The Global Flight Tracking (GFT) for Civil Aviation

WRC-15 Report

Dr. KY-Leng
Deputy Director General
General Department of Posts and Telecommunication
Ministry of Posts and Telecommunication
Email: leng-ky@mptc.gov.kh

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Resolution 185 (BUSAN, 2014)

- **01 Jan 2015 to Now**: about 20 accidents happened and cause over 760 dead.
- **01 Jan 2014 to 31-Dec-2014**: about 33 accidents happened and cause about 1189 dead.
- **08 Mar 2014, Malaysia Airlines, MH370, Boeing 777-200, 239 dead, Unknown Location**:

  Radar contact was lost with the aircraft 2 hours into the flight at 02:40. All indications are that the aircraft changed direction from its flight path and crashed in a **remote part of the Indian Ocean** southwest of Perth Australia. It is assumed all 227 passengers and crew of 12 perished.

www.planecrashinfo.com, http://www.airsafe.com/events/airlines/malaysia.htm

Resolution 185 (BUSAN, 2014)

Recalling:

the relevant provisions of Article 1 of the ITU … that the Union is to promote the adoption of measures for ensuring the safety of life through the cooperation of telecommunication services,

Considering:

a) that the loss of **Flight MH370** spurred worldwide discussions on global flight tracking and the need for coordinated action by ITU and other relevant organization(s), within the scope of their respective mandates;

b) that determination of the position of aircraft and reporting this information to air traffic control centers represents an important element of aviation safety and security;

…

Resolution 185 (BUSAN, 2014)

Resolves:

to instruct WRC-15, pursuant to No. 119 of the ITU Convention, to include in its agenda, as a matter of urgency, the consideration of global flight tracking, including, if appropriate, and consistent with ITU practices, various aspects of the matter, taking into account ITU-R studies,

Instructs the Secretary-General:

to bring this resolution to the attention of WRC-15 and ICAO

Instructs the Director of the Radiocommunication Bureau:

to prepare a specific report on the matter as referred to in resolves above for consideration by WRC-15.

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Proposal on GFT at WRC-15

- Member States of the Inter-American Telecommunication Commission (CITEL)
- Regional Commonwealth in the field of Communications Common Proposals
- European Common Proposals
- China (People's Republic of)
- Burundi (Republic of), Kenya (Republic of), Uganda (Republic of), Rwanda (Republic of), Tanzania (United Republic of)
- Australia, Malaysia, New Zealand, Singapore (Republic of), Thailand
- Angola (Republic of), Botswana (Republic of), Lesotho (Kingdom of), Madagascar (Republic of), Malawi, Mauritius (Republic of), Mozambique (Republic of), Namibia (Republic of), Democratic Republic of the Congo, Seychelles (Republic of), South Africa (Republic of), Swaziland (Kingdom of), Tanzania (United Republic of), Zambia (Republic of), Zimbabwe (Republic of)
- …

Proposal on GFT at WRC-15

China (People's Republic of) Support No Change (NOC) to the band 960-1164 MHz.

