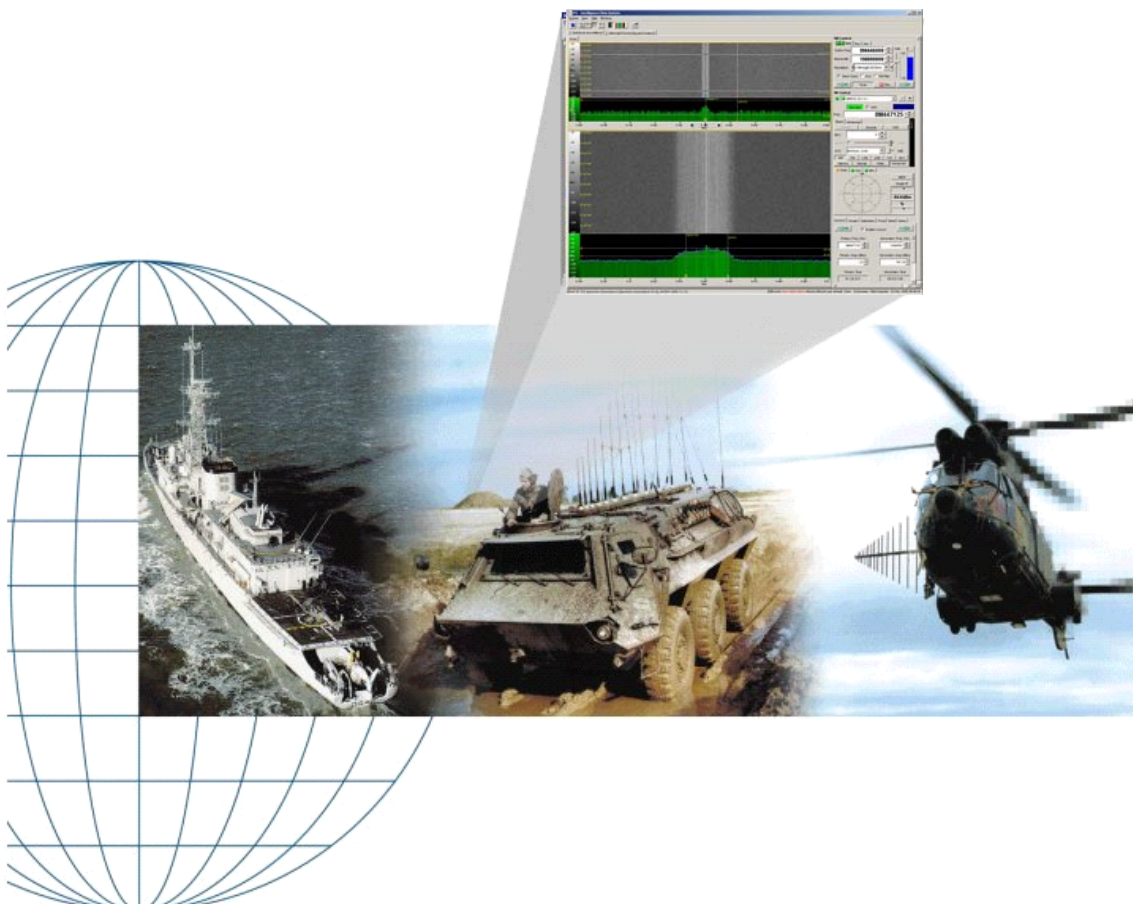
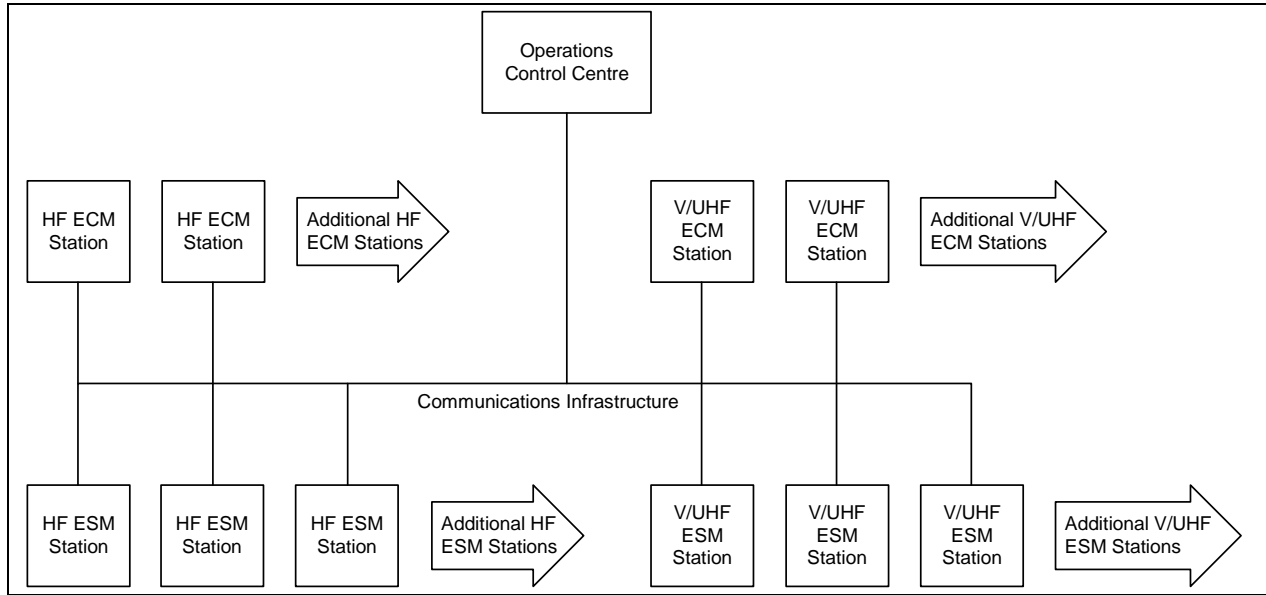


