EVOLUTION OF AERONAUTICAL SURVEILLANCE

By: M. Paydar
ICAO
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Aeronautical Surveillance

Airborne Surveillance

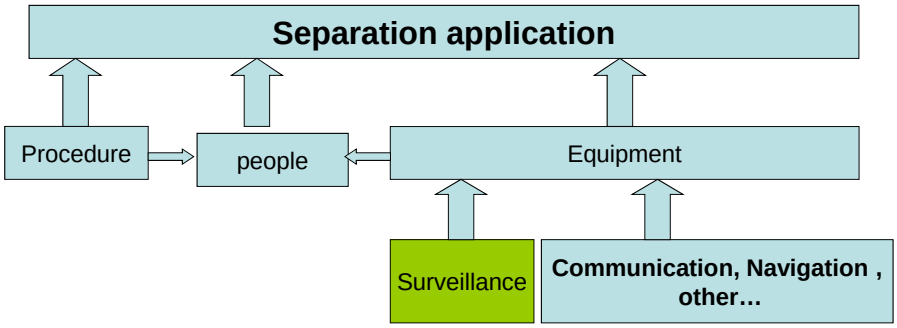
Identification

Position (at what time?)

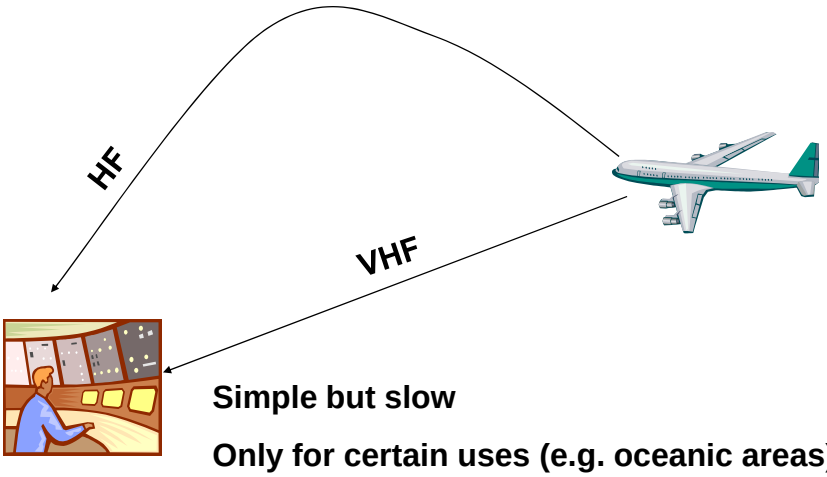
Additional info (e.g. velocity)

Ground Surveillance

Use of Surveillance



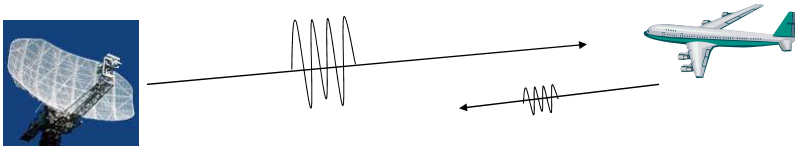
Voice Position Reporting



Simple but slow

Only for certain uses (e.g. oceanic areas)

Primary surveillance radar (PSR)