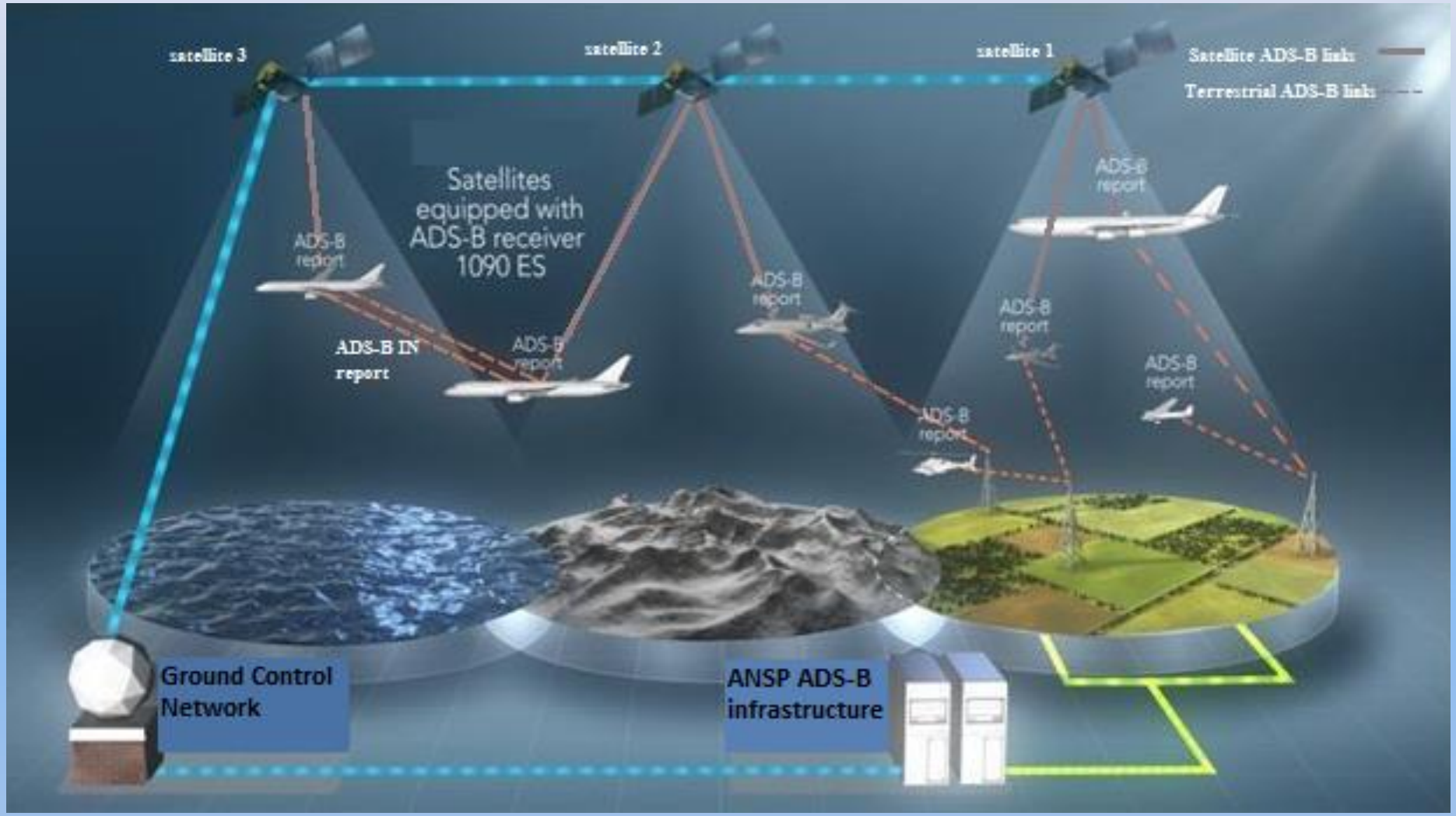
- **Primary Service in all Region are assigned to:**
  - AERONAUTICAL MOBILE (R) 5.327A
  - AERONAUTICAL RADIONAVIGATION 5.328
- **Reasons:**
  - With ITU-R studies not yet finalized, it is difficult at this stage to formulate technical and regulatory measures. At the same time, care should be taken to ensure that no limitations are imposed on incumbent services by new services in the frequency band 960-1 164 MHz.
  - The issue of global flight tracking should be included on the agenda of the next WRC.
  - The necessary modifications to the provisions of the Radio Regulations could be made based on the results of ITU-R studies, when such studies relating to the satellite ADS-B system are completed during the study cycle preceding the next WRC.

Proposal on GFT at WRC-15

Member States of the Inter-American Telecommunication Commission (CITEL)

- **A**utomatic **D**ependant **S**urveillance-**B**roadcast (ADS-B) is a terrestrial aeronautical monitoring system, broadcasting (twice per second) position, altitude, velocity, aircraft ID, and other related avionics information. The system is presently in use, as well as being implemented in a number of countries.
- ADS-B transmissions centred on **1 090 MHz** use pulse-position modulation in a ± 1.3 MHz bandwidth and ± 1 MHz carrier tolerance.
- ADS-B signals are currently received by other aircraft and terrestrial stations on the ground within line-of-sight.
- In oceanic, Polar regions, remote areas or other areas where deployment of ground based surveillance systems is not feasible, ADS-B signals are currently not being utilized to track aircraft.
- A number of satellite systems are in development that will place ADS-B receivers on-board low-earth orbiting satellites, permitting the existing aircraft signals to be received and relayed to appropriate air traffic management (ATM) centres and airlines. This will make it possible to monitor ADS-B equipped aircraft in remote, oceanic and Polar regions, augmenting the current ground-based surveillance systems to provide monitoring capability anywhere on the globe.

CITEL: Low Orbit Satellite + ADS-B



CITEL: Low Orbit Satellite + ADS-B

- The frequency band 1 087.7-1 092.3 MHz is also allocated to the aeronautical mobile-satellite (R) service (Earth-to-space) on a primary basis, limited to space station reception of Automatic Dependant Surveillance-Broadcast (ADS-B) transmissions from aircraft in accordance with recognised international aeronautical standards.

NOTE:

All proposals suggest to modify the frequency band 960-1164MHz, except China (support NOC).

