Mode S transponders recognize IC field and CL field (II and SI code)



Issues

- Not all Mode S transponders are SI code capable
- Mode S transponder not SI code capable recognizes only the IC field (matching II code only)
- In ICAO EUR region, II codes and matching SI codes are allocated to Mode S radar with overlapping coverage
 - Special mode of operation → Mode S radars have to enable the **II/SI code operation**
 - To acquire on the matching II code the aircraft which are not SI code capable, but no lockout
- In ICAO MID region, II codes and matching SI codes are not allocated to Mode S radar with overlapping coverage:
 - IC allocations on II codes are removed in order to allocate the 4 SI codes matching the II code
 - Mode S radars operating on **SI codes** have to enable the **II/SI code operation**
 - To acquire on the matching II code the aircraft which are not SI code capable, but no lockout

Users of Mode S IC Allocation Service

- **Mode S Operator:** a person, organisation or enterprise operating or offering to operate a Mode S radar, including:
 - Air navigation service providers;
 - Mode S interrogators manufacturers;
 - Airport operators;
 - Military authorities;
- **Focal Point:** a person representing a competent State or an international organisation applying for interrogator codes, who is responsible for the coordination of all matters concerning the IC allocations between the EUROCONTROL MICA Cell and the Mode S Operators in his area of oversight.
- **ICAO MID Super Focal Point:** ICAO MID regional officer who coordinates the IC allocation in the ICAO MID region

Overview of MICA Process

- 1. Mode S Operators** operating a Mode S radar for which no IC has been allocated, have to submit an IC application (IC allocation request) before starting Mode S transmission
 - IC applications have to be submitted a least one year before the planned date of first Mode S transmission on the MICA website
 - 2. Focal Points** have to check the validity of the IC applications submitted by Mode S Operators in their area of oversight.
 - 3. EUROCONTROL MICA Cell** has to:
 - Process submitted IC applications within the adequate MICA Cycle or in Ad-Hoc, on the basis of the planned date of first Mode S transmission, and
 - Propose IC allocations
 - 4. Focal Points** have to review the proposed IC allocations and accept them
 - 5. EUROCONTROL MICA Cell** has to issue the accepted IC allocations on the MICA website, where they can be retrieved by Mode S Operators and Focal Points.
- + **MICA users** can report IC conflicts on the MICA website

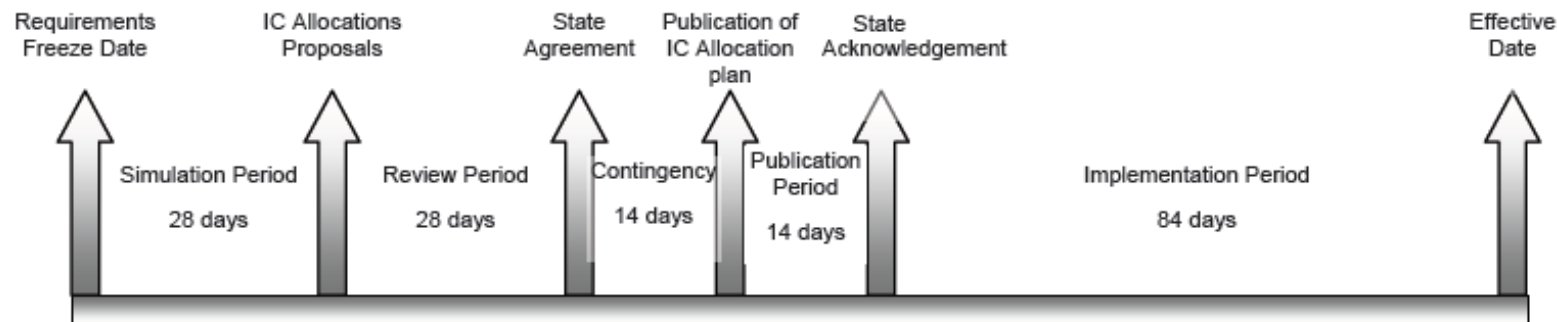
IC Allocation Process in MICA Cycle

- ~2 MICA Cycles per year (MICA Cycle = 168 days)
- By default, IC applications are processed during a MICA Cycle

