



# ITU-R studies on Spectrum Monitoring Evolution



# Issues under consideration

- Spectrum Monitoring is a **key element** of Spectrum Management and **improvement of equipment enhances the efficiency & effectiveness** of the spectrum management process
- **With a constant & rapid evolution of radiocommunication technologies & systems, need to study the impact** of SDR and CRS, among others, **on spectrum monitoring**
- **Impacts on administrations of the evolution of spectrum monitoring activities**
- **Need to assess the capability of existing spectrum monitoring systems for monitoring new radiocommunication technologies and systems**
- **The increasing amount of collected spectrum data may require adaptation** of the organisation and spectrum monitoring techniques

Sources: Question ITU-R 235/1 <http://www.itu.int/pub/R-QUE-SG01.235>

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# Specific questions under study

- What are the **new considerations for monitoring of radiocommunication systems** that are **based on new technologies**?
- What are the **new approaches** that may be required **in terms of organization, procedures and equipment to monitor systems** based on **future radiocommunication technologies**?
- What are the **needs for administrations** in order **to implement the new approaches** to monitor systems based on future radiocommunication technologies?

Sources: Question ITU-R 235/1 <http://www.itu.int/pub/R-QUE-SG01.235>

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# ITU-R information available

- **Detection of weak signal** using several kinds of technologies  
Locked-in amplifier; Sampled integration;  
Cross-Correlation & Auto-Correlation; Adaptive noise cancelling
- **Co-frequency signal separation**  
Single-channel separation; Multi-channel separation
- **Multi-mode location** (based on a combination of location technologies)  
Angle of arrival (AOA); Time difference of arrival (TDOA); Frequency difference of arrival (FDOA); Power of arrival (POA); ID-Aided; Gain ratio of arrival (GROA)
- Examples of the application of **advanced monitoring techniques**  
(e.g. Correlation application in satellite interference finding; Strong-signal recovery application in satellite monitoring; Spatial spectrum based beam-forming in HF/VHF monitoring; GSM base station geolocation; etc.)
- Examples of the application of **combined geolocation**  
Hybrid AOA/TDOA / Hybrid TDOA/GROA

Sources: Report ITU-R SM.2355 <http://www.itu.int/pub/R-REP-SM.2355>

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# ITU-R further studies on this topic

- Draft addition of new elements on the **Detection of weak signal**  
e.g. use of other characteristics and properties of the signals:  
Power Spectral Density; Cyclostationarity; High Order Statistics (HOS)
- Draft addition of some **Spectral Estimation Techniques and associated Analysis**  
(for extracting signal information)  
Singular Value Decomposition; Natural Resonance; Wavelet Edge Detection
- Draft addition of other details on:
  - ❖ Description of the Higher Order Statistic Variables
  - ❖ **Complex natural resonance signals of a linear system**
  - ❖ Hierarchical Monitoring Network based on distributed cognitive sensors

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Sources: Preliminary draft revision of Report ITU-R SM.2355, [Doc. 1C/39 Annex 6](#) [www.itu.int/md/R15-WP1C-C-0039/en](http://www.itu.int/md/R15-WP1C-C-0039/en)



# Summary

- As the eyes and ears of the Spectrum Management process, Spectrum Monitoring continues to play a key role in the management of spectrum resource, radio station and electromagnetic environment, by providing valuable monitoring data to maximize spectrum efficiency, minimize interference and eliminate unauthorized and improper use of the spectrum.
- Future spectrum monitoring systems should have capability for monitoring new radiocommunication technologies and systems, such as detection of weak signal, co-frequency signal separation and multi-mode location based on digital signal processing (DSP) and network, etc.
- These topics and many others on Spectrum Monitoring will continue to be addressed at the next meeting of ITU-R Working Party 1C (13-20 June 2017, at ITU HQ in Geneva, see details in [BR Circular Letter 1/LCCE/100](#)).

Your participation in these activities is more than welcome!



# *Thank you!*

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