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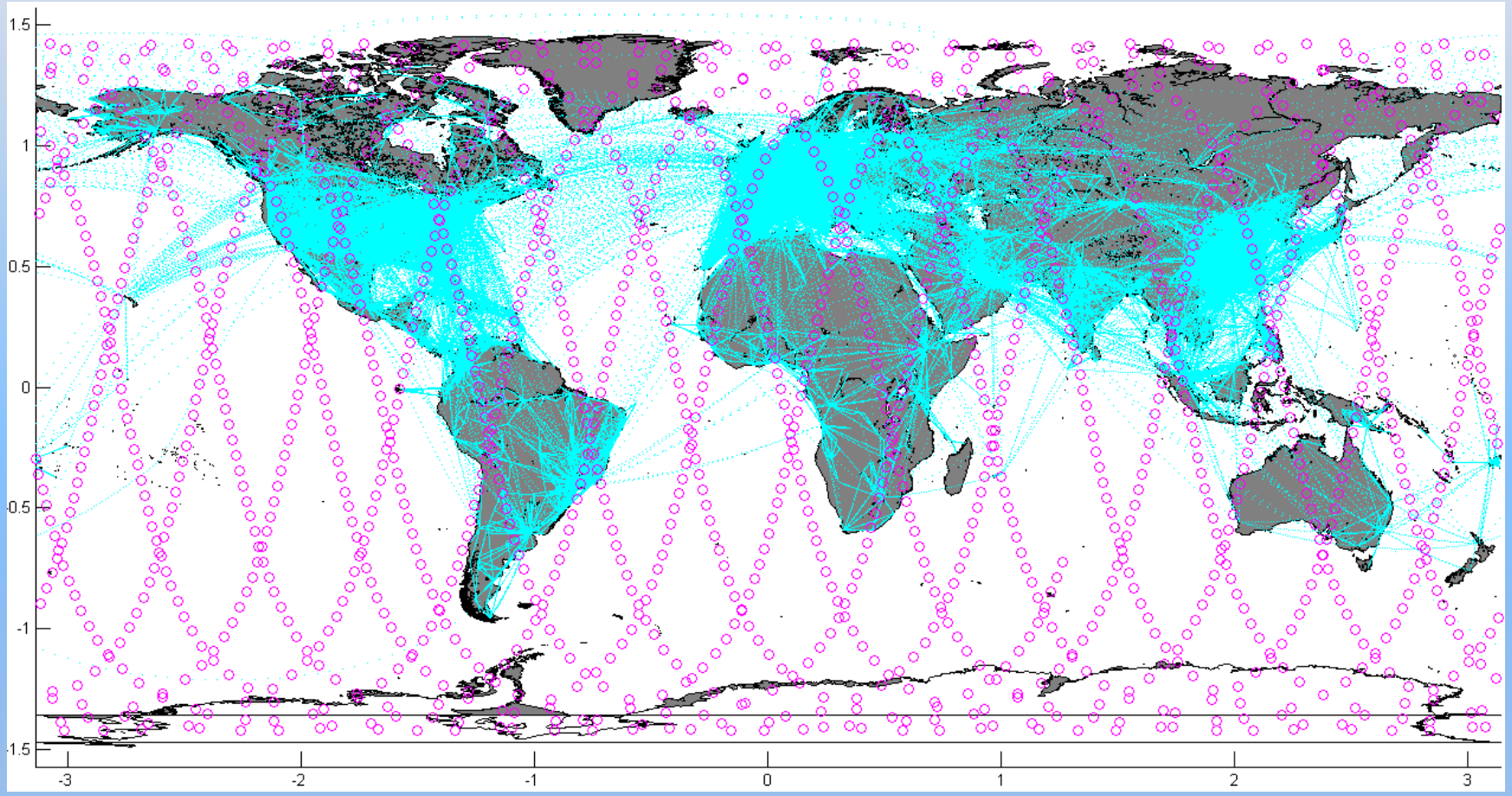
Contribution from France

Methodology:

- Determining, **dynamically and statistically**, the ADS-B pulse frames received and decoded by the satellite when emitted by aircraft in its line of sight.
- The simulation is **dynamic** in that it takes into account not only actual satellite trajectories but also the world air routes used by commercial aircraft.
- It is **statistical** in that the instants in time defining the calculation area are selected randomly. In other words, at each time t, the satellite position and the positions of all the aircraft throughout the world are drawn randomly, noting however that the aircraft are distributed over all known air routes.
- At each time t, the power levels of ADS-B messages received from an aircraft by the satellite are compared with the sensitivity levels of its receiver, adding in the interference emanating from the various messages emitted by the other aircraft in line of sight.