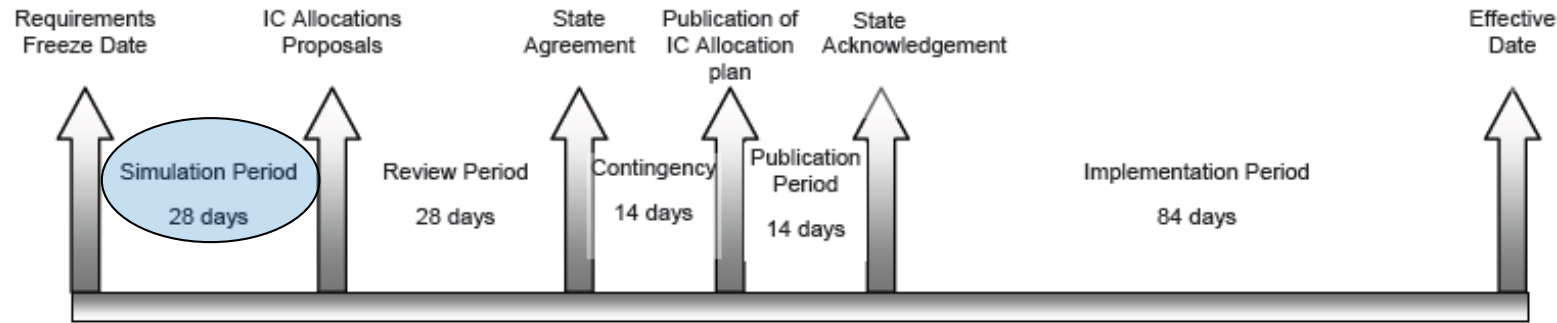


Processing of IC applications submitted on short notice or urgent request
 → Ad-Hoc process

- During a MICA Cycle, existing IC allocations may be modified to provide an IC allocation to new Mode S radars.
- Key periods of MICA Cycle:

