Regional Workshop on SSR Mode S II Code and 24 Bits Addresses assignment
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MODULE 2: Assignment of Interrogator Identification Codes (II Codes) for SSR Mode S Operation

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Module 1 Headlines

I.   **Background on Mod S All call and Selective call.**

II. **Management of Mode S interrogations and responses in SSR Mode S overlapping coverage areas**

III. **Assignment of II Code to Mode S interrogators**

IV. **Frequency Finder (FF) software tools**

Objectives of the Module

Based on the limitations that can be experienced in SSR Mode S operations and the opportunities provided by SSR Mode S operation:

- **Increase States and the industry awareness on Mode S operation in coverages overlapping environment**

- **Harmonize best practices in Mode S II code assignment**

At the end of the Module, the participants will be able to request the assignment of Mode S II Codes and keep their proper record

Background on Mod S All call and Selective call.

Acquisition of all aircraft in coverage by the interrogator

1: The interrogator sends out an All-Call signal with its Identification Code (1 to 15)
2. Each A/C in coverage replies giving its 24 bits address 16 777 214 24-bit aircraft addresses)
3.   Having acquired all A/c in coverage, the interrogator   <u>selectively interrogates</u> every A/C (roll–call)

Mode S Acquisition and Lock out

Once an aircraft is " **acquired**" by the ground radar, ideally it should not reply to subsequent **All-call** interrogations.

That is why the interrogator can "**lock out**" an already detected aircraft from replying to further **All-call** interrogations.

However, the aircraft should be able to reply to **All-call** interrogations **from other/adjacent radars**.

This is why each interrogator can have its own " **I**nterrogator **C**ode (**IC**)".

Management of Mode S interrogations and responses in SSR Mode S overlapping coverage areas
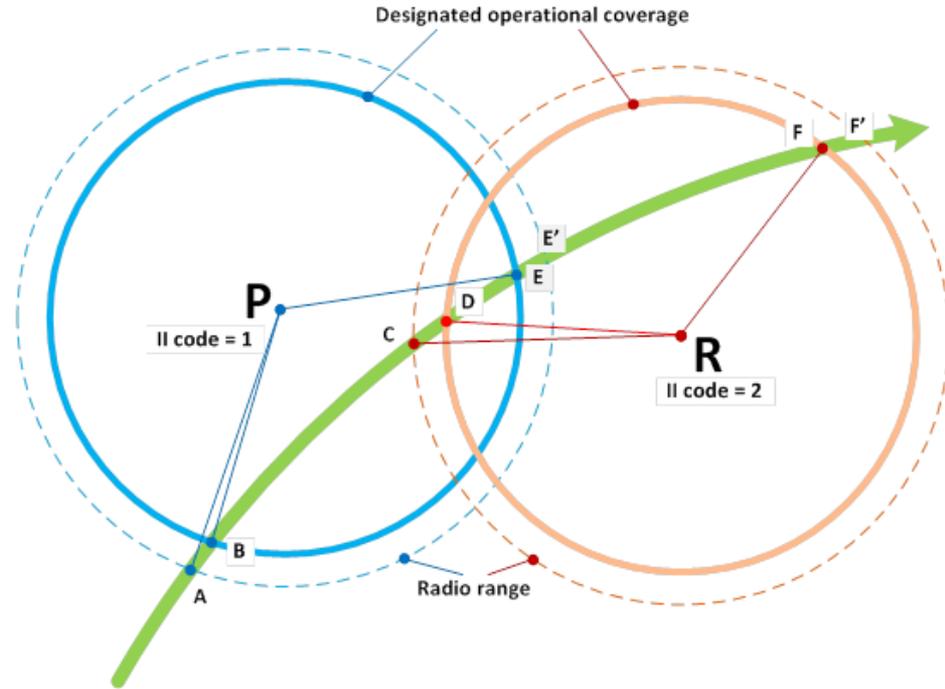
Definitions

Range: Maximum distance to the radio horizon (---- & -----)

DOC (Designated Operational Coverage): Coverage within which the station is designed to operate (— & —)

Designated operational coverage

II code = 1

II code = 2

P

R

A

B

C

D

E

E'

F

F'

Radio range

Designated operational coverage

F F'

