Integrated Spectrum Management & Monitoring Systems

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Spectrum Monitoring Systems

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Spectrum management

… comprises mainly the following tasks:

▮ Planning of new transmitters
  ▪ Coverage area
  ▪ Avoid negative impact on existing transmitter

▮ Licensing

▮ Billing

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Spectrum monitoring

… comprises mainly the following tasks:

▮ Interference investigations due to co-channel emissions, out-of-channel emissions and intermodulation (i.e. detect, identify, locate and "fix" transmitter which cause problems)

▮ Verification that licensed transmitter operate within their assigned limits

▮ Provide / verify management data

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Spectrum monitoring

… comprises mainly the following tasks:

▌ Frequency and frequency offset measurements (ITU-R SM.377)

▌ Field strength measurements (ITU-R SM.378)

▌ Bandwidth measurements (ITU-R SM.443)

▌ Modulation depth and frequency deviation measurements (ITU-R SM.328)

▌ Spectrum occupancy measurements (ITU-R SM.1880)

Spectrum monitoring

▮ Radio direction finding and location, listening and identification in the HF (ITU-R SM.854), V/UHF and higher frequency ranges (to determine non-licensed stations)

▮ Radio direction finding and location of TDMA and CDMA signals (ITU-R SM.1598)

▮ Technical identification of digital signals (ITU-R SM.1600)

▮ DVB-T coverage measurements and verification of planning data (ITU-R SM.1875)

▮ …

Spectrum management

Spectrum management knows exactly how the world should be

Spectrum monitoring

Spectrum monitoring knows exactly how the world really is

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Spectrum management & monitoring

❚ Spectrum management and monitoring need to exchange information

❚ From management to monitoring
- License information
  - Reference for control of compliant operation
  - Reference for detection of unlicensed transmitters
  - Reference for identification of interferer

- Measurement tasks
  - Spectrum management operator can define task to get required information

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Spectrum management & monitoring

❚ Spectrum management and monitoring need to exchange information

❚ From monitoring to management
  ▪ Measurement results
    ▪ Real data for control of compliant operation
    ▪ Real data for detection of unlicensed transmitters
    ▪ Real data for identification of interferer
    ▪ Reference for coverage calculation
    ▪ Reference for interference analysis

  ▪ Statistic data
    ▪ Occupancy
    ▪ Measurement value distribution

Spectrum monitoring
ARGUS 6 – The 6th generation

❚ ARGUS: Dedicated software for ITU-compliant spectrum monitoring

❚ Key input
- ITU spectrum monitoring handbook and recommendations
- Close cooperation with operators
- Experience from 30 years in the market