Contribution from France



Satellite positions and Air routes (59 000 air routes worldwide) used for the simulations

Contribution from France

Satellite Reception Hypotheses:

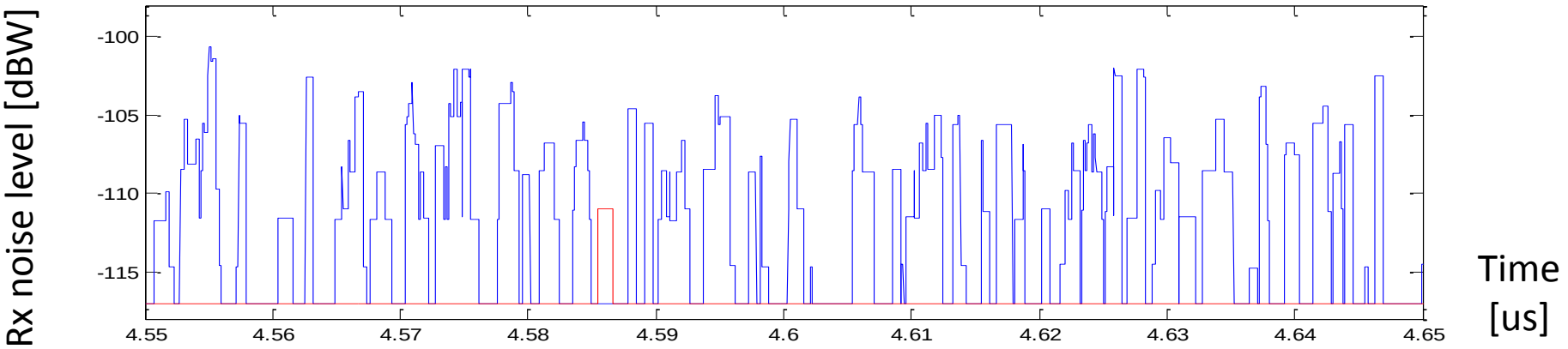
1. Only ICAO-type aircraft are distributed on the world air routes.
2. Their count is always the same worldwide and equal to more than 59 000 randomly distributed on the air routes.
3. Non-ICAO type aircraft are only distributed at positions where ICAO aircraft are in line of sight.
4. The number of non-ICAO aircraft in the spot beam of a satellite is taken randomly for each time t and can be between 1 and 10.
5. The simulation considers that beyond an angle of 30° between the satellite and the aircraft, the aircraft are no longer detected and do not contribute to interference in the satellite receiver.
6. The simulation does not take into account any carrier-to-noise ratio (C/N) on reception of the signals and is based solely on the receiver sensitivity.
7. The time increment in the pulse frames of each aircraft emission is 1 µs.
8. The number of pulses of each emission for each aircraft is taken randomly in the range provided in Table 2.

Contribution from France

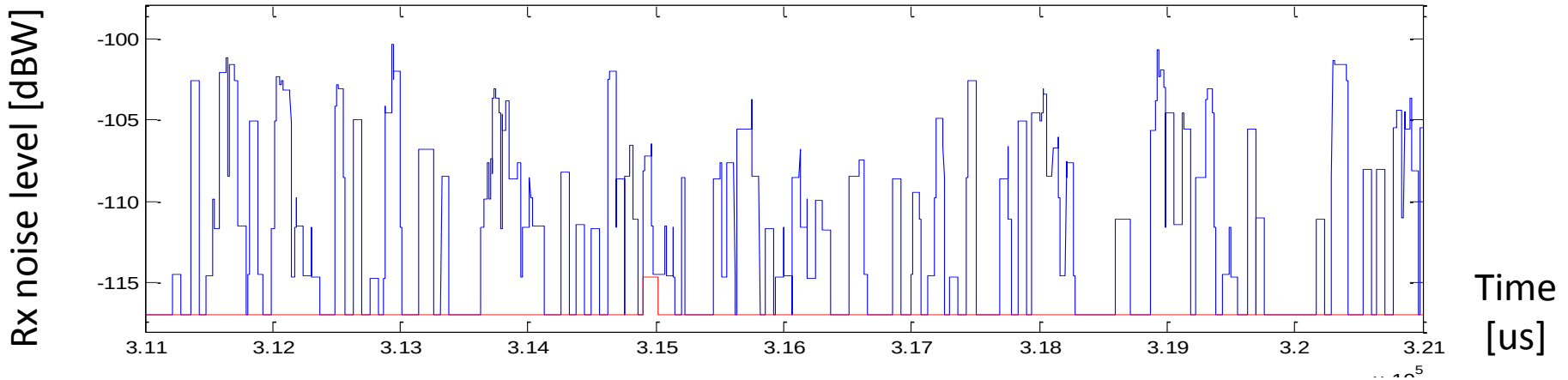
Satellite Reception Hypotheses (Cont.):

9. The power distribution in all transponders in the satellite spot beam is related to that described in Table 1.
10. All emissions other that ADS-B are considered as interference (Mode A/C, SSR, Mode S with or without long message).
11. ICAO emissions responding to an interrogation are considered to be present solely above land masses or within a maximum distance of coastlines. These hypotheses do not apply to non-ICAO emissions, which are considered to be independent of the environment.
12. The simulation considers **3** ADS-B pulses per aircraft (those that employ ADS-B emissions) distributed periodically over 500 ms. Of the **6** ADS-B messages emitted by an aircraft, **2** contain position information.
13. The simulation takes account of the propagation time of messages to the satellite.
14. The simulations do not take account of terrestrial stations transmitting in the 1 090 MHz band.
15. Finally, the simulations consider that an ADS-B message that is partially or totally drowned in interference is lost and cannot be decoded by the receiver.