STRATEGIC WIDEBAND SEARCH, DIRECTION FINDING AND MONITORING ELECTRONIC WARFARE SYSTEM

- ◆ Scalable system architecture that may include HF and/or V/UHF ESM stations as well as HF and/or VUHF ECM stations
- ◆ Individual ESM stations scalable to meet operational requirements
- ◆ ESM stations have integrated Search, Direction Finding and Monitoring capabilities
- ◆ Audio and IF recording for subsequent analysis and transcription
- ◆ Online and offline signal analysis and data decoding
- ◆ Scheduled Audio and IF recording and decoding
- ◆ Automatic detection and notification of signal activity on pre-defined target frequencies
- ◆ Wideband IF recording for offline demodulation and de-hopping of Frequency Hopping Spread Spectrum (FHSS) transmissions
- ◆ Automatic analysis and classification of transmission type and protocol
- ◆ Geographic Information System (GIS) with map for display of results
- ◆ Intercepted information is stored locally and sent to central Operations Control Centre for archiving, analysis and tasking of ECM stations
- ◆ HF stations operate in the 1 - 30 MHz range
- ◆ V/UHF stations operate in the 20 - 3600 MHz range



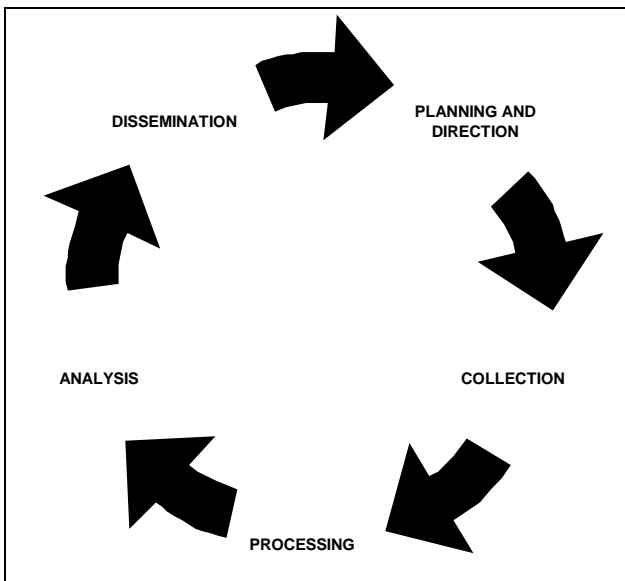
STRATEGIC EW SYSTEM OVERVIEW



Strategic System Overview

PURPOSE

The purpose of the strategic EW system is to support the strategic intelligence cycle.



Strategic Intelligence Cycle

ESM stations are tasked by the central Operations Control Centre, based on strategic intelligence requirements. Transmissions of interest are intercepted and transmitters are located by the ESM stations. Collected transmission data consisting of intercepts with Audio and IF recordings and Direction Finding LOBs can be processed either at the local ESM station or at the central Operations Control Centre.

Processed intercepts are archived and are available for data mining and intelligence analysis. ECM stations are tasked for strategic jamming operations based on data collected by the ESM stations.

