

# **S-band primary surveillance radars – Potential co-existence issues with 2.6 GHz mobile services**

Ofcom  
29 May 2009

## Setting the scene

- **What is the issue?**
  - S-band radar receivers ‘listen’ to transmissions from neighbouring bands
  - This has been confirmed for Watchman radars and is likely to be the case for other ATC radar types
- **What is required?**
  - Radars will have to be upgraded to improve selectivity. A solution has been identified for Watchman radars already. Work is under way to find a solution for other radar types
- **What does the upgrade involve?**
  - Likely to be modifications to the filter specifications and other changes to radar front-end as determined by radar studies
- **What are the arrangements for radar upgrades?**
  - Likely to be modifications to the filter specifications and other changes to radar front-end as determined by radar studies
- **What happens in the meantime?**
  - Transition period during which 2.6 GHz roll-outs have to meet certain requirements to protect radars which have not been upgraded. Also applies to T&D transmissions

## Agenda

- Section 1 – Context overview
- Section 2 – Analysis to date
- Section 3 – Issues arisen - CAA
- Section 4 – Way forward
- Section 5 – Q&A

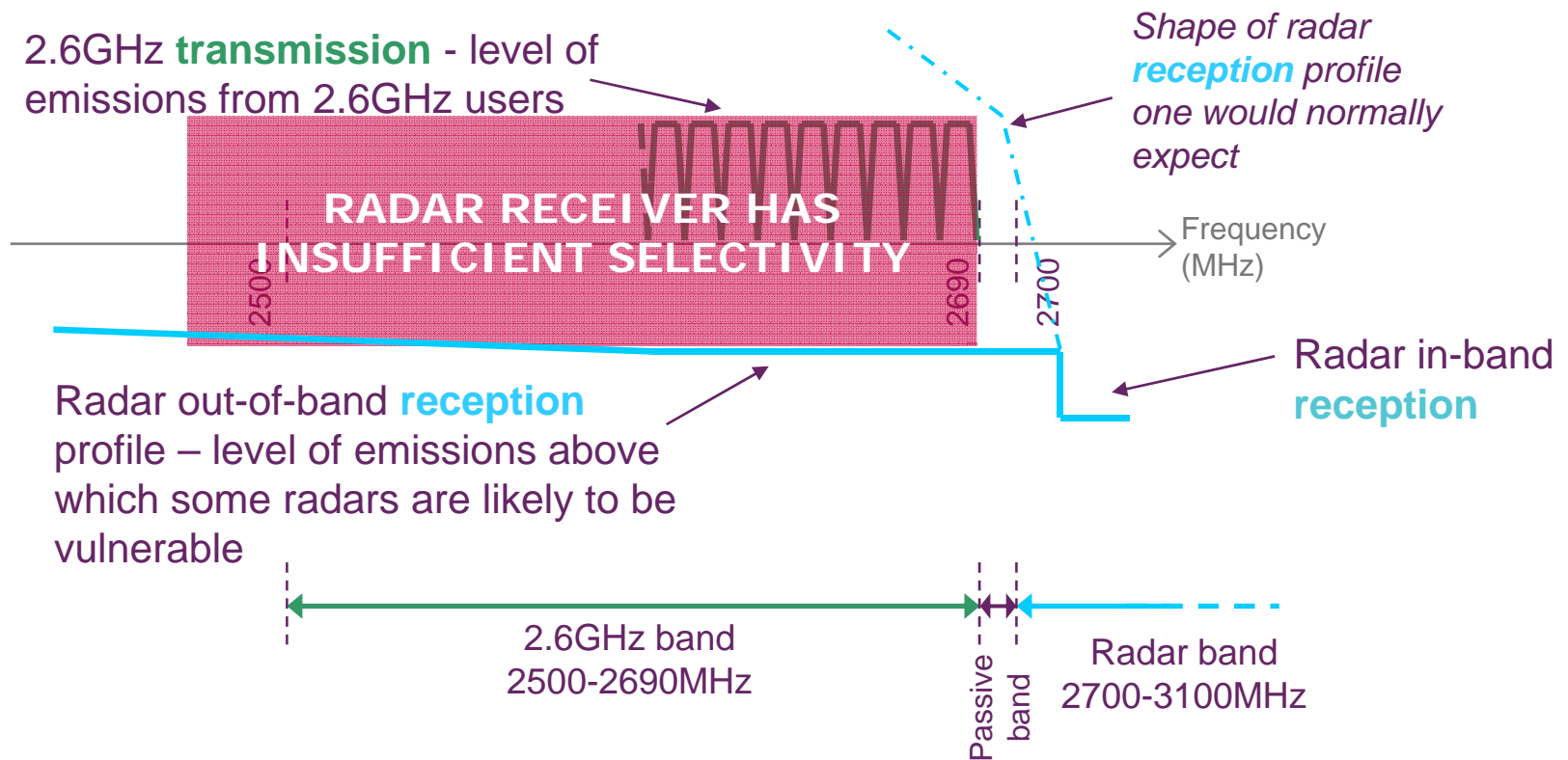
## Distribution of S-band civil ATC radars