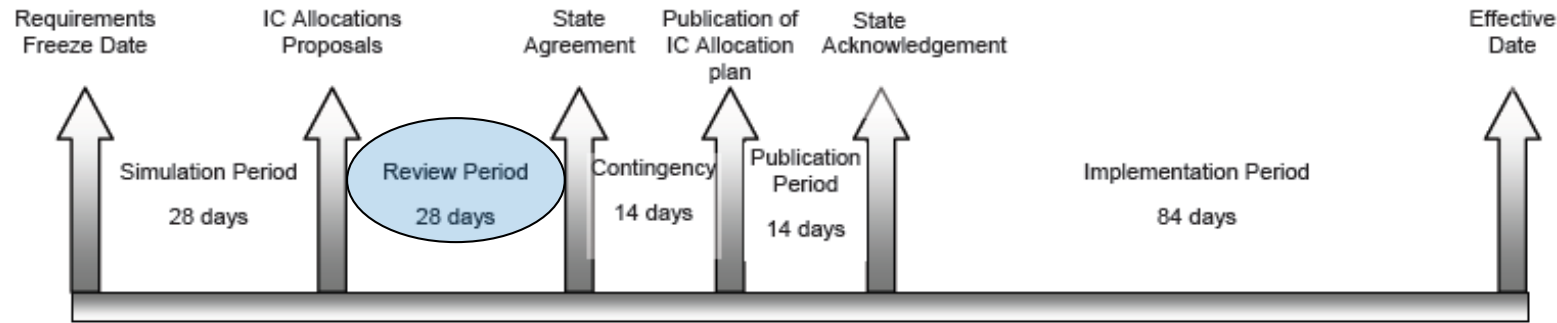


MICA Cycle Process – Simulation Period



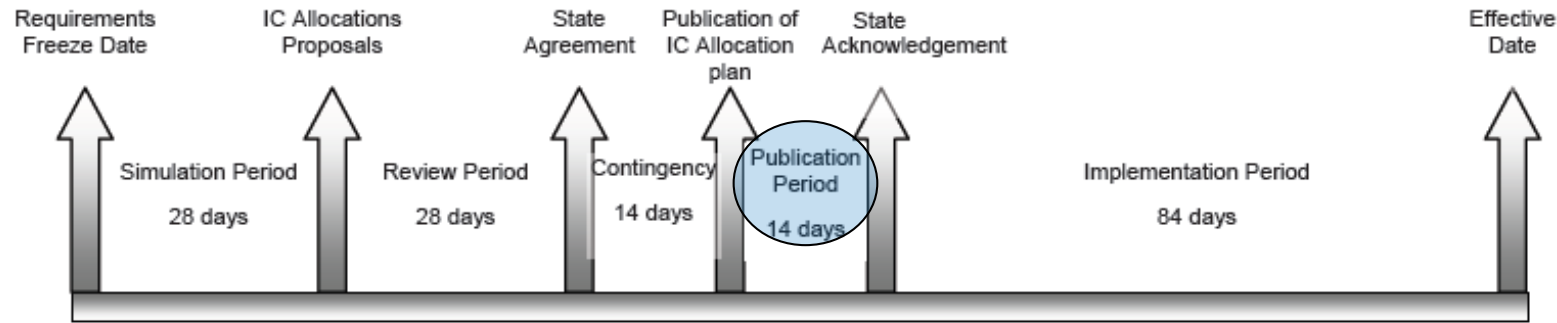
- **EUROCONTROL MICA Cell** performs interrogator code allocation plan update simulations using MICA tools (ICAT+ and SMGET) and prepares a proposed update of the interrogator code allocation plan.
- IC allocation proposals are created on the MICA website covering:
 - pending IC applications
 - changes to existing IC allocations impacted by the proposed interrogator code allocation plan update
- Proposed Implementation Sequence is provided if required
 - To identify which IC allocation programming needs to be coordinated and the order in which these IC allocations will have to be programmed in the Mode S radars.

MICA Cycle Process – Review Period



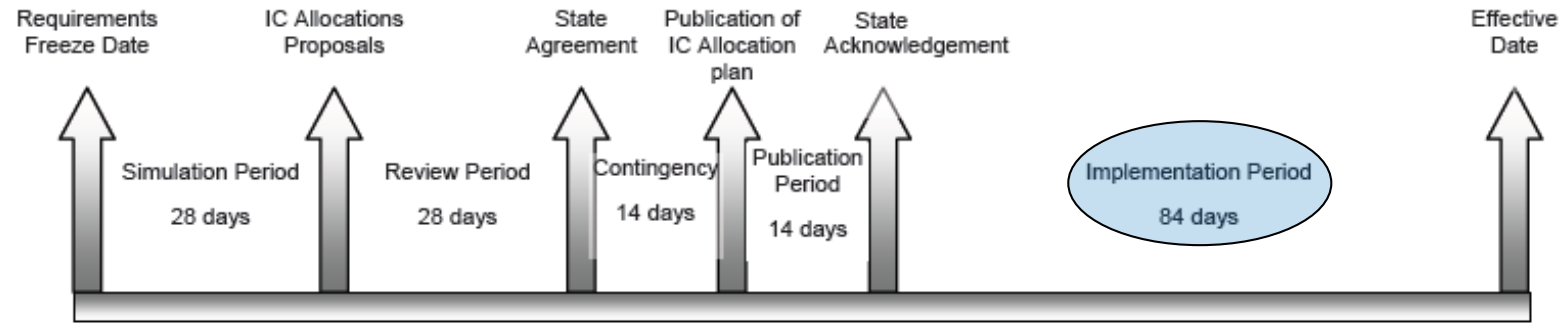
- The **Focal Points** have 28 days to review the IC allocation proposals with the impacted Mode S Operators
 - Contingency of 14 days is foreseen to extend the review period when necessary.
- The **Focal Points** have to accept or reject IC allocation proposals for Mode S radars within their area of oversight (State) before the end of the review period on the MICA website
 - Rejected IC allocation proposals may be reprocessed
- The **Focal Points** can raise an objection for IC allocation proposals outside their area of oversight