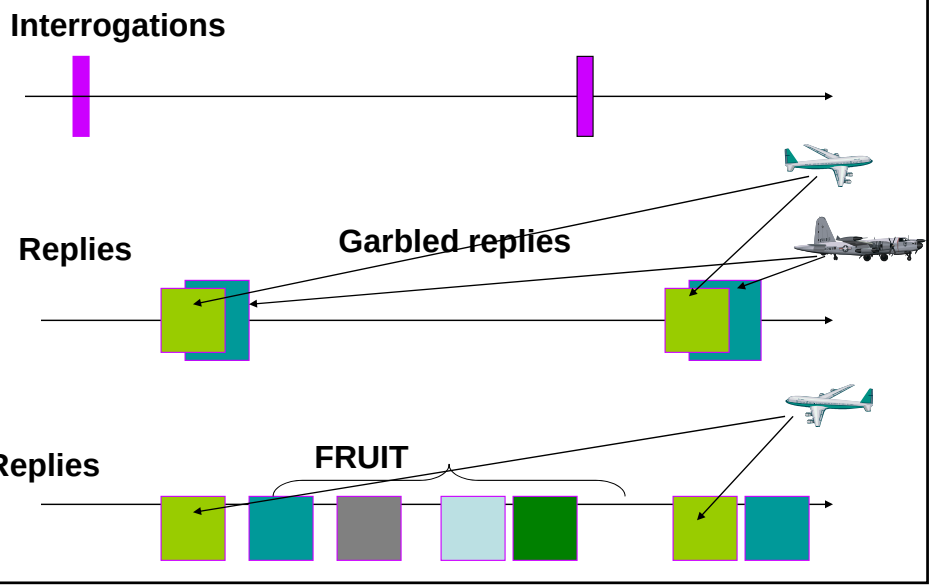


* Detects all flying objects - A/C equipage not an issue
* Doesn't provide A/C identity, altitude or other information
* Rather expensive to install and maintain – high power needed for long range is an environmental hazard
* Low update rate (once every 4 to 12 S)
* Vulnerable to interference, noise and clutter

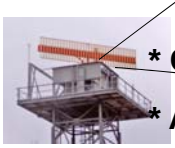
secondary surveillance radar (SSR)

* Requires A/C transponder
* Needs less power (than PSR)
* Provides information on A/C identity and pressure altitude (through Modes A and C)
* Not affected by noise and clutter
* Can suffer from garbling/FRUIT

More on SSR (Modes A and C)



SSR Mode S



Mode S: The answer to garbling and FRUIT (mainly in high density areas)

Aircraft can be selectively interrogated

* Can resolve closely spaced targets

* A/C identity and altitude protected against errors

*Can provide altitude in 25 ft increments

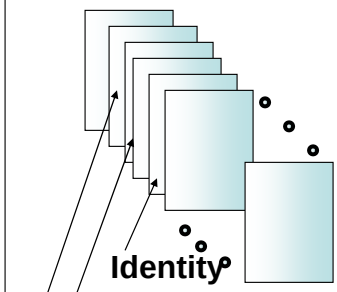
* Can provide much more A/C information

* Needs Mode S transponder (needed for ACAS)