Radar type	Count
Watchman/Watchman-S	17
S511/ S511H / ASR 511	12
ASR10/ASR-10SS	7
AR15	4
EN4000	2
ATCR-33S	2
Star 2000	1
<b>TOTAL</b>	<b>45</b>

- There are also 2 non-ATC mobile bird strike radars
- In addition, the MoD has ATC radars

# Radar selectivity issue

- Tests carried out in 2008 suggested that some radars may be susceptible to transmissions by new mobile services in the 2.6 GHz band



## 2.6GHz band – a key band for new mobile technologies

- 2.6GHz is a key band worldwide for the development of mobile broadband services using new technologies such as LTE and WiMAX. Likely deployment of networks is expected to be within a couple of years of the award
- The band is already in use for wide-area mobile in the US and Japan
- EU Member States are under a duty to make the band available in accordance with detailed European harmonisation decision
  - Completed awards in Norway (2007) and Sweden (2008).
  - France, Germany and Netherlands are actively preparing their awards
- We anticipate substantial benefits for UK citizens and consumers from the use of the band
- HMG appreciates importance of the 2.6 GHz band for future mobile broadband services in the UK

## 2.6GHz band – long standing mobile allocation and thorough consultation

- ITU and UK allocations of 2500-2690MHz band to Fixed and Mobile services. There have been high power uses in that band in the UK for a number of years
- WRC 2000 identified the band specifically for advanced mobile technologies such as 3G on a worldwide basis
- The UK regulator - RA then Ofcom – was clear about plans for wide-area mobile uses such as 3G
  - March 2000 and April 2002 - UK spectrum strategy documents
  - October 2003 – first consultation on conditions of use
  - January 2005 to December 2007 – 5 Ofcom consultations on the award of the band
  - April 2008 – statement on the award
- The issue of radar selectivity only arose after Ofcom conducted some precautionary analysis in mid-2008. The 2.6GHz band will come into use and we will ensure that radars can continue to operate safely when that happens

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## What has been done to address the selectivity issue?