Contribution from France



ADS-B message exceeding the level of noise emanating from other emissions in the spot beam of the satellite



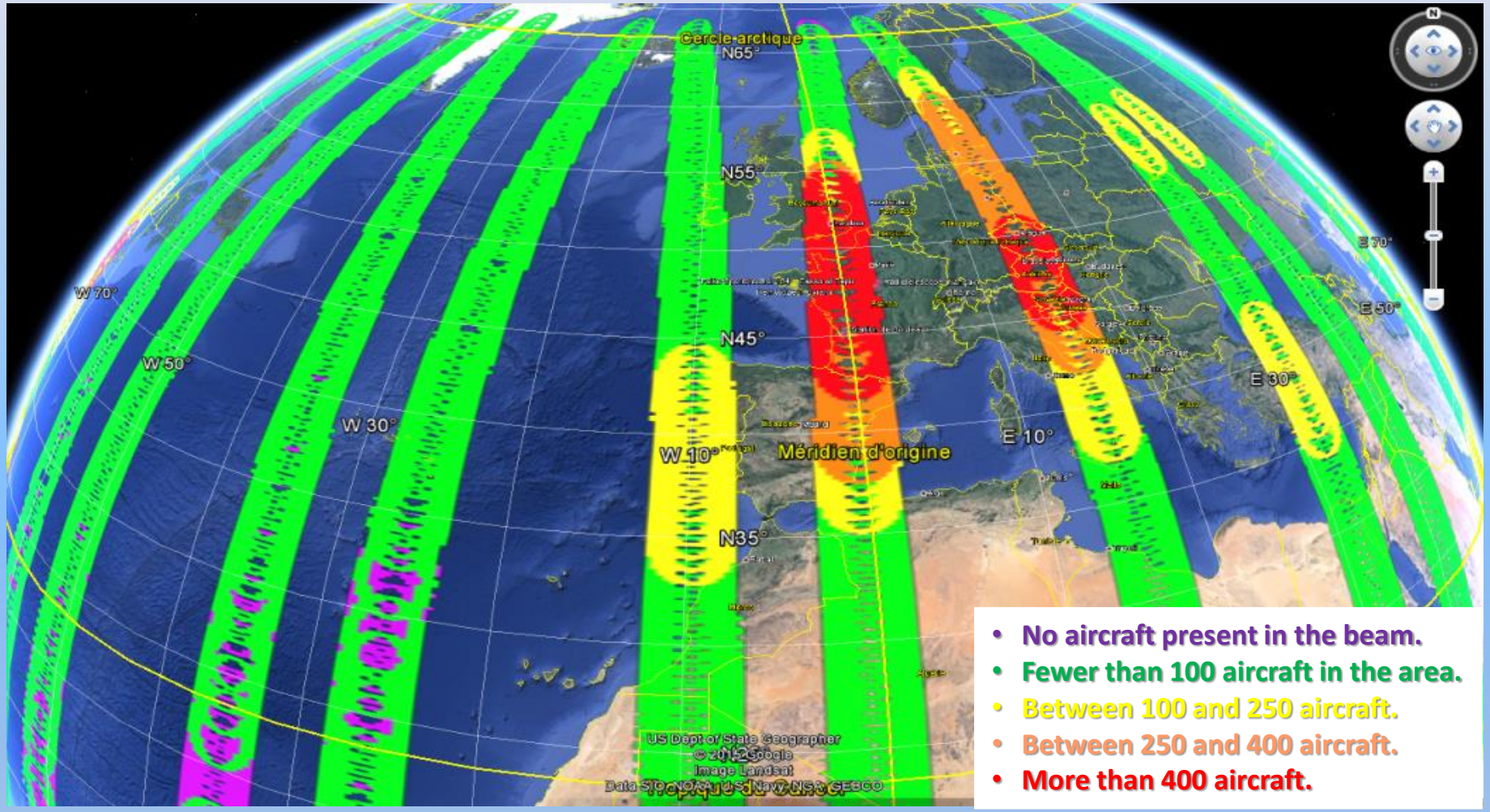
ADS-B message drowned in interference from the other emissions in the spot beam of the satellite

Contribution from France

Satellite Reception Hypotheses (Add.):