MICA Cycle Process – Publication Period



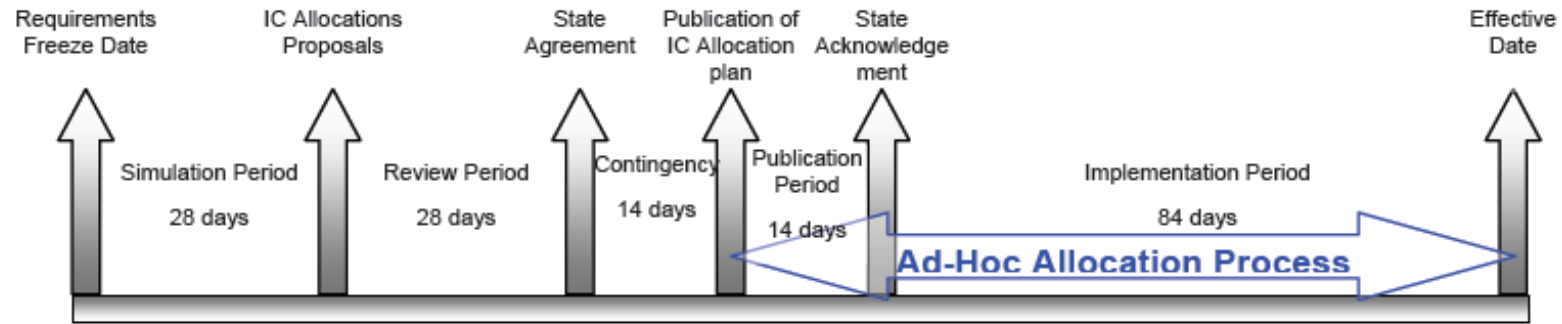
- The IC allocation proposals which have been accepted are issued.
- The Implementation Sequence (if any) is issued.
- The **Focal Points** have to:
 - Communicate issued IC allocations covering pending IC applications as well as changes to existing IC allocations to the relevant Mode S Operators under their responsibility;
 - Provide the Implementation Sequence to relevant Mode S Operators;
- The **Mode S Operators** can also retrieve the IC allocations issued for their Mode S interrogators and the Implementation Sequence on the MICA website.

MICA Cycle Process – Implementation Period



- The **Mode S Operators** have to implement all changes to existing IC allocations before the end of the implementation period.
- IC allocations issued for new Mode S radar should be programmed conforming to the planned date of first Mode S transmission provided in the IC application.
- When programming a Mode S radar, **Mode S Operators** have to comply with:
 - the allocated IC provided in the issued IC allocation;
 - the surveillance and lockout coverage provided in the issued IC allocation;
 - the Implementation Sequence (if applicable) and coordinate IC allocation programming with other Mode S Operators and EUROCONTROL MICA Cell;

Ad-Hoc Process (1)