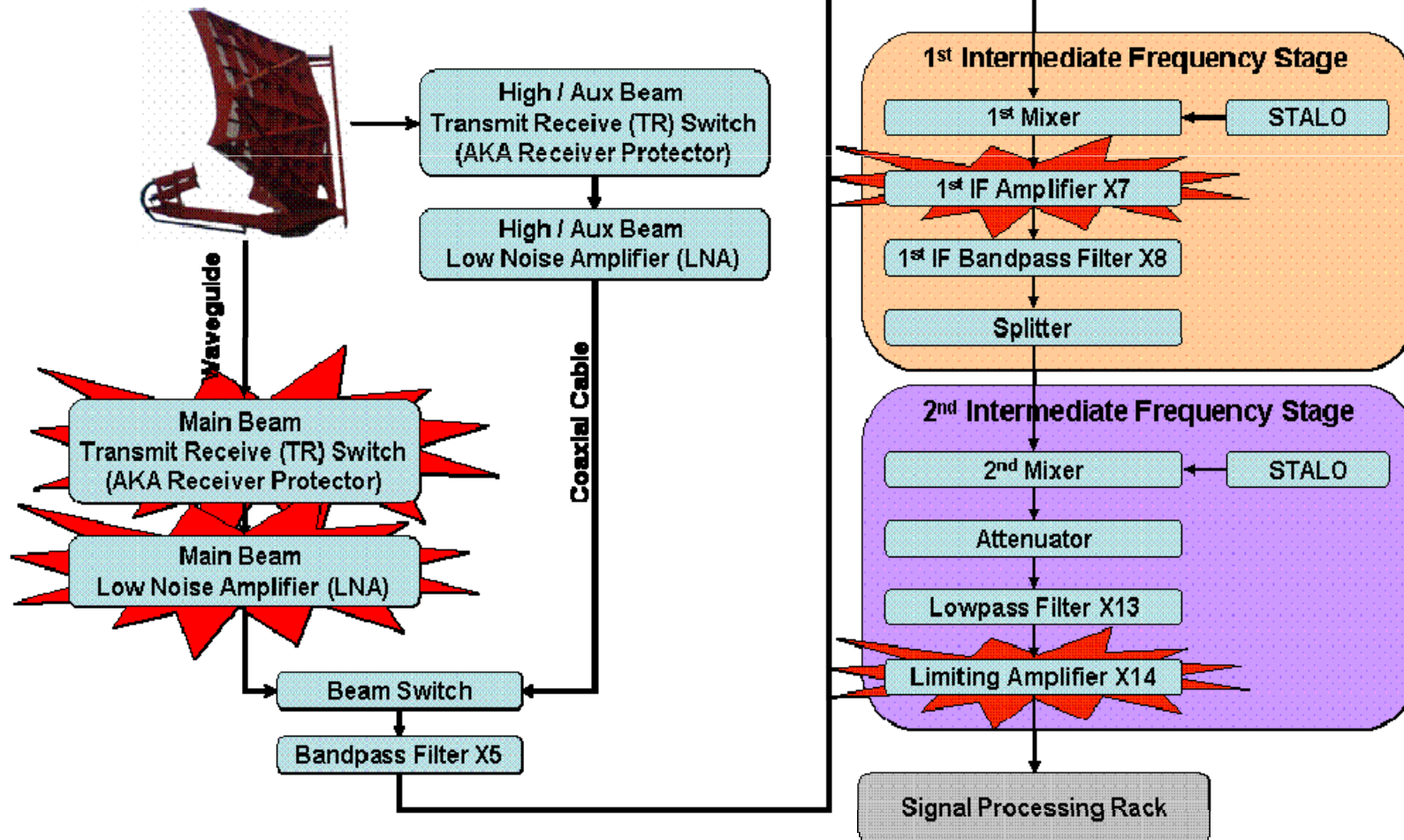
- Preliminary theoretical in-house interference investigation
  - Highlighted radar selectivity issue
- Initial set of studies on Watchman radars
  - Predominant type within fleet of ATC radars
  - It appears that Watchman is the most sensitive to use of adjacent bands
- Injected tests by ERA on a Watchman radar (commissioned by Ofcom with CAA and MoD)
  - 2.6 GHz interfering signal is injected at the radar receiver
  - Confirmed radar selectivity issue identified by the theoretical study
  - Out-of-band emissions from 2.6 GHz band is not an issue for radar band due to tight out-of-band limits for 2.6 GHz systems

## What has been done to address the selectivity issue? (cont'd)

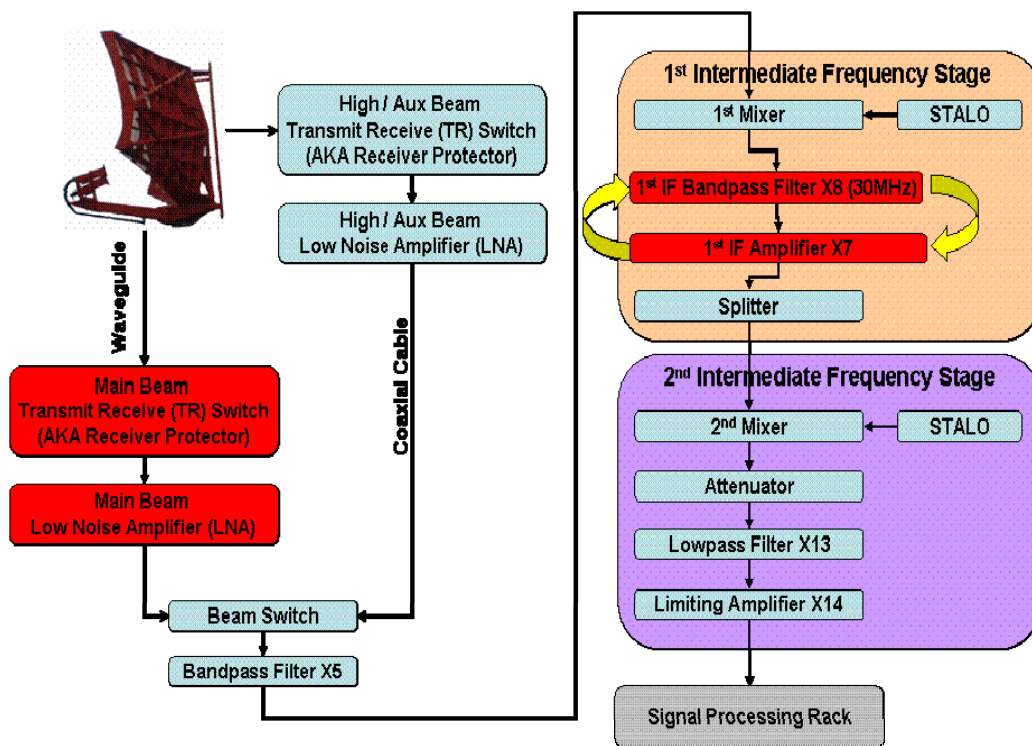
- Radiated tests by ERA on a Watchman radar (commissioned by Ofcom with CAA and MoD)
  - Interfering signal as radiated in the environment by a 2.6 GHz transmitter is picked up by the radar receiver
  - Maximum interfering power into LNA before onset of degradation is -41 dBm
  - Radiated test results show that Watchman is more resilient to 2.6 GHz interference by ~ 7 dB when compared to injected test results
- Isotek study to develop improved filters for S-band radars (commissioned by Ofcom)
  - Filters are developed for a range of frequency offsets from the 2700 MHz band edge and for different passbands.
  - Expected completion date: mid June