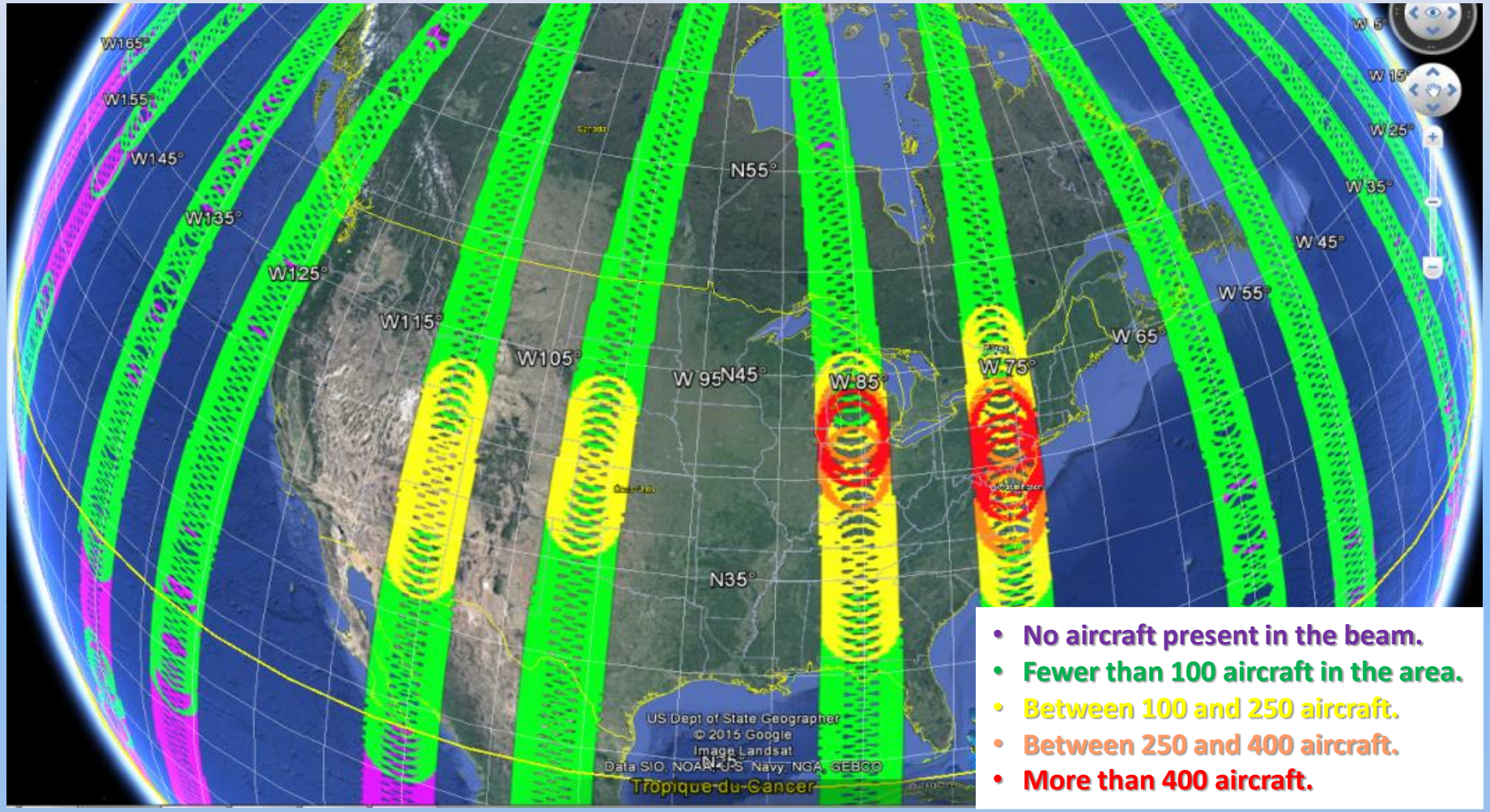
- The minimum power received from an aircraft with a 125 W transponder at the edge of the coverage area (between 12.5° and 16.5° in relation to the satellite nadir) does not exceed the receiver sensitivity level.
- In a spot beam, the propagation loss of emissions to the satellite is almost identical for all aircraft.
- Transponder power and receiver gain are the only determining factors.
- **Aircraft making ADS-B emissions with a 125 W transponder (i.e. more than 16% of the world's fleet, see Table 1) would not be visible from the satellite system for around 16% of the time, without taking account of any interference.**