* More complex to set up and operate

The Mode S Transponder has 256 registers

Registers (00 to FF $_{HEX}$) contain A/C information



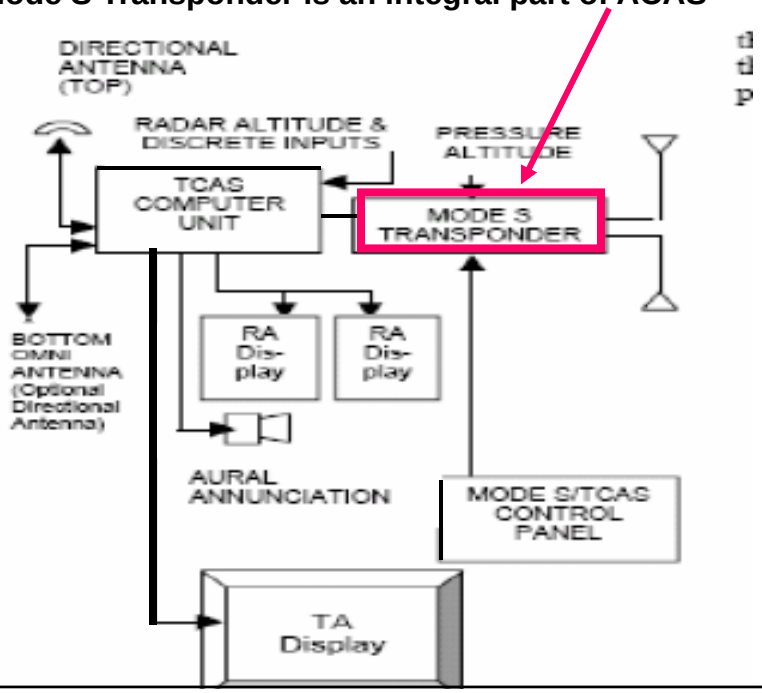
Track and Turn Report

Heading and Speed Report

Mode S transponder

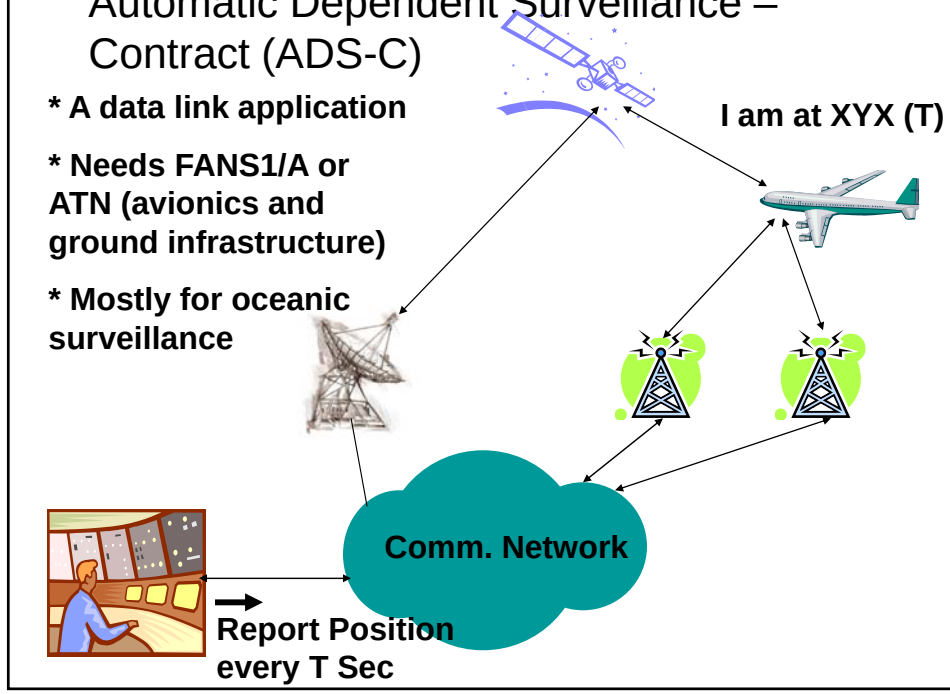
Registers enable downlinking (and broadcasting) of A/C data

Mode S Transponder is an integral part of ACAS



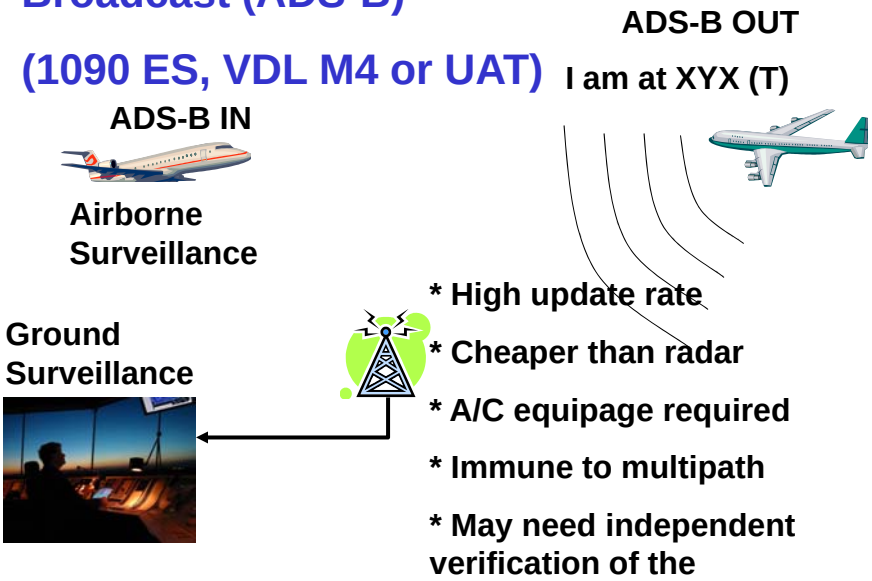
Automatic Dependent Surveillance – Contract (ADS-C)