# Issues with Watchman radar

Simplified schematic of Watchman front-end receiver  
(Source: SELEX SI)



## Mitigation solution for Watchman radar



Simplified schematic of Watchman front-end receiver  
(Source: SELEX SI)

- Mitigation solution consists of
  - Swapping sequence of filter and amplifier in 1<sup>st</sup> IF stage
  - Using a filter followed by a main-beam ultra low noise amplifier (ULNA)
  - Using a higher spec main beam TR switch
- Solution has been identified to have a **performance neutral impact** on the radar to facilitate safety case recertification
- Lab tests and flight tests are scheduled to start in June and end of August respectively

## Mitigation studies for other radar types

- In Q4 08, Ofcom and CAA sent a questionnaire to radar manufacturers to make an initial assessment of susceptibility of S-band ATC radars to 2.6 GHz transmissions
  - Watchman, ATCR33, S511, EN4000, AR15, ASR10 and Thales Star 2000
- Feedback received indicates that S-band radars likely to suffer from interference from 2.6 GHz transmissions
  - Still awaiting feedback on Thales Star 2000
- Ofcom and CAA have sent invitations to tender for studies on the following radar types
  - ATCR33, S511, EN4000, AR15 and ASR10
  - Indicative timelines for key milestones are given in Section 4

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## Work programme

### Pre-implementation phase

Organisation	Activities
<b>Ofcom &amp; CAA (Lead)</b>	Mitigation solution development
	Radar prioritisation
	Notice under radar licence
	Develop programme for implementation phase

### Implementation phase

Organisation	Activities
<b>Airport/Radar owners (Lead)</b>	Procurement
	Implementation of mitigation solution (including safety case recertification)

Organisation	Activities
<b>Ofcom &amp; CAA</b>	Monitoring



## Indicative timelines for mitigation studies

	Jun 09	Jul 09	Aug 09	Sept 09	Oct 09	Nov 09	Dec 09	Jan 2010	Feb 2010
<b>Watchman study</b>	—————								
- Lab tests	—————								
- Field tests				—————					
<b>Further radar studies</b>	—————								
- Mitigation solution identified	—————								
- Lab tests					—————				
- Field tests							—————		

- **We welcome your cooperation and suggestions to identify suitable radars for flight tests purposes within the mitigation studies**

## Radar prioritisation

- We need to consider a range of factors to prepare a detailed prioritisation and implementation programme e.g.
  - Likely key areas for 2.6GHz roll-outs – main urban areas first
  - Extent of selectivity issue of radar types
  - Operational conditions of specific airports
  - Teams that will carry out the equipment upgrades
- Develop principles of prioritisation and finalise on basis of input from (prospective) 2.6GHz licensees
- **We are keen to receive feedback on issues relating to radar prioritisation**