Contribution from France



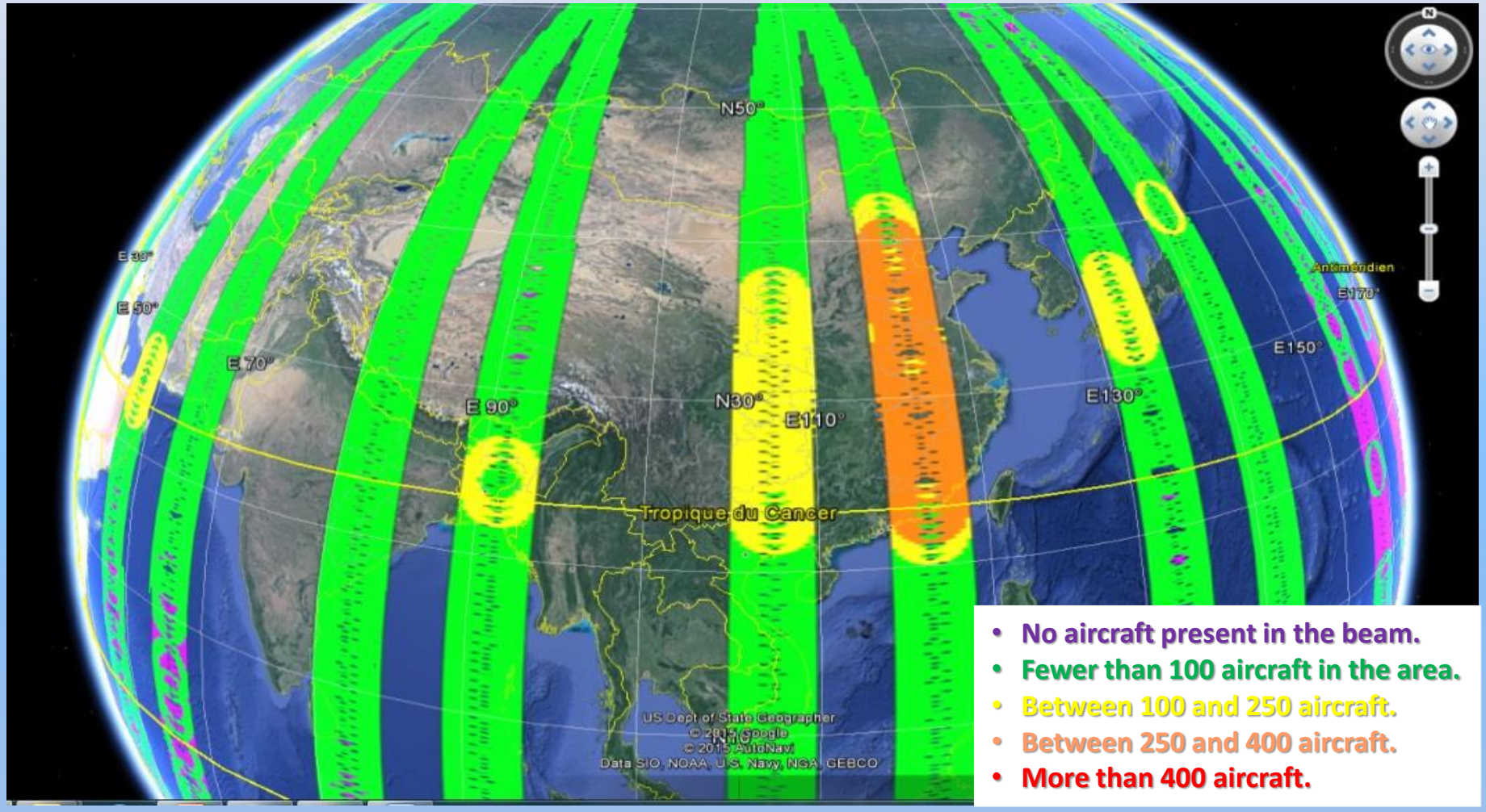
Positions of **spot beams** simulated over the northern part of **Region 1**