STRATEGIC EW SYSTEM COMPOSITION

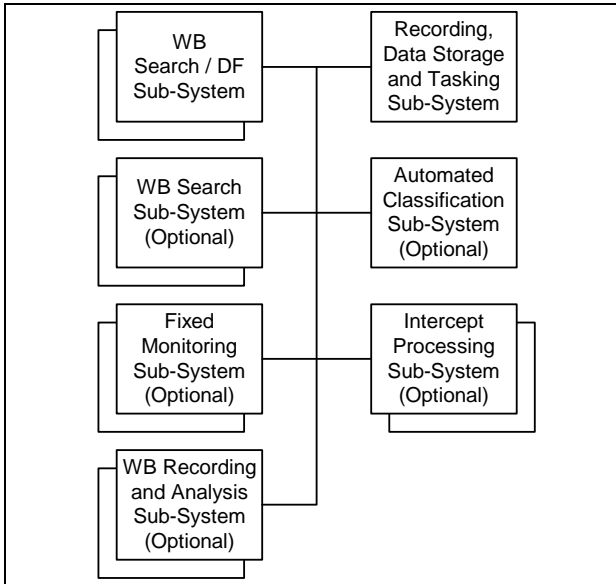
A strategic EW system can either be a HF system, a V/UHF system or both. A minimum of three HF or V/UHF ESM stations are required for location of target emitters, by means of triangulation. Additional ESM stations can be added to increase area coverage of the system and also to allow flexible assignment of triangulation baselines.

In addition, ECM stations can be added to the system for the jamming of identified target transmitters.

Communications between the stations and the central Operations Control Centre is done via the communications infrastructure that is normally supplied by the system user. This is typically a fixed Wide Area Network (WAN) or a satellite communications system but can also be a microwave link or other fixed line or wireless network. The speed and bandwidth of this communications network is a key factor in determining the performance of the system.

ESM STATION SUB-SYSTEMS

Each station consists of a number of sub-systems, some of which are optional. Multi-client servicing by sensors together with pooled resource management provides scalability which allows for multiples of each sub-system to be added depending on operational requirements.



Station Sub-Systems

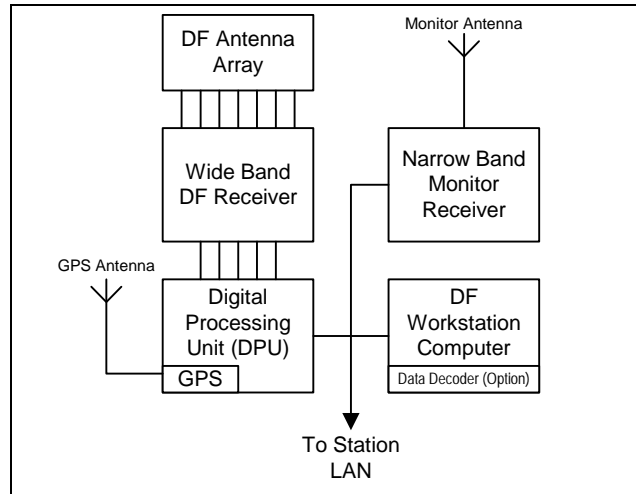


View of typical Strategic EW Station showing equipment cabinets and workstations

WIDEBAND SEARCH / DF SUB-SYSTEM

The most basic of EW stations shall contain at least one Wideband Search / DF sub-system. This sub-system consists of an antenna array, a Wideband DF Receiver with Digital Processing Unit (DPU), a GPS receiver, a Narrow Band Monitor Receiver and a DF Workstation Computer. The server nature of the DPU allows easy scaling of the number of workstations connected as clients.

Optionally one or more data decoders can be installed on the DF Workstation where no additional decoding capability is present in the system.



Wideband Search / DF Sub System

Depending on the performance required a number of HF and V/UHF direction finders are available.

HF Direction finders:

- MRD30W family of direction finders
- MRD5000W9 9-channel direction finder

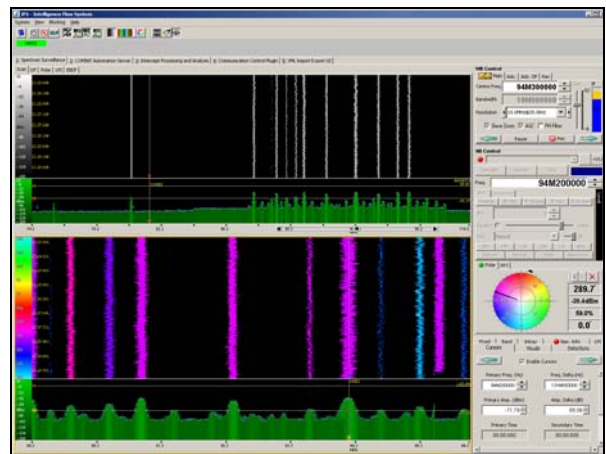
V/UHF Direction finders:

- MRD3000W family of direction finders
- MRD7000W family of direction finders

Combined HF and V/UHF Direction finders:

- MRD3030W family of direction finders
- MRD7000HU direction finders

A range of active and passive interferometric and Watson-Watt antenna arrays are also available.