Spectrum monitoring
ARGUS 6 – The 6th generation

Basic			
Device control	**Measure-ments**	**Evaluation**	**Interfaces**
Receiver	Interactive	Occupancy	Spec Mgmt
DF	Automatic	Statistics	Ext. app
Analyzer	Location	Data fusion	Windows
Sys. dev.	Guided	Reports	GIS
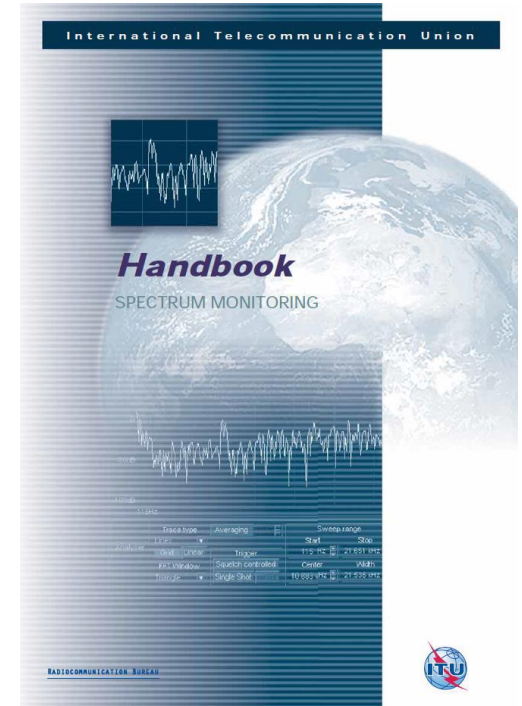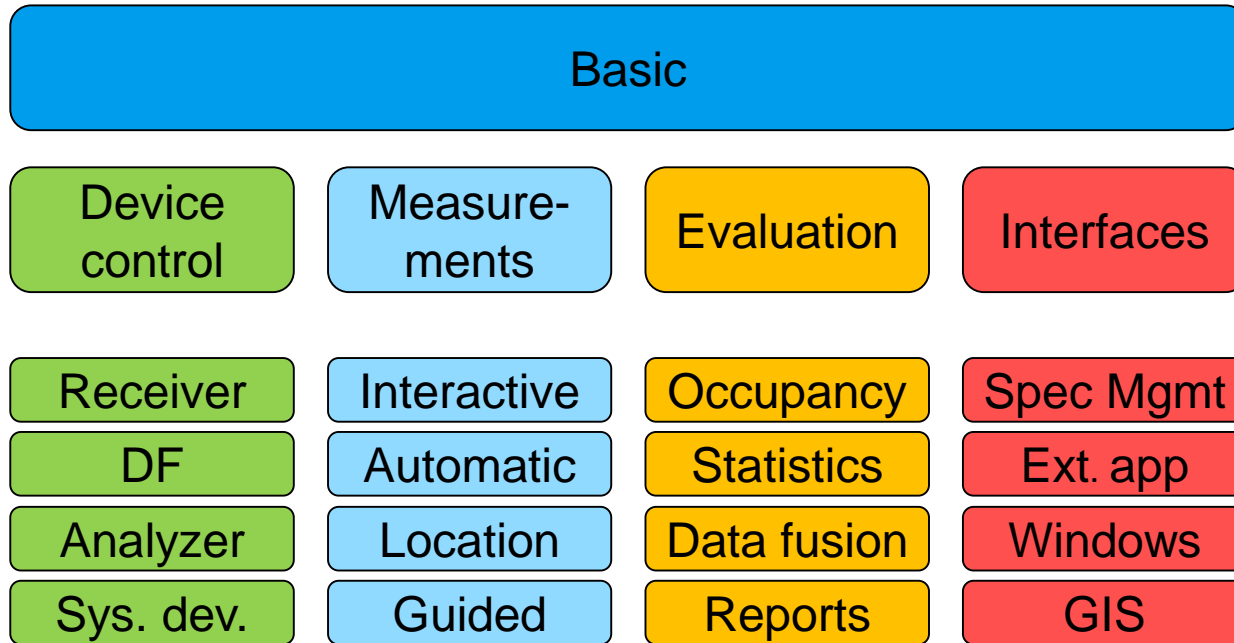
The modular structure

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The ARGUS world
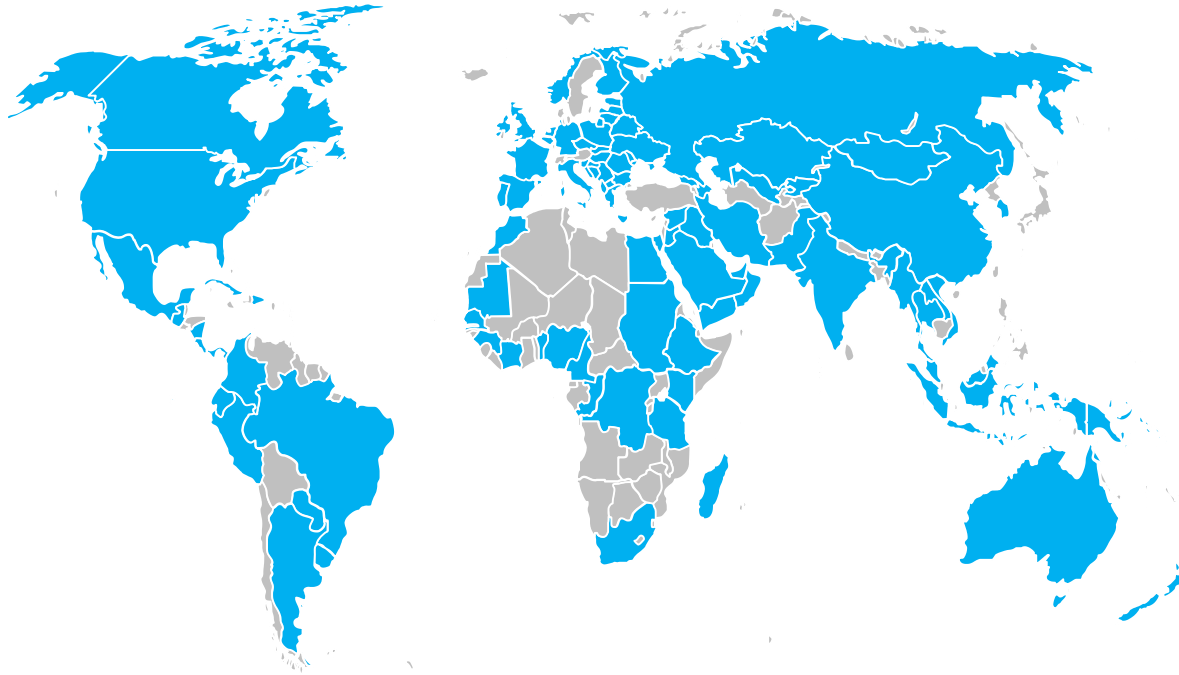
Spectrum monitoring
ARGUS 6 – The 6th generation