Contribution from France



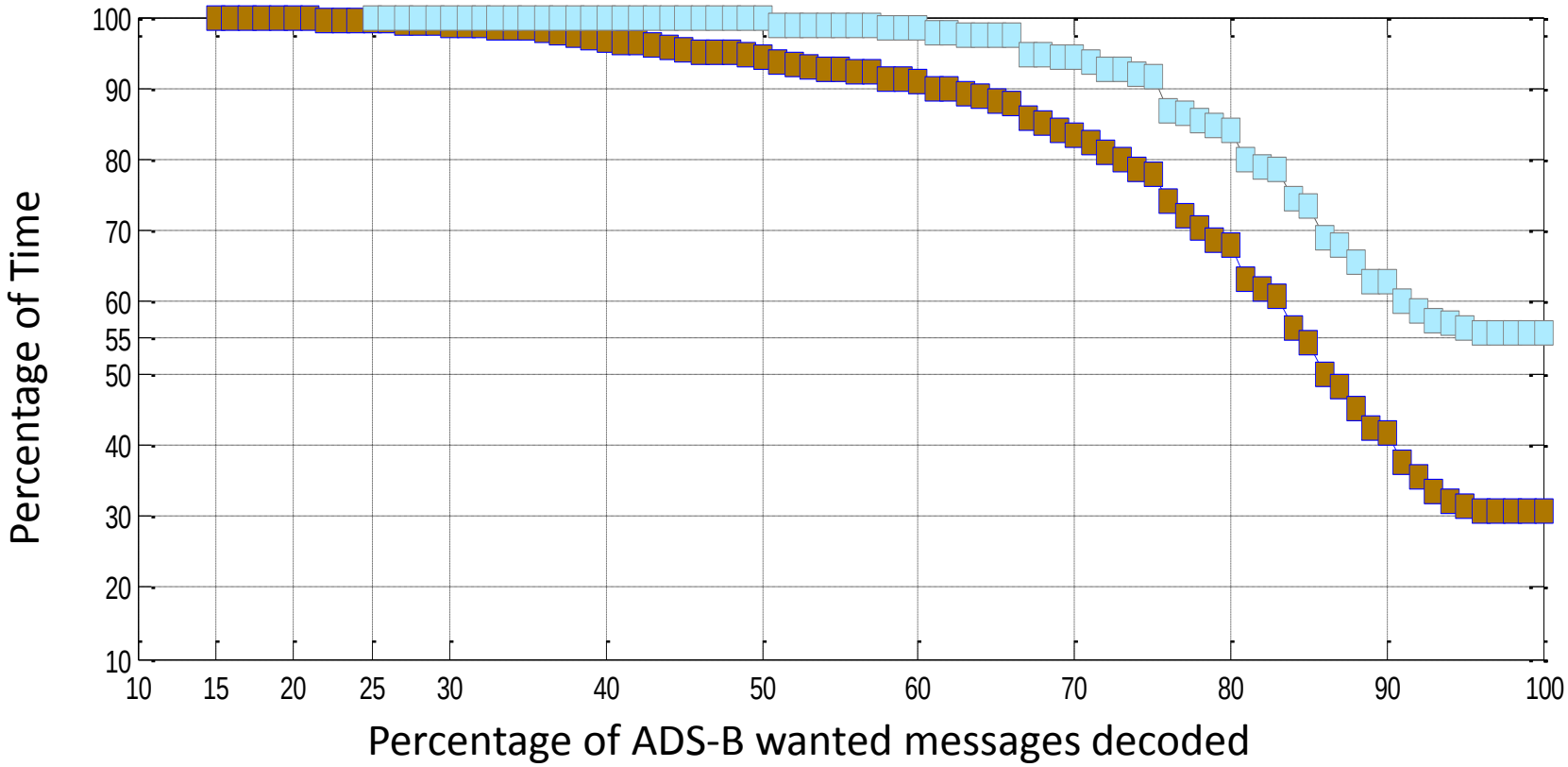
Positions of **spot beams** simulated over the northern part of **Region 2**

Contribution from France



Positions of **spot beams** simulated over **Region 3**

Contribution from France



- **Land Area:** the percentage of wanted messages decoded is **100% for 30%** of the time, and at least greater than **15%**.
- **Sea Area:** the percentage of wanted messages decoded is **100% for 50%** of the time, and at least greater than **25%**.

Contribution from France

Summary:

- 15% of wanted messages could be received and decoded by the satellite over areas with dense traffic.
- The study does not allow us to define accurately the maximum time necessary to obtain two consecutive wanted messages for one and the same aircraft.
- The satellite receiver sensitivity is a key factor for determining accurately the system's capacity to decode ADS-B messages. For the receiver used, 16% of the world's fleet could not be located accurately more than 16% of the time.
- A higher sensitivity would doubtless make it possible to receive all the messages emanating from low-power transponders (125 W) at the edge of coverage, but their contribution would necessarily have a sizeable impact on the receiver noise, and there is nothing to suggest at this stage that the results could be improved.

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Conclusion

Use of the frequency band 1 087.7-1 092.3 MHz by the **Aeronautical Mobile-Satellite (R) Service** (Earth-to-space) to facilitate Global Flight Tracking for civil aviation

is adopted in Resolution COM4/2 (WRC-15).

Conclusion

Resolves

1. that the use of the frequency band 1087.7-1092.3 MHz by AMS(R)S systems shall be in accordance with recognized international aeronautical standards;
2. that AMS(R)S systems (Earth-to-space) in the frequency band 1 087.7-1 092.3 MHz shall be designed so that they can operate in the interference environment as described in *considering c)*;
3. that, taking into account *resolves* 2, AMS(R)S use of the frequency band 1087.7-1092.3 MHz shall not constrain administrations which have responsibilities as referred to in *considering h)*,

Considering

c) that the frequency band 960-1 164 MHz is used by International Civil Aviation Organization (ICAO) standardized and non-ICAO systems, thus creating a complex interference environment;

h) that, taking into account *considering c)*, use of the frequency band 1 087.7-1 092.3 MHz requires some administrations to control all users to ensure proper operation of all terrestrial systems,

Conclusion

Invites the ITU Radiocommunication Sector

to complete, as a matter of urgency, the studies related to the space station reception of ADS-B in the frequency band 1 087.7-1 092.3 MHz,

Further invites the International Civil Aviation Organization

to continue to participate in the studies,

instructs the Secretary-General

to bring this resolution to the attention of ICAO and communicate the results of the studies when available

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THANK YOU

Luke 12:2–3:

But there is nothing covered up that will not be revealed, and hidden that will not be known.

Accordingly, whatever you have said in the dark will be heard in the light, and what you have whispered in the inner rooms will be proclaimed upon the housetops.