E'
E

P
II code = 1

D
C

R
II code = 2

B
A

Radio range

Point A

A/C outside DOC of Interrogator P but within Range of P

- **Receives all-call interrogations from P**

- **Generates an all-call reply with P II code and A/C 24-bit address**

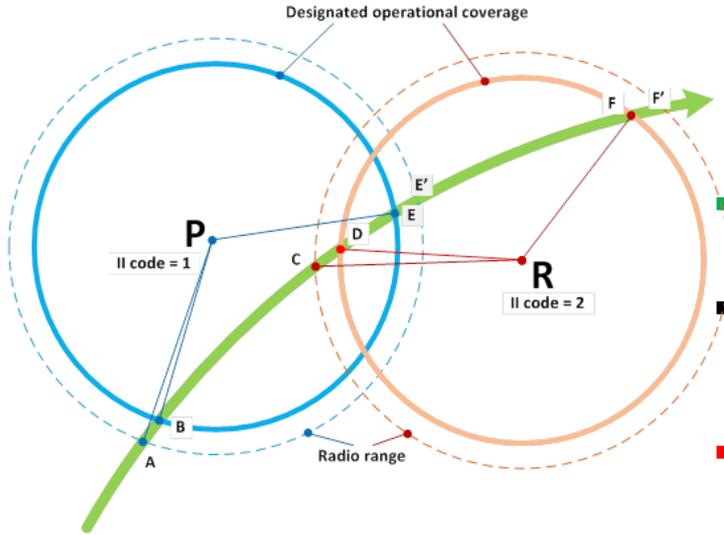- **P will not accept this reply as long as the A/C is outside its DOC**

A/C enters Interrogator P DOC

Designated operational coverage

P
II code = 1

R
II code = 2

Radio range
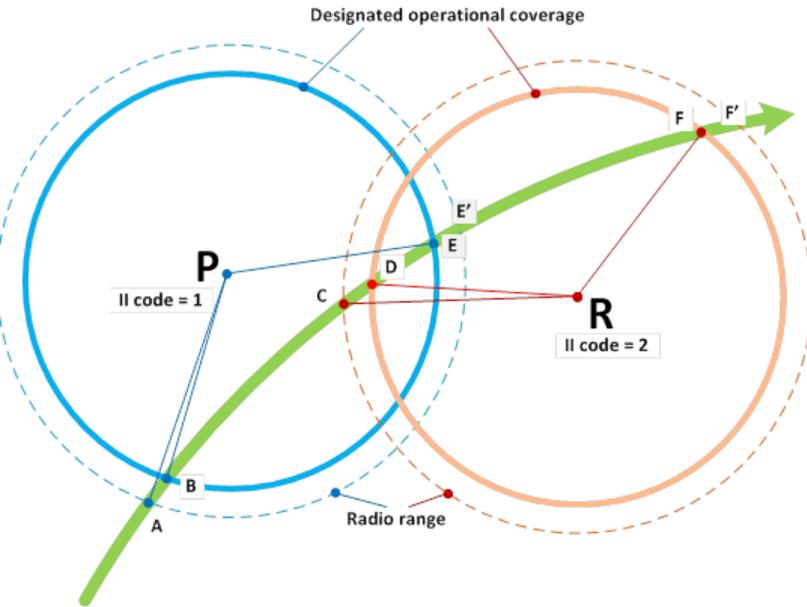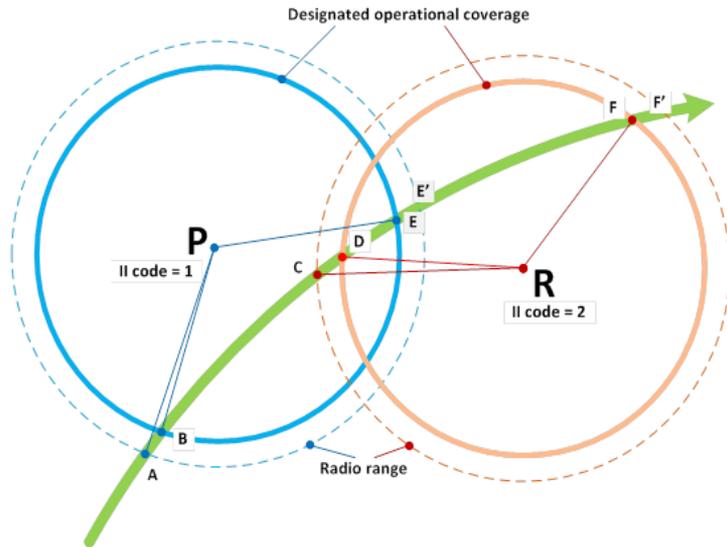
Point B

- A/C all-call reply with P II code and A/C 24-bit address is accepted by P

- A selective interrogation commanding lockout to II=1 sent to A/C

- A/C added to list of "acquired A/C" maintained by P

- A/C transponder will not respond to further all-call from P and from other interrogators with the same II code= 1.