❙ Monitoring operator can define filter criteria for license database query

❙ Criteria include:
- Assigned / unassigned frequencies
- Frequency range
- Location
- Service type
- Call sign
- License state
- …

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Spectrum monitoring
ARGUS 6 – The 6th generation

▌ Example: Automatic license violation detection

▌ Information from spectrum management is supplemented by measurement results, clearly showing license violation

Spectrum monitoring
ARGUS 6 – The 6th generation

❚ Example: Automatic interferer detection
  ▪ Procedure:
    ▪ Scan frequency range of interest
    ▪ ARGUS automatically detects emissions (calculates local maxima in spectrum)
    ▪ Comparison with reference list (transmitters known to be licensed / "good" / …)

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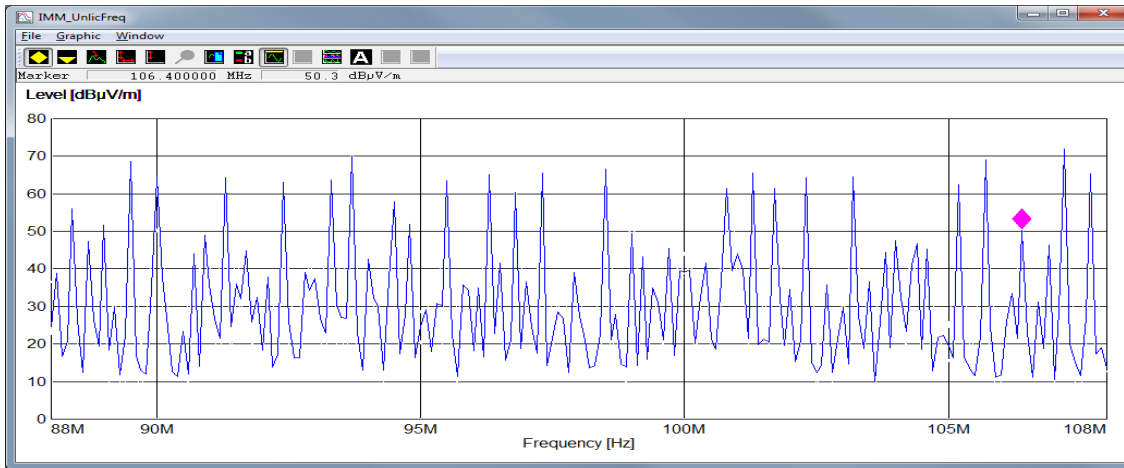
Spectrum monitoring
ARGUS 6 – The 6th generation
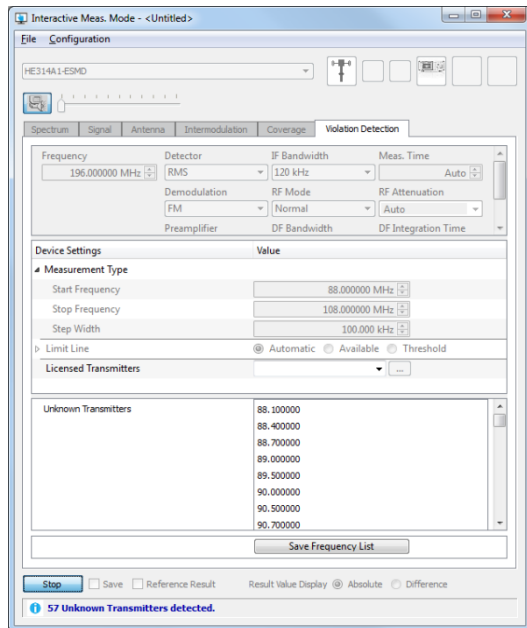
Complete list of active Tx
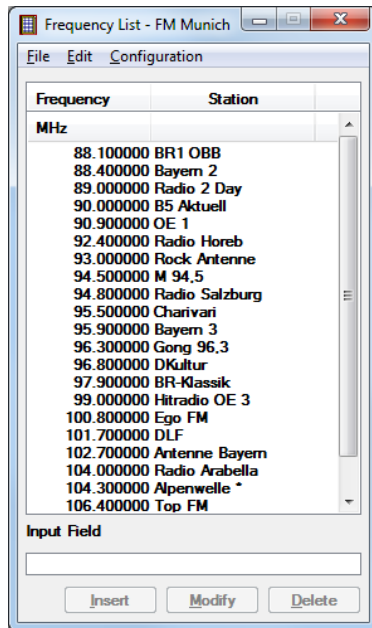
Reference list
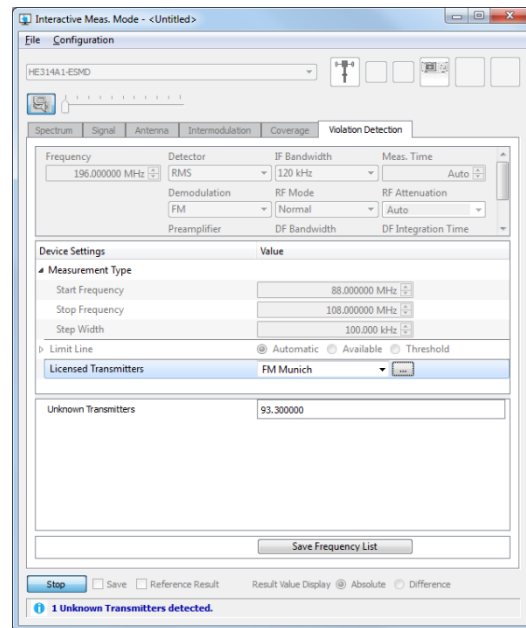
Automatically detected unknown Tx

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Spectrum monitoring
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❚ Result of a hybrid TDOA – AOA location combined with transmitter data imported from spectrum management

❚ Location of interferer does not coincide with licensed transmitter
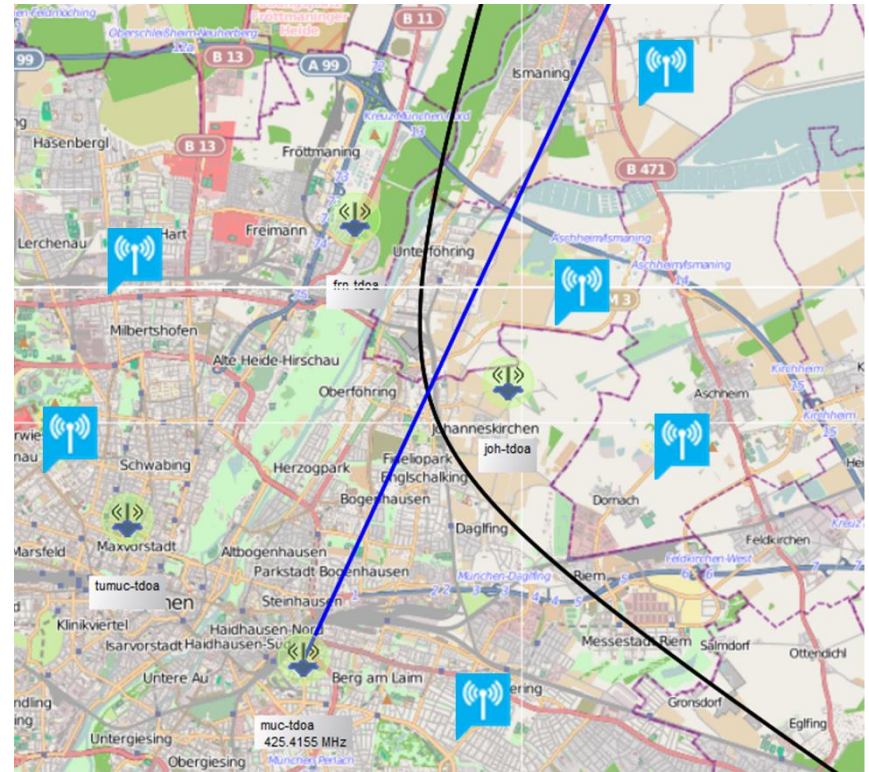
Spectrum management
SMS4DC