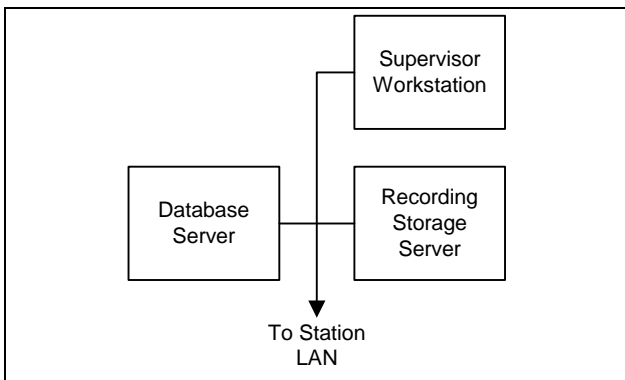
Wideband Search / DF User Interface

The Wideband Search / DF sub-system is tasked by the Station Supervisor via the LAN. The DF operator can task DF sensors in other stations in the system to do co-ordinated baseline direction finding in order to locate transmitters using triangulation. All the DF measurements can be displayed on a built-in map for best point calculation and can be linked to an intercept and saved via the LAN to the local Recording and Data Storage Sub-System. The WB Search / DF sub-system also has a Low Probability of Intercept (LPI) capability for identifying and doing direction finding on frequency agile signals like burst and FHSS signals.

The Narrow Band Monitor Receiver is used for monitoring transmissions and can stream digital Audio and Narrowband IF data for recording to the Recording Storage Server. For monitoring, one of the MRR6000 compact series of HF, V/UHF or combined HF and V/UHF receivers can be used.

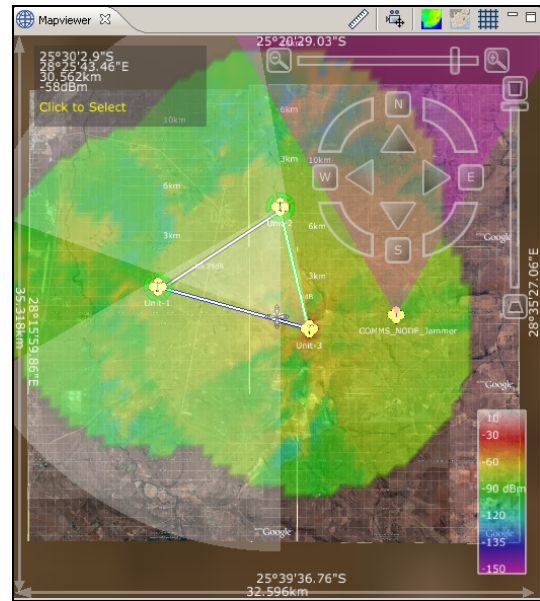
RECORDING, DATA STORAGE AND TASKING SUB-SYSTEM

This sub-system is also an essential part of a basic EW station. The sub-system consists of a Supervisor Workstation, a Database Server and a Recording Storage Server. For smaller systems, these functions may be combined on a single computer.



Tasking, Recording and Storage Sub-System

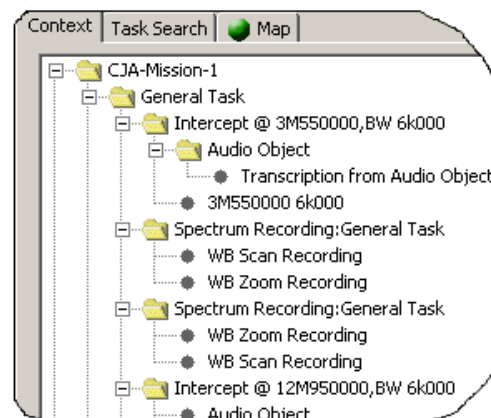
The Supervisor Workstation can receive tasks from the central Operations Control Centre. It can also create additional tasks for the station. Tasks are allocated to the different sub-systems in the station for execution. Intercepts are verified by the supervisor and sent to the central Operations Control Centre. The Supervisor can also view DF results on a built-in map viewer.



Map Viewer

Digital Audio and IF is streamed from the monitor receivers in the system to the Recording Storage Server. This server is also responsible for archiving of recordings to secondary storage media.

