Present and Future Dangers
The Growing Interoperability Challenge

RF operational issues:
• Ever expanding ground terminals
• Complex Environment LEO and HTS Satellites
• Ubiquitous Small Sat projects
• Competing terrestrial users
• Bands and services interleave
• Doppler

⇒ How to monitor these new resources that are both local and global

⇒ Difficult challenges for satellite operator and regulators
Scalable and Flexible Sensor System

• Data processing and display challenges:
  – Lot more data and more types of data
  – Non-RF experts doing real-time operations
  – How process, display, & alarm

• Technical complexity:
  – Mesh Network of Measurement Servers
  – Independent of hardware, so grows as hardware capability grows
  – Scalable - from single to multi-site
  – Fast, Accurate
  – Applications layered on system
  – Virtualized, Cloud
  – Interference Detection & Characterization
Centralized Topology with Data integration

- Difficult with stove pipe systems
  - Networks too big, complex,
  - Dynamic
  - RF data alone will not be enough
  - Need everything in the link
- Data integration is required
- Can also add:
  - Modem/TDMA hub information
  - Analytics
  - Contract/mission requirements
  - Planning/scheduling system inputs
  - NMS
Data Acquisition Challenges:

- Number of beams
  - Cost to put sensors in all of them
  - Different value beams, services (missions)
- Hard to monitor beams
  - Beams that only covers water
  - Beams that move
- Dynamic system will have transient problem
Ensure LEO/MEO/GEO Environment

- Measuring RF energy to show compliance with ITU EPFD requirements
- Algorithms and measurements are fast enough to adjust to affects of Doppler during satellite pass
- Accurate time stamping of data acquisition
- Interference characterization, determine local (terrestrial) interference affecting gateway.
- Automated In Orbit Testing with Frequency Response, satellite gain and group delay
Radio Monitoring for Regulators
Comprehensive Solution for RF Monitoring Missions

MONICS

Centralize licenses, known satcoms and visible satellites

Plan and execute missions for license validation, interference resolution and ITU filing.

Provide results and generate mission reports

Monitor & Scan

Resolve & Report

CONCEPT OF REGULATORY OPERATIONS

CORE SYSTEMS

REGULATOR LAYER
Plan and execute missions for license validation, interference resolution and ITU filings.

MONITORING LAYER
Capabilities to detect, characterize and geolocate interference and control and assure equipment

RF LAYER
Full motion multi-band antennas covering all available extended frequency ranges and polarizations

MOBILE SYSTEMS

MOBILE MONITORING
RF monitoring analysis using monitoring vehicle and remote controlled drone.

ANTENNAS

GEOMON

LICENSING DATABASE

REMOTE CONTROLLED DRONE

MOBILE MONITORING SYSTEM

MONICS

ANTENNAS

DRONE

VEHICLE
GeoMon : 3 Main Regulator Tasks

1. Validation of Licenses
   • Mission: Ensure that transmitters from the country are identified and respect the bandwidth & power allocations of their license fee.

2. Location of Interferences
   • Mission: Find the location of unwanted transmitters using all provided tools by KISE.

3. ITU filing
   • Mission: Scan the orbital arc, find unknown and paper satellite.
Mission 1: License validation

- Main selections for mission 1
  - Satellites
  - Licenses to be checked
  - Antenna to be used

- Schedule and execution
  - Mission date and duration
  - Asset booking
  - Automated execution

- Results
  - Check of the central frequency
  - Check of the bandwidth
  - Check of the EIRP
  - Generation of report with all details and status
Mission 2: Interference Location

• Interference information
  – Drives operator in data collection
  – Log all interference details

• Schedule and execution
  – Book assets to run mission
  – Location performed from satID system
  – Log mission details

• Results
  – Generation of report with all details and status
Mission 3: ITU Filing

- Selections for mission 3
  - Slot
  - Frequency Band

- Schedule and execution
  - Mission date and duration
  - Asset booking
  - Automated execution

- Results
  - Comparison of Spectrum with database
  - Colorized matching display
  - Results tables display
  - Spectrum display
  - Generation of report with all details and status
• Identical concept for each mission
  – Creation
  – Schedule
  – Results and reports