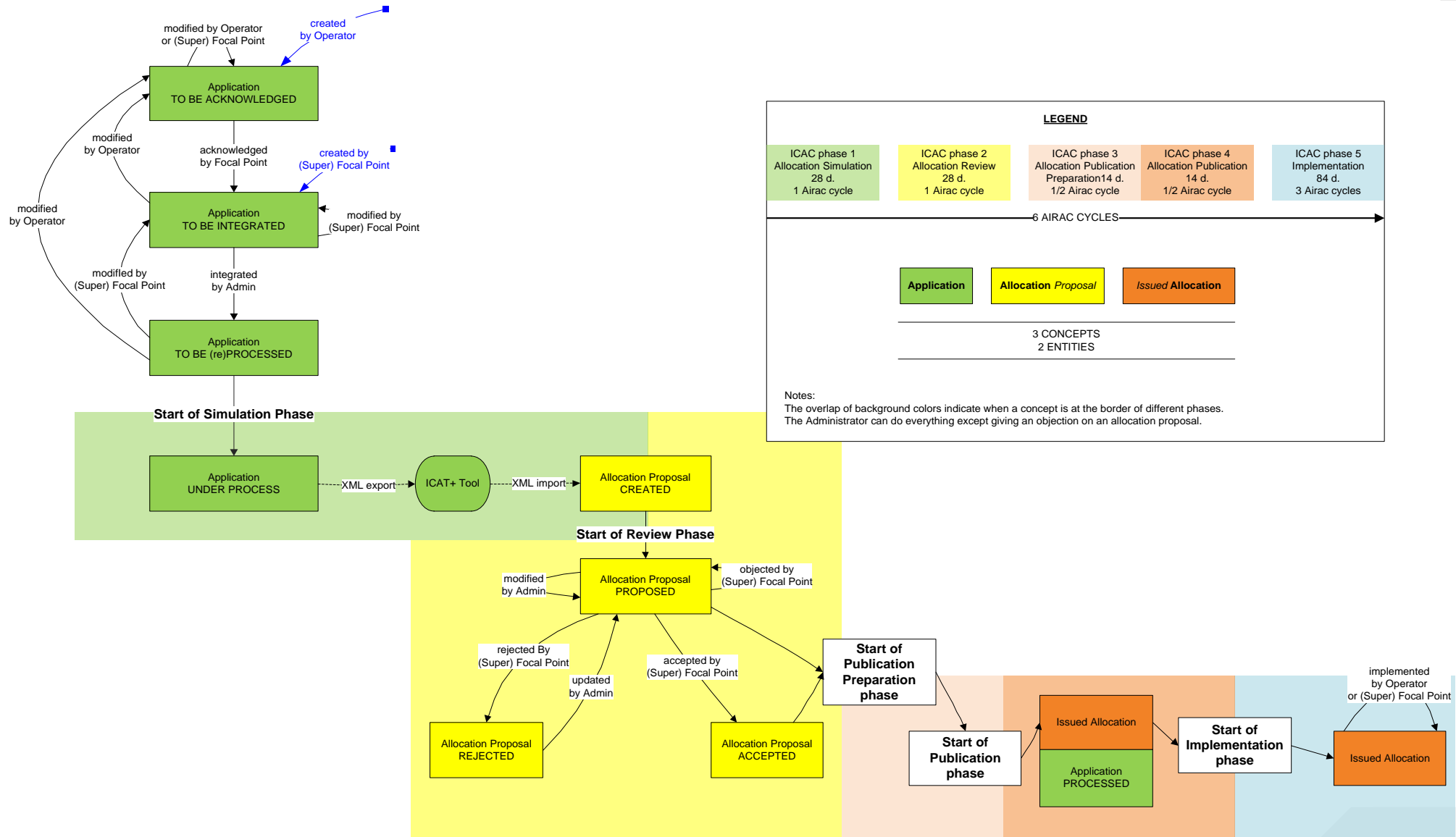


- IC applications received on short notice may be processed on Ad-Hoc basis
 - E.g. an IC allocation is requested before the next MICA Cycle
- Ad-Hoc process must not impact any existing IC allocation issued to other Mode S radar.
 - Not recommended for the processing of IC applications for operational Mode S radar.
 - No change is made to existing issued IC allocations → an IC allocation processed in Ad-Hoc may be more constraining than if processed within a standard MICA Cycle.
- Short process, typically 15 days