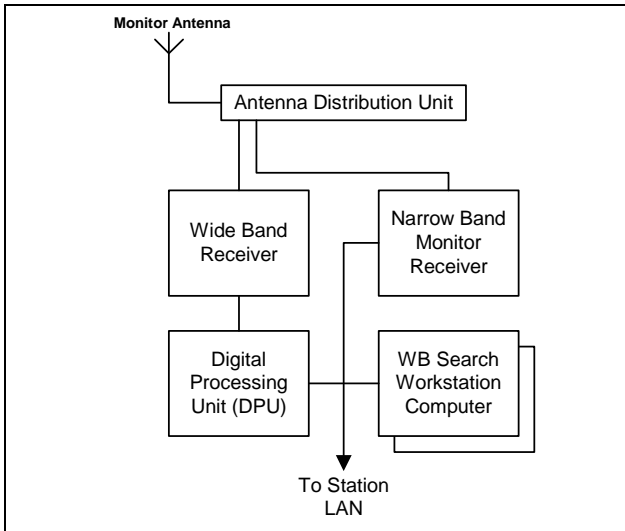
Tasking and intercept data are stored on the database server. All Audio and IF recordings, LOBs, Best Points and other detections for a specific transmission are linked to a corresponding intercept. Intercepts are processed by extracting data like message content, call signs, data decoding parameters, transmitter locations, etc. from the linked detections and entering the data on an intercept form. In smaller systems, intercepts are processed by the intercepting operator but in larger systems, operators in a dedicated intercept processing sub-system will do the processing in order to increase the availability of the sensors.



Tasking and Intercepts

WIDEBAND SEARCH SUB-SYSTEM

In stations where additional Wideband search capability is required, an optional Wideband Search sub-system can be added. The sub-system consists of a Wideband Receiver with Digital Processing Unit (DPU), a Narrow Band Monitor Receiver and a WB Search Workstation Computer.



Wideband Search Sub-System

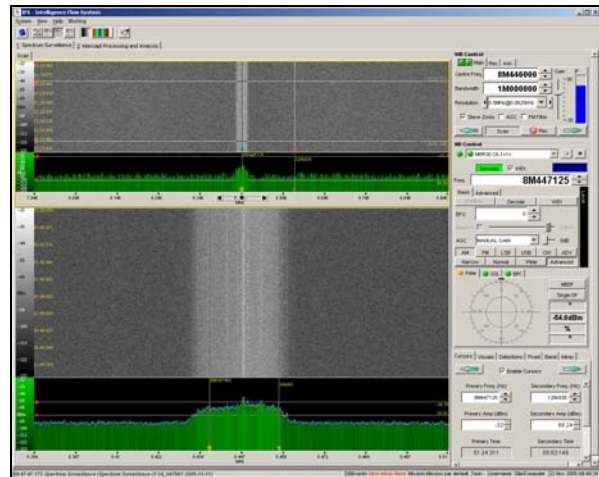
The Wideband Search sub-system is similar in operation to the Wideband Search / DF sub-system except that no Wideband direction finding data is available. This sub-system can however independently task the Wideband Search / DF sub-system for ad-hoc DF operations and the DF results returned can be linked to intercepts.

In a system where a Fixed Monitoring Sub-System is available, the Wideband Search Operator may hand down active frequencies to Fixed Monitoring Operators for monitoring in order to improve the utilisation of the wideband search resources.

For HF WB Search, the MRS8000LH or MRS30E receivers are available. The MRS8000LH has a built-in demodulator and does not need an additional narrow band monitor receiver.

For V/UHF WB Search, the MRS8000VU or MRS3000D receivers are available. The MRS8000VU has a built-in demodulator and does not need an additional narrow band monitor receiver.

For the MRS30E and MRS3000D receivers, two Wideband Search Workstations can share the wideband receiver, increasing the search capability of the system.

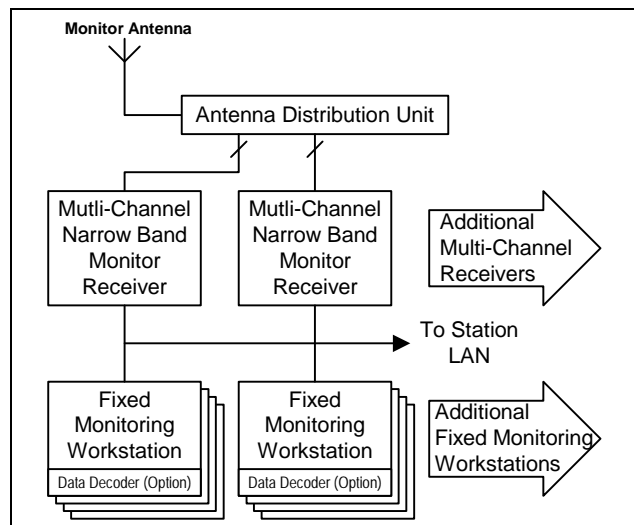


Wideband Search User Interface

FIXED MONITORING SUB-SYSTEM

In a station where it is required that a number of fixed frequencies be monitored, a Fixed Monitoring Sub-System can be added. This sub-system consists of one or more multi-channel narrowband receivers and for each multi-channel narrowband receiver one or more fixed monitoring workstations. Receiver channels are allocated to workstations as required by the operational requirements.

Optional data decoders can be installed in the fixed monitoring workstations.



Fixed Monitoring Sub-System

Fixed Monitoring Workstations can operate in one of two modes:

In **Direct Monitoring mode**, the workstation is manned by an operator. The operator scans through a list of frequencies allocated to him by the Supervisor. When a frequency goes active, the operator stops scanning and starts an intercept on the active frequency.

