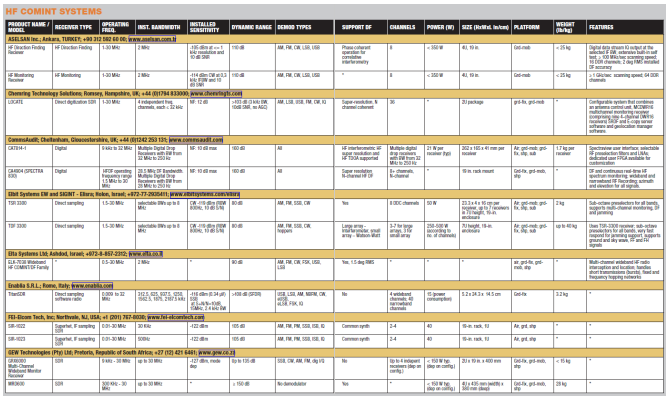
Technology Survey: A Sampling of HF COMINT and DF Systems and Receivers – JED, September 2018

– By Barry Manz –

As the DOD has moved toward higher and higher operating frequencies as new threats have appeared, the SIGINT community spent considerably less time worrying about the spectrum between about 3 and 40 MHz. A few years ago, however, some within the defense community began warning why ignoring HF in the future is bad policy, and HF SIGINT is now slowly rising from the dead, with programs such as DARPA's HF GEO among others working to make detecting and locating threats more effective using smaller equipment and more sophisticated signal analysis techniques.