Ad-Hoc Process (2)

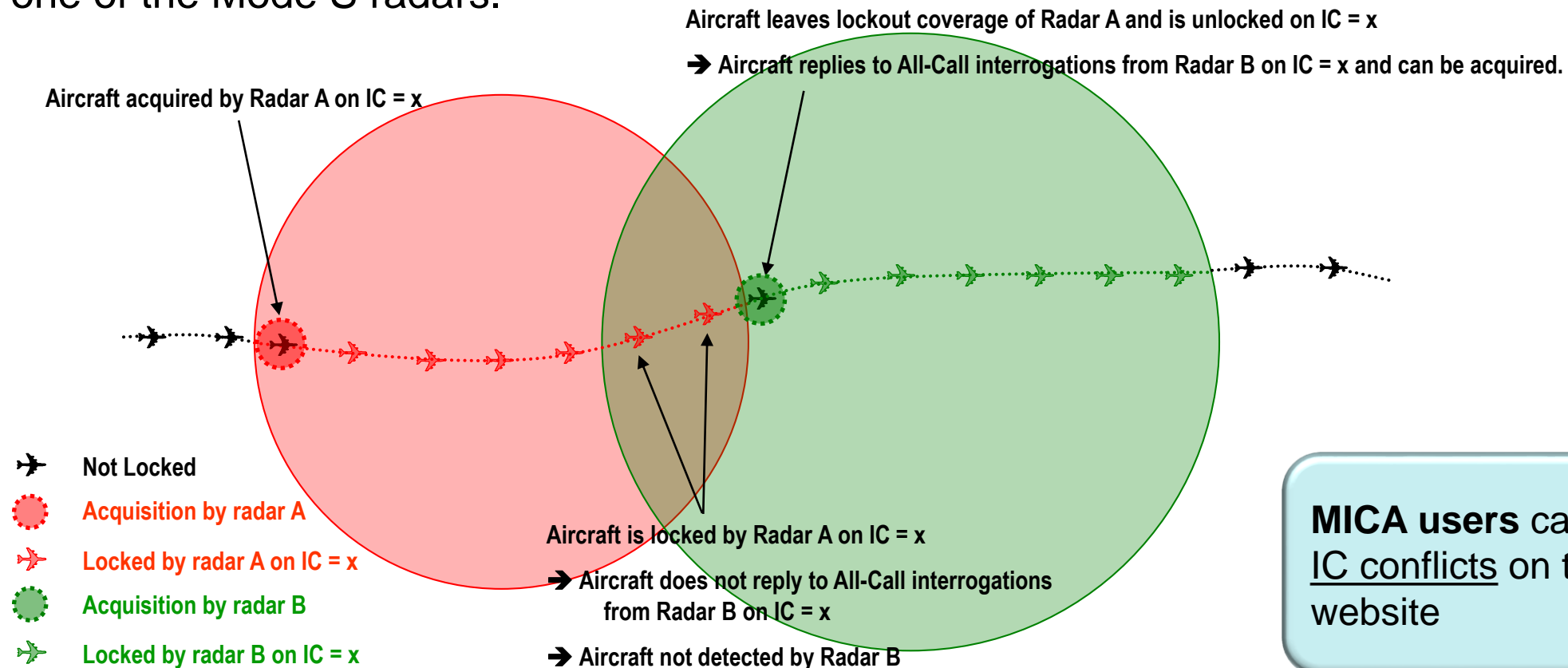
- Simulation period
 - Very short (typically one day) as existing IC allocations are not impacted
 - IC allocations are proposed at the end of the simulation period
- Review Period:
 - generally limited to 14 days.
 - **Focal Points** have to accept or reject IC allocations proposals for Mode S radars within their area of oversight (State) before the end of the review period
- IC allocations are issued at the end of the review period
 - No coordination (no Implementation Sequence) is required with other Mode S Operators as there is no change to the existing Mode S allocations
- **Mode S Operators** can program the IC allocations processed Ad-Hoc once issued by the **EUROCONTROL MICA Cell**.