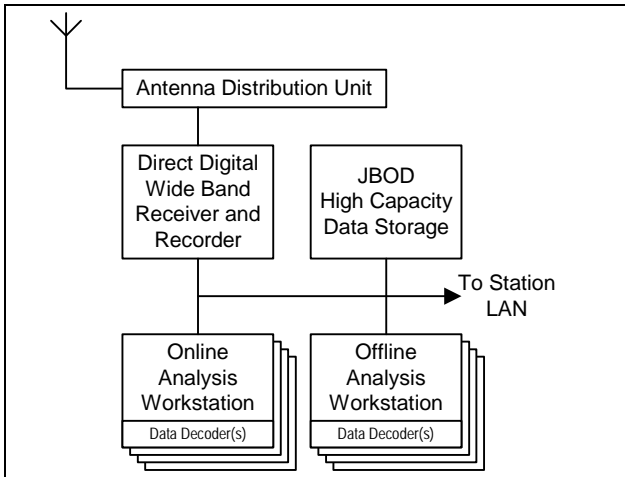
The operator can now initiate an Audio or IF recording and also request a local or baseline DF operation from the Wideband Search / DF sub-system. All recordings and DF results are attached to the active intercept. Once the intercepted frequency goes inactive, the intercept information can be saved and the operator can continue scanning of frequencies in his list.

In **Scheduled Monitoring mode**, the list of frequencies assigned to the workstation is submitted to the COMINT Automation Server (CAS) for automatic execution at scheduled times. The CAS will then automatically initiate Audio or IF recordings and DF operations on the frequencies at the scheduled times. All recordings and DF results are attached to intercepts.

In a station where no intercept processing sub-system is available, intercepts are processed by the operators whom extract data like message content, call signs, data decoding parameters, etc. from the linked detections and entering the data on an intercept form. Offline data decoding can also be done for recorded signals.

WIDEBAND RECORDING AND ANALYSIS SUB-SYSTEM

The Wideband Analysis and Recording Sub-System consists of a Direct Digital Wideband Receiver and Recorder unit, a JBOD High Capacity Data Storage unit, one or more Online Analysis Workstations and one or more Offline Analysis Workstations.



Wideband Recording and Analysis Sub-System

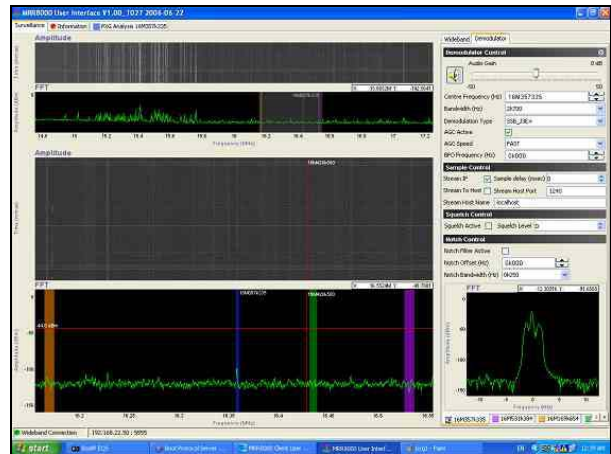
The MRR8000 family of Direct Digital Wideband Receivers each have a single wideband receiver and 4 to 16 Direct Digital Conversion (DDC) demodulators in the same unit.

The MRR8050 family of Direct Digital Wideband Receivers have three independent wideband receivers with 8 Direct Digital Conversion (DDC) demodulators each, making 24 in total.

For a MRR8000 based Wideband Analysis and Recording Sub-System, there is a single Online Analysis Workstation and one or more Offline Analysis Workstations.

For a MRR8050 based Wideband Analysis and Recording Sub-System, there can be up to three Online Analysis Workstations and one or more Offline Analysis Workstations.

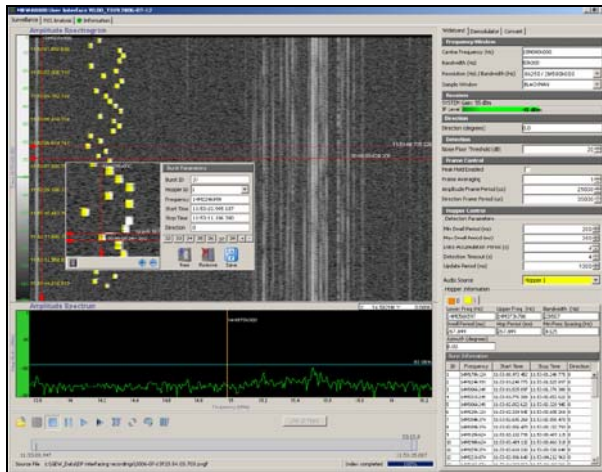
The Online Analysis Workstation can do wideband search and can tune any of the DDC demodulators to active frequencies in the band. The digital IF streams from these DDC demodulators can be recorded to the Recording Sub-System or can be routed to data decoders for online decoding. The Online Analysis Workstation can also initiate wideband IF recordings. These recordings are stored on the JBOD mass storage unit.