A/C outside DOC of Interrogator R but within Range of R

Point C

- ▪ **Receives all-call interrogations from R**

- ▪ **Generates an all-call reply with R II code and A/C 24-bit address if the P &R II codes are different**

- ▪ **R will not accept this reply as long as the A/C is outside its DOC**

A/C enters Interrogator R DOC
Point D

- A/C all-call reply with R II code and A/C 24-bit address is accepted by R

- A selective interrogation commanding lockout to II=2 sent to A/C

- A/C added to list of "acquired A/C" maintained by R

- A/C transponder will not respond to further all-call from R and from other interrogators with the same II code= 2)

- A/C now acquired by P & R **will respond to their selective Interrogations**

Designated operational coverage

P
II code = 1

R
II code = 2

Radio range
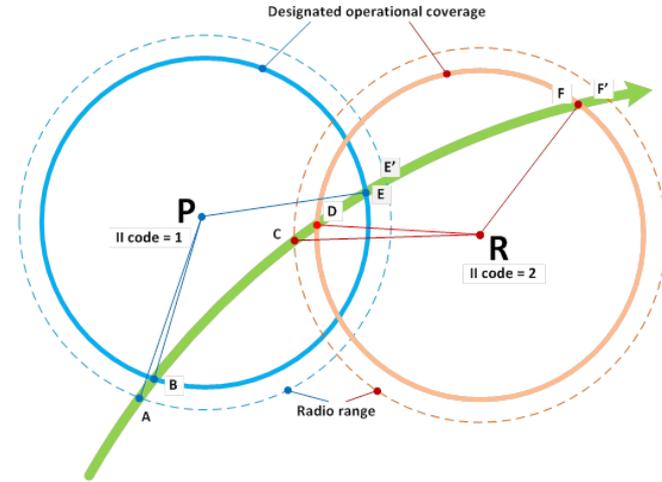
A/C outside DOC of Interrogator P but within Range of P

Point E

- **P will no longer selectively interrogate the A/C**

- **A/C will lose its lock-out status with respect to interrogator P (II=1) after a period of 18 seconds**

- **All-call replies to P will not be accepted because the A/C is outside P DOC**
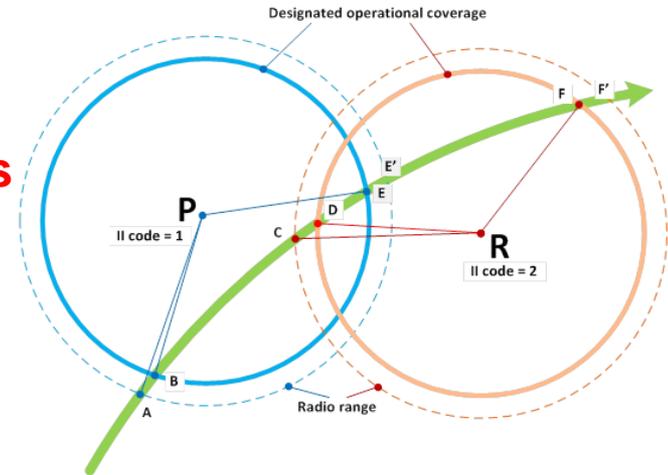
- **A/C under R surveillance only**
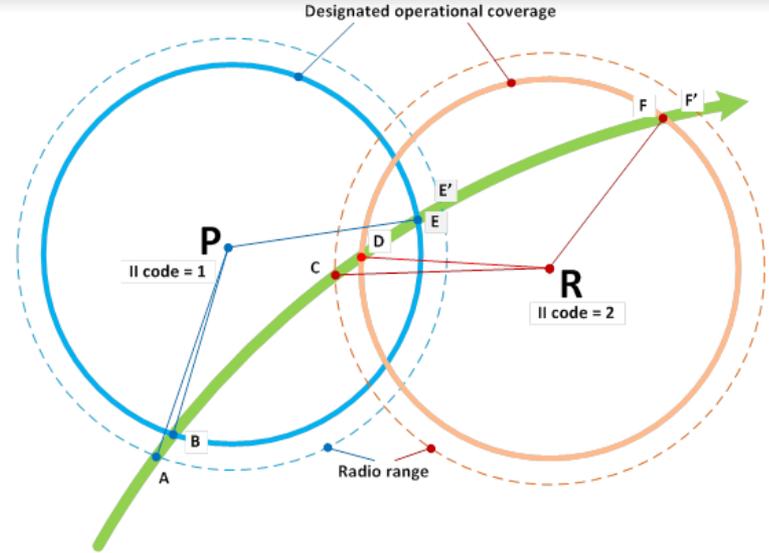
A/C outside DOC of Interrogator R
### Point F