▌ SMD4DC operator can define monitoring task for ARGUS

▌ The entire available equipment in all monitoring stations can be used

▌ Tasks can include live comparison of measurements results with user
defined thresholds (automatic violation detection)
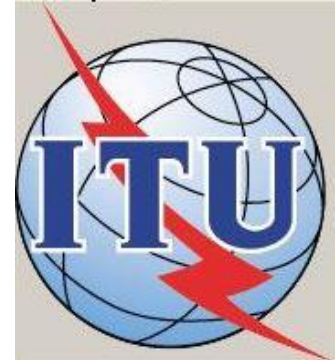
Spectrum management SMS4DC

▌ Define monitoring task for ARGUS

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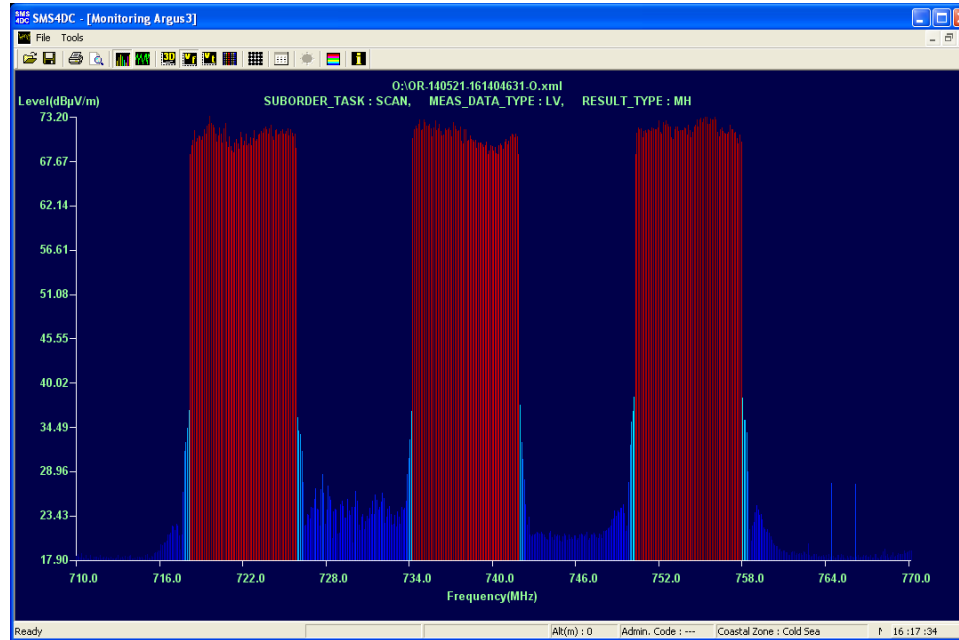# Spectrum management SMS4DC

❚ Define schedule

Spectrum management SMS4DC

▮ Define output and alarms

Spectrum management
SMS4DC

❚ Measurement results from ARGUS displayed and analyzed in SMD4DC

Integrated spectrum management and monitoring systems