The MRR8000 User Interface

The Offline Analysis Workstation features the MRWA8000 application that can be used to play back the wideband recordings made by the Online Analysis Workstation. Individual narrow band signals in the wideband recording can be demodulated offline and the narrowband IF can be extracted and stored in the Recording Sub-System. Narrow band IF streams extracted from the wideband recording can also be routed to data decoders for offline decoding.

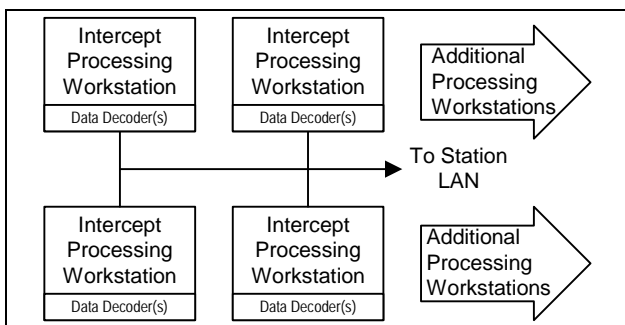
The MRWA8000 application can also be used to de-interleave and demodulate Frequency Hopping Spread Spectrum (FHSS) signals. The application can also use synchronised wideband DF recordings from the MRD family of wideband direction finders in order to distinguish between different overlapping hopper transmitters in the same band.



The MRWA8000 User Interface

INTERCEPT PROCESSING SUB-SYSTEM

In EW stations where large numbers of intercepts are made, it is more efficient to have an offline intercept processing sub-system. This will free up intercept operators to do more interceptions.

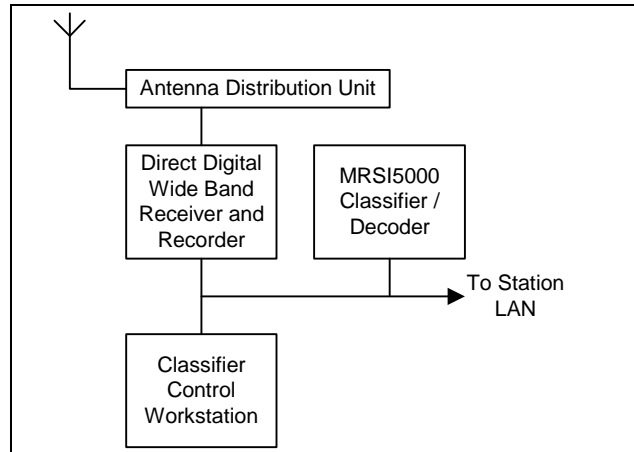


Intercept Processing Sub-System

The Intercept Processing Sub-System consists of a number of workstations with data decoding capability that can access stored intercepts and process the intercepts by transcribing voice communications to the intercept form, identify message details like call signs and do offline decoding on recorded data signals. The operator can also plot measured LOBs and calculate best points on the built-in map.

AUTOMATED CLASSIFICATION SUB-SYSTEM

The Automated Classification Sub-System consists of a Direct Digital Wideband Receiver, a MRSI5000 Classifier / Decoder and a Classifier Control Workstation.



Automated Classification Sub-System

The Direct Digital Wideband Receiver can be either a MRR8000 or MRR8050 family receiver. The number of channels that can be simultaneously classified and decoded ranges from 8 to 24 channels. (Refer to previous page.)

The Sigma user interface on the Classifier control workstation provides a number of modes of operation:

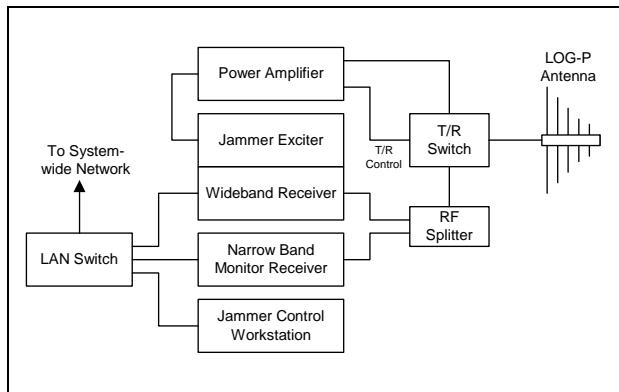
In **Traffic Analysis mode**, the sub-system will scan a given section of the spectrum over a period of time and will classify the modulation and protocol of each signal encountered. This mode can be used to determine the types of signals and transmission schedules of the signals present in the portion of the spectrum.