- **R will no longer selectively interrogate the A/C**

- **A/C will lose its lock-out status with respect to interrogator R (II=2) after a period of 18 seconds**

- **All-call replies to R will not be accepted because the A/C is outside R DOC**

- **A/C no longer under surveillance of none of P&R**

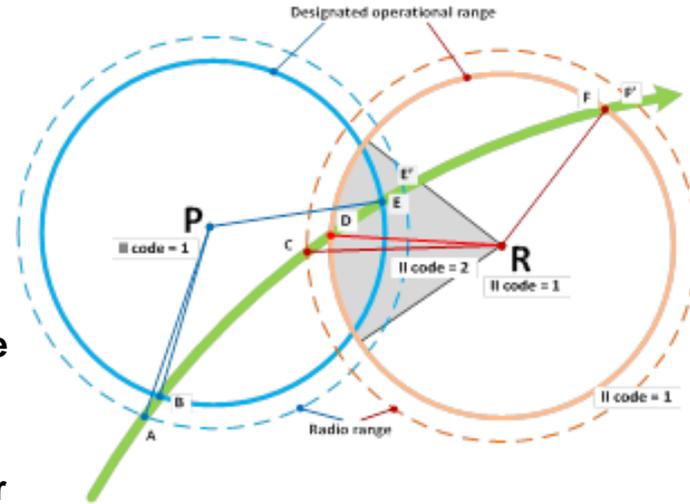# Clustering of Interrogators -Ground stations networking

- **Sharing of the same II (II=1) by SSR Mode S Stations P & R**

- **Sharing of tables of acquired A/C (24-bit Addr. & approximate acquired A/C location)**

- **Both P & R send selective interrogations to A/C and obtain valid responses**

- **Allow use of the same II by two (or more) stations with overlapping coverage areas (Clustering)**