• Optimization of assets
  – Antenna locked when mission
  – Assets conflict management
  – Mission execution progress display
  – Mission status display
SkyMiner Solution For Big Data Analysis

Monics

Compass

Epoch IPS

NMS & Other

Data Collector agent

Data Collector agent

Data Collector agent

Data Collector agent

Other Data Sources

External Analytics systems

SkyMiner Web UI

SkyMiner REv UI

Data Integration Frontend

Reporting & analytics Frontend

Storage

KairosDB

SkyMiner From Data to Knowledge
SkyMiner: Big Data Analysis

- Cradle to Grave understanding of the availability and long term performance metrics
- Status, alerts and near real-time performance on all aspects of the operations
- Reporting, trending and analysis on every facet of the content delivery landscape
- Rich visualization, web and mobile based applications for access anywhere/anytime.
- Correlation: determine if events have been seen before or if multiple seemingly not related events are linked
- Predictive analysis: Capacity management, trends and weather driven performance issues
- Hardware failures and optimization: Put capacity where it will be needed, when it will be needed

Why pick one datasource when you can have them all?
satID GEO TDMA Geolocation

- TDMA Geolocation can be exploited for more than just interference resolution
- Gain insight into the real satellite user base
  - Use TDMA Geolocation to geographically profile entire networks
  - Can facilitate better satellite planning in future
Unique Regulators Solutions

1. Already delivered Unique solution
   - Turning Head Regulator Designed Antenna
   - Moscito (Drone)
   - Mobilt Units (uplink and downlink)

1. New solution for Leo Monitoring
   - HTS Monitoring
   - LEO IOT system
   - LEO Monitoring system
   - LEO Geolocation System
Conclusion
What can we provide?

• Combination of **interacting** fixed and mobile Assets
  - **Fixed** Assets:
    • Earth Stations covering L, S, C, X, Ku and Ka-band
    • Spectrum monitoring and scanning
    • Geolocation of transmitters
    • Network Management
    • System database and automated procedures covering regulator missions
  - **Mobile** Assets:
    • Reference transmission unit for geolocation
    • Vehicle to monitor Earth-to-Space and Space-to-Earth transmissions
    • UAV based solution to track the transmitter like a very high mast
At Kratos, we have developed systems:

- Using proven COTS products leaders on the satellite communication market
- Already used by many commercial, military and government entities
- Scalable and innovative solutions
- Turned Key and regulator tailored system (GeoMon)
- Solution can be networked with other regulators to coordinate geolocation events
- Already used by TRAs (e.g. Oman, Brazil, Ukraine or Europe)
- Affordable cost

TRY KRATOS, We deliver!
Back Up Slides
Skyminer Solution

- Virtually keep all data forever... Scale to any size
- Enable Automated analysis to detect unknown information
- Enable Learning model to anticipate failures
- Enable Correlation between data sources
Simple and Quick User Interface

Mission 1: License validation
create, plan and report missions for license checks based on RF downlink measurement.

Mission 2: Interference Location
create, plan and report for interference geolocation missions.

Mission 3: ITU filing
create, plan and report mission to check orbital slot occupancy based on RF downlink measurement.

Database
Synchronisation tools for ITU License database or Satcom user details.

Operational Tools
Useful tools to ease daily operator missions.

Mission execution
Display of planned and executed missions.
Detection: Monics

- Identifies interference with advanced signal characterization
- Speed cross-verification between operators by identifying source of an interfering carrier with CarrierID
- Minimize resources to resolve incidents and decrease impact to service
Geo-location: satID Industry Leading Solution

- Industry’s leading, fastest, most accurate solution
- Map-based GUI offers unmatched awareness and ease of use
- Integrated with Monics, shares common hardware
- Performs interference and carrier-under-carrier characterizations
- Requires only two satellites for a location and only two antennas
- Works in any frequency band and across multiple beams
satID – Most Accurate Geolocation Solution

Enhance workforce utilization with intuitive interface

Improve geolocation accuracy with signal cancellation

Geo-locate within 5km of the interfering signal

Geo-locate hidden signals