## Radar licence notice

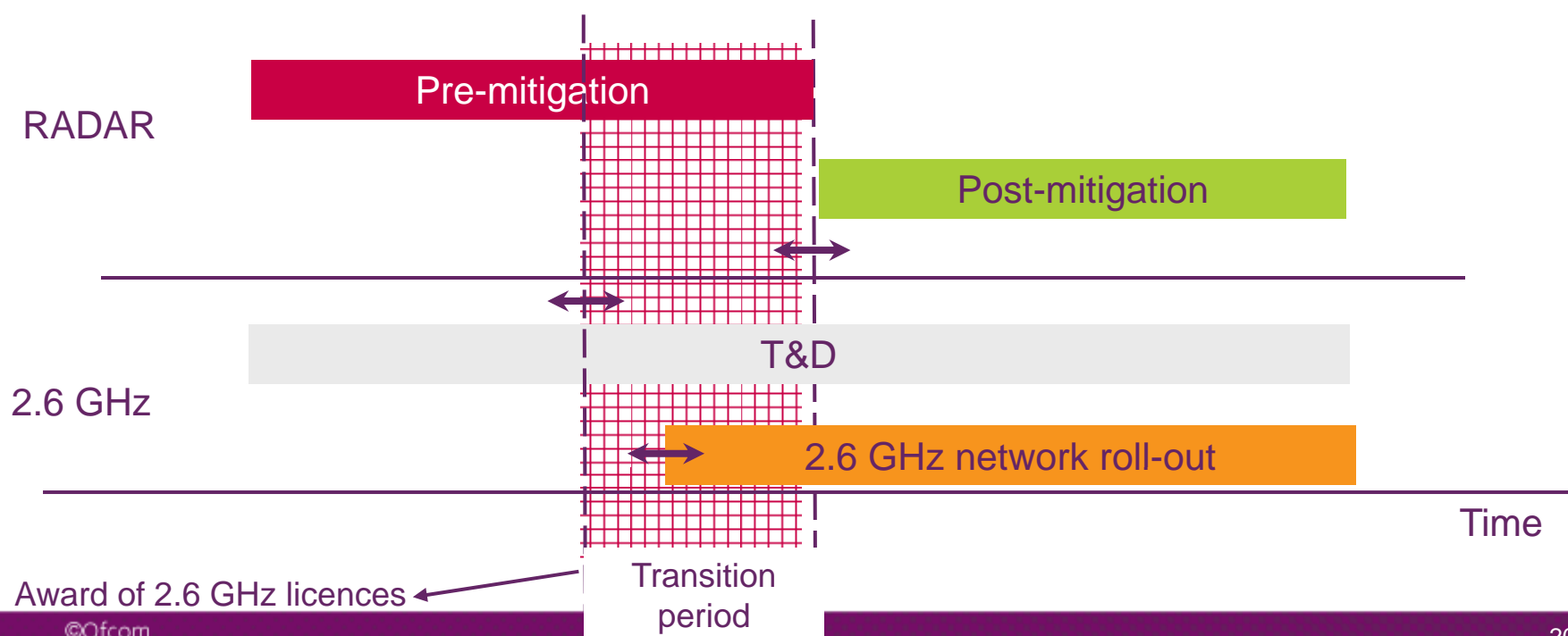
- Civil ATC radar licences have provision for Ofcom to vary licence terms for spectrum management reasons which are applicable under current circumstances
- Ofcom has to make the 2.6 GHz band available for use under European law (a binding Radio Spectrum Committee Decision)
- Ofcom is currently considering how to require licensees to upgrade their receivers

## Funding of radar upgrades

- The costs for the radar upgrades are likely to include: managing the process of implementation, mitigation equipment, operational cost of tests and recertification
- Fundamentally, inadequate selectivity of radar receivers is at the source of the issue and the radar upgrade will need to be carried out
- HMG is aware of the issue and we are exploring potential funding options. However, at present, the outcome and its timing are unclear

## ... in the meantime

- Need to manage the issue of 2.6 GHz T&D licences (Already discussed in Section 3)
  - Modelling methodology in the process of being finalised
- Transition period extending from the award of 2.6 GHz licence to radar upgrade
  - Size of exclusion area for 2.6 GHz transmitters influences duration of transition period



## Transition period

- Transitional arrangements will apply to new 2.6GHz licensees from date of grant. These will be designed to ensure safe operation of a radar before it is upgraded
  - Arrangements will be specified in 2.6 GHz licence
- 2.6 GHz licence to specify a modelling methodology (consistent with T&D) to assess impact on radar
  - 2.6 GHz licensee assesses whether radar selectivity threshold may be exceeded
  - If threshold not exceeded, 2.6GHz licensee can go ahead with base station
  - If threshold exceeded, 2.6GHz licensee can either:
    - Modify planned base station parameters and go through modelling loop; OR
    - Abandon planned base station
- Duration of transition period should avoid material impact on commercial use of 2.6 GHz band. However, it might be possible for 2.6 GHz and radar licensees to enter bilateral negotiations to extend the duration of the transition period
- In case of interference complaints, Ofcom will act swiftly to resolve the issue in collaboration with relevant parties
- Post-transition period, these restrictions on 2.6 GHz licensees in respect of ATC radars are lifted

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## Ofcom contacts

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