Mode S IC Allocation Workflow



Interrogator Code (IC) conflict reporting

- An IC conflict is an uncoordinated overlap of lockout coverage of two or more Mode S radars operating on the same IC, potentially resulting in aircraft remaining undetected by at least one of the Mode S radars.



MICA users can report IC conflicts on the MICA website

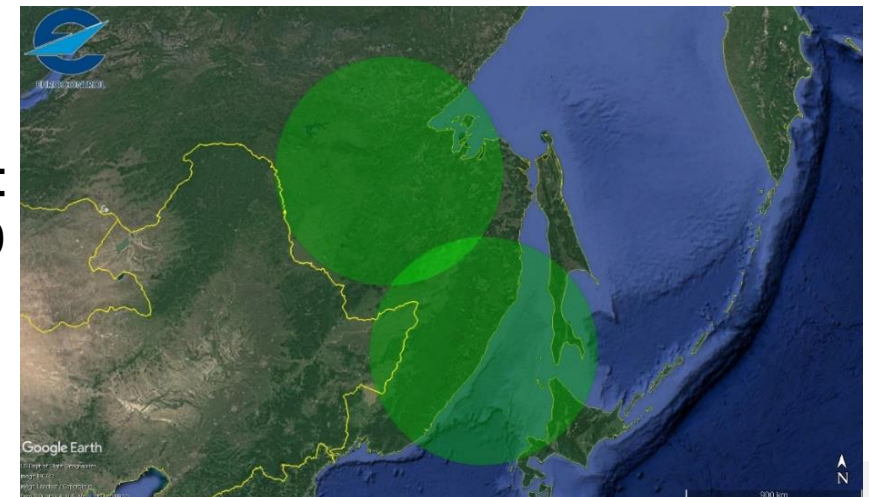
Coordination with adjacent ICAO regions

- Mode S radars are deployed in adjacent ICAO regions:
 - **Asia and Pacific (APAC)**
 - Eastern and Southern Africa (ESAF)
 - Western and Central Africa (WACAF)
- Two Mode S radars from two adjacent ICAO regions may have overlapping coverage
- ➔ **Inter-regional coordination is necessary to avoid IC conflict between Mode S radars**
 - ➔ Section 4.2.4 of Doc 9924 (Third Edition, 2020).

EUROCONTROL MICA Cell performs inter-regional coordination between ICAO EUR and ICAO MID regions

Coordination with adjacent ICAO regions (2)

- Coordination with adjacent ICAO Regional Office:
 - Only required for new Mode S radar having a coverage overlapping the adjacent ICAO region
 - Should take place before the Mode S radar starts Mode S transmission
- 2-steps coordination
 1. To identify free ICs in adjacent ICAO region that can be allocated to the new Mode S radar
 2. To confirm to adjacent ICAO region the IC and the coverage allocated to the new Mode S radar
 - This IC allocation will be recorded in the adjacent ICAO Regional Office in order to prevent any IC conflict in the future
- 2-steps coordination followed to provide an IC allocation to 2 Mode S radars in eastern Russia (ICAO EUR region):
 - ICAO APAC Regional Office contacted end November 2020 to identify free ICs for the 2 radars
 - IC allocations (IC and coverage of the 2 radars) provided to ICAO APAC Regional Office beginning February 2021.



Recommendations

The meeting members are invited to:

- Note of the centralized process applied to coordinate the allocation of interrogator codes to Mode S radars in the ICAO European region and in the ICAO Middle-East region
- Note that IC allocation coordination has been performed recently between EUROCONTROL MICA Cell and ICAO APAC regional office
- Note the need to strengthen the IC allocation coordination between EUROCONTROL MICA Cell and ICAO APAC regional office

Thank You!



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