The **Spectrum Surveillance Mode**, is similar to the Traffic Analysis mode but in addition, the system will decode a sample of each data signal to enable the operator to identify the user of the channel.

In **Production mode**, a prioritised list of target frequencies is provided. The sub-system will scan the list of frequencies for activity and will decode any active signals. When all channels on the classifier are occupied, higher priority frequencies will override lower priority frequencies.

ELECTRONIC COUNTER-MEASURE (ECM) STATION

An Electronic Counter-measure Station will have of one or more frequency jammers. The GRJ8000 family of single and multi-channel HF and V/UHF jammers are available.



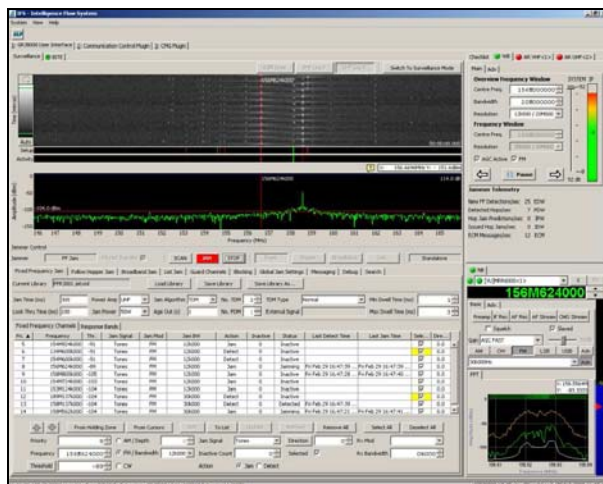
ECM Station Layout

A jammer system consists of a Jammer Control Workstation for tasking and control of the jamming equipment, a Narrow Band Monitor Receiver for monitoring target frequencies, a Wideband Receiver for detection of target signals, a jammer exciter to generate jamming waveforms, one or more power amplifiers for amplifying the jamming signals, a Transmit / Receive Switch to switch the antenna for monitoring or transmission.

The ECM station will be tasked by the central Operations Control Centre. A list of targets will be provided.

The following jamming modes are available:

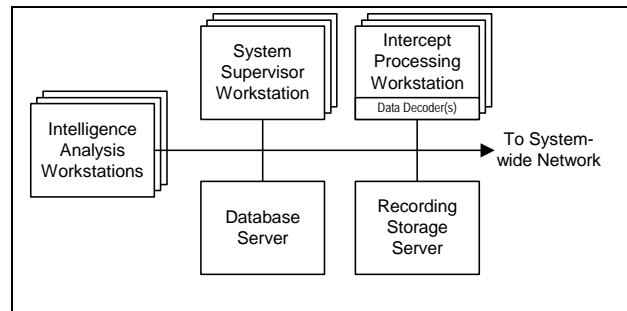
- Fixed-frequency look-through jamming
- Wideband barrage jamming
- Hopper follower jamming



Jammer Control Interface

OPERATIONS CONTROL CENTRE

The Operations Control Centre is the central facility that directs the activities of all the stations in the Strategic EW System. All information collected by the stations is sent to the Operations Control Centre for intelligence analysis and dissemination.



Operations Control Centre

The Operations Control Centre will have one or more System Supervisor Workstations. The System Supervisors will each be responsible for tasking and direction of a number of stations in the Strategic EW System. They will also verify incoming intercepts. Verified intercepts will be archived and are available for data mining and intelligence analysis. For this purpose, Intelligence Analysis workstations can be provided.

Incoming intercepts and recordings from the different stations will be stored on the Database Server and Recording Storage Server.

If required, optional Intercept Processing Workstations with data decoders can be provided for offline processing of intercepts at the Operations Control Centre. The function of these workstations will be the same as described for the Intercept Processing sub-system.

ABBREVIATIONS

BP	Best Point
CAS	COMINT Automation Server
CASUI	COMINT Automation Server User Interface
COMINT	Communications Intelligence
DDC	Direct Digital Conversion
DF	Direction Finding
DPU	Digital Processing Unit
FHSS	Frequency Hopping Spread Spectrum
GIS	Geographic Information System
GPS	Global Positioning System
ESM	Electronic Support Measures
ECM	Electronic Counter-Measures
EW	Electronic Warfare
HF	High Frequency
IF	Intermediate Frequency
JBOD	Just a Box Of Disks
LAN	Local Area Network
LOB	Line of Bearing
LPI	Low Probability of Intercept
SSUI	Spectrum Surveillance User Interface
TCP/IP	Transmission Control Protocol/Internet Protocol
V/UHF	Very/Ultra High Frequency
VHF	Very High Frequency
WAN	Wide Area Network
WB	Wideband

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