* A data link application
* Needs FANS1/A or ATN (avionics and ground infrastructure)
* Mostly for oceanic surveillance



Automatic Dependent Surveillance – Broadcast (ADS-B)

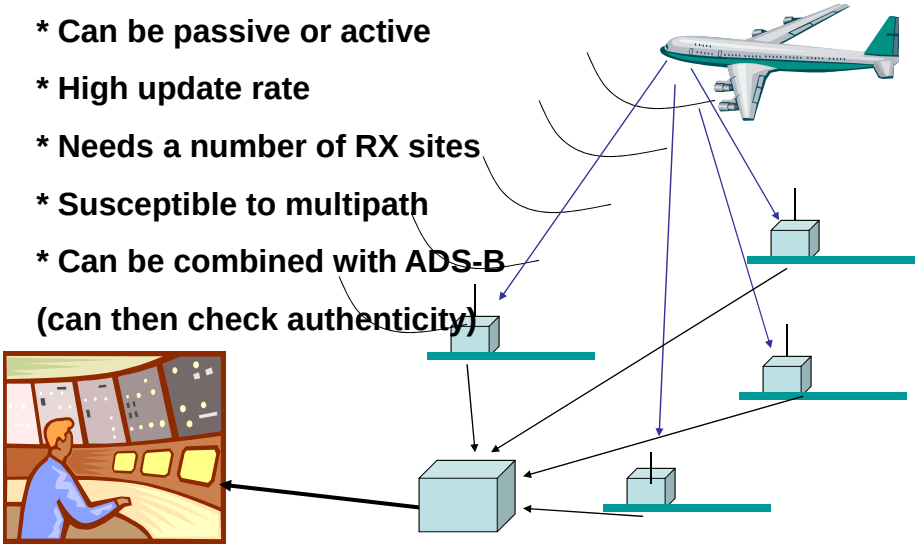
(1090 ES, VDL M4 or UAT)



* High update rate
* Cheaper than radar
* A/C equipage required
* Immune to multipath
* May need independent verification of the authenticity of the reports

Multilateration system

* Uses SSR replies from the A/C
* Can be passive or active
* High update rate
* Needs a number of RX sites
* Susceptible to multipath
* Can be combined with ADS-B (can then check authenticity)



Status of Standardization

PSR:	Not standardized
SSR:	Mature, SARPs in Annex 10
ADS-C:	Forms part of ATN SARPs and related data link applications (FANS-1/A not done by ICAO)
ADS-B:	VDL Mode 4 : SARPs in Annex 10
	UAT: SARPs part of Amendment 82 (Nov. 07)
	1090 ES: Version 0 (Amendment 77 in 02)
	Version 1 (Amendment 82 (Nov 07)
	Note: *Data formats for both versions are included in Doc 9871*
	Version 2 (being developed for 2012)
MLAT:	SARPs in Annex 10 (Amendment 85, Nov. 2010)

Relevant ICAO Technical Documents

*Annex 10 – SARPs

*Manual on the SSR Systems (Doc 9684)

*Manual on Testing of Radio Navaids (Doc 8071), Vol III

(Testing of Surveillance Radar Systems)

*Manual on Mode S Specific Services (Doc 9688)

*ACAS Manual (Doc 9863)

*Technical Provisions for Mode S Services and Extended Squitter (Doc 9871 – under publications)

* Manual on UAT (Doc 9861 – under publication)

* Manual on VHF Digital Link (VDL) Mode 4. (Doc 9816)

Note: Documents shown in red are to be replaced with the new Aeronautical Surveillance Manual (Doc 9924)

Traditional ICAO approach: Define the signal in space for various technical systems to ensure interoperability and leave to States to decide which system (s) should be implemented in their airspace.

PSR

ADS-B

SSR (Mode A/C and/or S)

MLAT

What is the decision based on?

Sensor characteristics

Operational requirements

Regional agreements

Cost considerations

Aircraft equipage

Other factors

An ideal situation?

Operational scenario

Identification of application (s)

Determination of Performance **requirements**

Other factors

Regional issues

Choice of surveillance system (s)

Thank You for Your Attention