Designated operational range

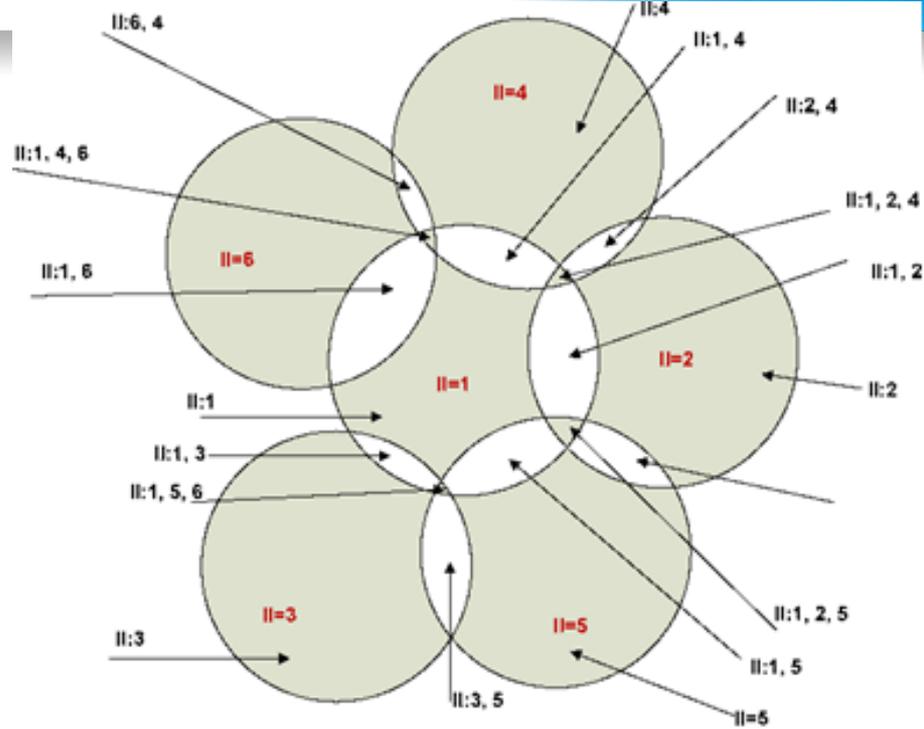P II code = 1

R II code = 1

Radio range
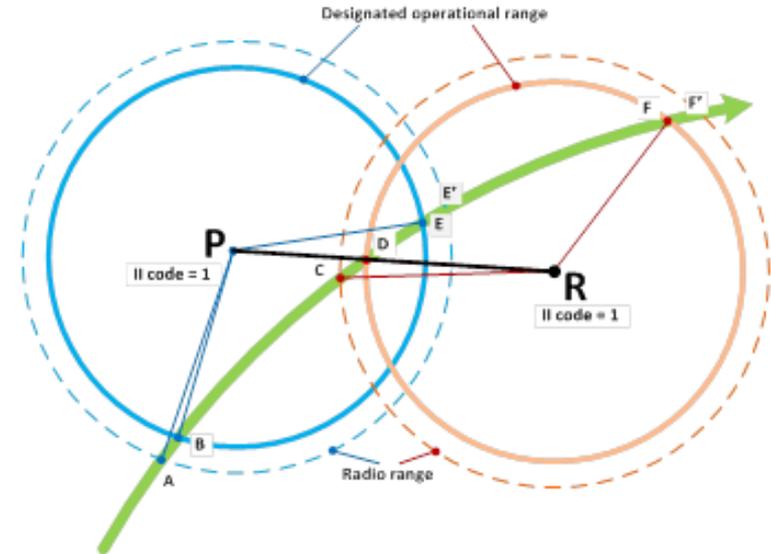
Multiple II codes by a single Mode S ground station: Sectorization (1)

- **Assignment of different II codes to different sectors of an Interrogator**

- **Sector overlapping with another Interrogator will have a different II code while (II=2)**

- **Parts coverage that is not overlapping can have the same II code (II=1)**

- **However, it is recommended to use the minimum possible number of Interrogation Identifiers by one single Mode S ground station**

Practical examples of II code assignments

II:6, 4

II:4

II:1, 4

II=4

II:2, 4

II:1, 4, 6

II:1, 2, 4

II=6

II:1, 6

II:1, 2

II=1

II=2

II:1

II:2

II:1, 3

II:1, 5, 6

II=3

II:3

II=5

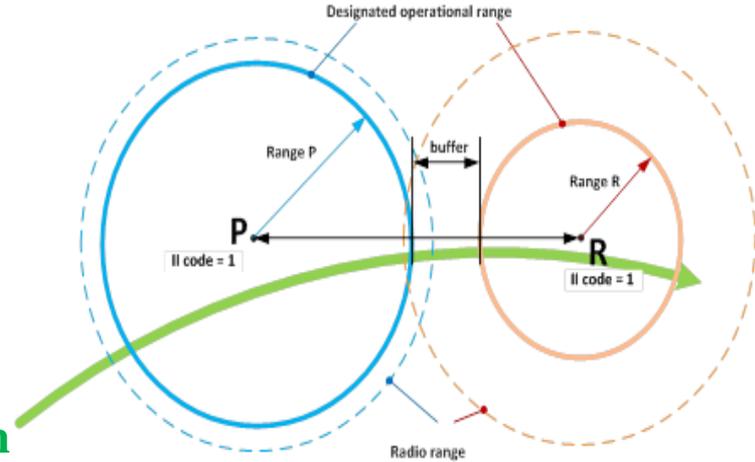II:1, 2, 5

II:1, 5

II:3, 5

II=5

II=Interrogator Identifier
II=1; Interrogator Indentifier code assigned to MODE S ground station
II:1, 2, 5: Interrogator Identifier codes used in coverage area, including overlapping areas

Planning parameters for SSR Mode S ground stations.

- **Minimum Separation Distance (MSD) between stations with the <u>same II code</u>: MSD = Range P + 10NM + Range R**

- **P & R with <u>different II codes</u>, no separation criteria need to be applied.**

Designated operational range

Range P   buffer   Range R

P   R

II code = 1   II code = 1

Radio range

Summary

- **SSR Modes S Range**

- **SSR Mode S Designated Operational Coverage (DOC)**

- **A/C 24 bits Address**

- **Interrogator Identifier code (II) four digits (1-15) code**

- **A/C acquisition principles Based on :**
  - ✓ **Range and DOC**
  - ✓ **All-call (lock out) & Selective (Roll)-call**

- **SSR Modes S II code assignment principles & techniques**

Thank you for your Kind attention !
Any Question????