HF COMINT SYSTEMS

PRODUCT NAME / MODEL	RECEIVER TYPE	OPERATING FREQ.	INST. BANDWIDTH	INSTALLED SENSITIVITY	DYNAMIC RANGE	DEMOD TYPES	SUPPORT DF	CHANNELS	POWER (W)	SIZE (HxWxd, in/cm)	PLATFORM	WEIGHT (lb/kg)	FEATURES
ASELSAN Inc., Ankara, TURKEY; +90 312 592 60 00; www.aselsan.com.tr													
HF Direction Finding Receiver	HF Direction Finding	1-30 MHz	2 MHz	-135 dBm at <= 1 MHz BW and 0+7 dB SNR	110 dB	AM, FM, CW, LSB, USB	Phase-coherent antenna for correlative interferometry	8	< 550 W	40, 19 in.	Cot-mob	< 25 kg	Digital data stream IQ output at the antenna; 1 kHz IBW; 360° azimuth full test; < 500 MHz/sec scanning speed; 10 DOA channels; 2 deg RMS emitted DF accuracy
HF Monitoring Receiver	HF Monitoring	1-30 MHz	2 MHz	-114 dBm CW at 3.1 kHz BW and 10 dB SNR	110 dB	AM, FM, CW, LSB, USB	"	8	< 350 W	40, 19 in.	Cot-mob	< 25 kg	> 1 GHz/sec. scanning speed; 64 DOR channels
Chemring Technology Solutions; Romsey, Hampshire, UK; +44 (0)1794 833000; www.chemringtn.com													
LOCATE	Direct digitization SDR	1-30 MHz	4 independent freq. channels, each < 24 kHz	NF: 12 dB	>433 dB (3 kHz IBW, 10dB SNR, no AGC)	AM, LSB, USB, FM, CW, IQ	Super-resolution, N-channel coherent	36	"	3U package	grd-fix, grd-mob	"	Configurable system that combines multi-channel receiver, DF and multichannel monitoring receiver accompanying data. 4 digitiser DMN19 or DMN20 units. Includes control software and geolocation manager software.
CommsAuditt; Cheltenham, Gloucestershire, UK; +44 (0)1242 253 131; www.commsaudit.com													
CAT914-1	Digital	0 kHz to 32 MHz	Multiple Digital Drop Receivers with IBW from 12 MHz to 250 Hz	NF: 10 dB max	160 dB	All	HF interferometric HF signal resolution and HF TDOA supported	Multiple digital drop receivers, with IBW from 12 MHz to 250 Hz	21 W per receiver (typ)	3OD x 162 x 41 mm per receiver	Air, grd-mob, grd-fix, ship, sub	1.7 kg per receiver	Spectrowiser user interface; selectable SK preselection filters and LNAs; dedicated user FPGA available for customisation
CA4024 (SPECTRA 220)	Digital	MCSF operating frequency range 1.5 MHz to 30 MHz	32.5 MHz Of Bandwidth Multiple Digital Drop Receivers with IBW from 20 MHz to 250 Hz	NF: 10 dB max	160 dB	All	Super-resolution N-channel HF DF	8 – channels, N-channel	"	19 in. rack mount	Grd-fix, grd-mob, ship	"	HF and multi-channel real time HF spectrum monitoring, wideband and narrowband HF Recording, azimuth and elevation for all signals.
Elbit Systems EW and SIGINT – Elisra; Holon, Israel; +972-77-2626541; www.elbitsystems.com/elisra													
TSR 3300	Direct sampling	1.5-30 MHz	selectable BWs up to 8 MHz	CW: <10 dBm (SNR 6DHz), 10 dB S/N	90 dB	AM, FM, SSB, CW	Yes	8 DOC channels	50 W	22.3 x 4 x 10 cm per receiver, up to 7 receivers in a single 19 in. enclosure	Air, grd-mob, grd-fix, ship, sub	2 kg	Sub-octave preselectors for all bands; supports multi-channel monitoring, DF and jamming
TSF 3330	Direct sampling	1.5-30 MHz	selectable BWs up to 8 MHz	CW: <10 dBm (SNR 6DHz), 10 dB S/N	90 dB	AM, FM, SSB, CW, hoppers	Large array – interferometer, small array – Watson-Watt	3-7 for large arrays, 3 DF small array	250–330 W (according to no. of channels)	3U height, 19 in. enclosure	Air, grd-mob, grd-fix, ship, sub	up to 40 kg	Uses TSR-3300 receiver; sub-octave preselectors for all bands; wary fast request for jamming support; supports wideband and sky wave, FF and FH signals
Elta Systems Ltd; Ashdod, Israel; +972-8-857-2202; www.elta.co.il													
ELA-7030 Wideband HF COMINT/DF Family	"	0.5-30 MHz	2 MHz	"	90 dB	AM, FM, CW, FSK, LSSL, LSD	Yes, 1.5 deg RMS	"	"	"	air, grd-fix, grd-mob, ship	"	Multi-channel wideband HF radio interception and location; handles short transmissions (bursts); fixed and frequency-hopping networks
Enodia S.R.L.; Rome, Italy; www.enodia.com													
ThorESR	Direct sampling software radio	0.009 to 32 MHz	512.5, 625, 937.5, 1250, 1562.5, 1875, 2187.5 kHz	-110 dBm @ 24 dB SINAD, 2.4 kHz BW	>109 dB (SFDR)	USB, LSB, AM, NBFM, CW, eCSB, FSK, IQ	No	4 wideband channels; 48 narrowband channels	15 (power consumption)	0.2 x 24.3 x 14.5 cm	Cot-fix	3.2 kg	"
FEI-Elcom Tech, Inc; Northvale, NJ, USA; +1 (201) 767-0030; www.fei-elcomtech.com													
SIR-1522	Superhet, IF sampling SDR	0.01-30 MHz	30 kHz	-122 dBm	105 dB	AM, FM, FM, SSB, ISB, IQ	Common-synth	2-4	40	19-in. rack, 1U	Air, grd, ship	"	"
SIR-1622	Superhet, IF sampling SDR	0.01-30 MHz	500kHz	-122 dBm	105 dB	AM, FM, FM, SSB, ISB, IQ	Common-synth	2-4	40	19-in. rack, 1U	Air, grd, ship	"	"
SDR Technologies (Pty) Ltd; Pretoria, Republic of South Africa; +27 (12) 421 4481; www.sdr.co.za													
SDR8000 Multi-Channel Wideband Monitor Receiver	SDR	9 kHz – 30 MHz	up to 30 MHz	-127 dBm, mode dep	Up to 135 dB	SSB, CW, AM, FM, sky I/Q	No	Up to 4 indepent receivers (dep on config)	< 150 W typ. (dep on config.)	20 x 19 in. x 400 mm	Cot-fix, grd-mob, ship	< 15 kg	"
MR3630	SDR	100 KHz – 30 MHz	up to 30 MHz	"	> 150 dB	No-Semiconductor	Yes	"	< 150 W typ. (dep on config.)	43 x 435 mm (width) x 560 mm (deep)	Cot-fix, grd-mob, ship	28 kg	"

Click the image above to view the complete survey table. For the best viewing experience, open in PDF viewer and select "Two Page View" in Page Display settings.

There are plenty of good reasons why the resurgence of SIGINT

at these frequencies is not only necessary but urgent, and it has a lot to do with signal propagation characteristics that are different than anywhere else in the spectrum. These characteristics vary with time of day, the day of the year, the sunspot cycle, and other factors that make propagation at these frequencies far less predictable than their VHF, UHF and microwave counterparts.

It’s also the only region of the spectrum where, at some time during the day, everywhere on Earth, it’s simultaneously possible to communicate great distances via skywave propagation, as well as short distances via ground wave propagation. At higher frequencies, propagation is, with a few exceptions, almost exclusively line-of-sight over a tiny fraction of these distances. Collectively, they make HF an excellent spectral region for hiding communications, without the need for massive amounts of equipment or deep technical expertise. What it does take is a reasonable knowledge of signal propagation, preferably bolstered by hands-on experience, an amateur radio transceiver, antenna, and 12 V battery — and a fair amount of luck.

Consider this simple scenario. An adversary is operating an amateur transceiver with an RF output of 50 W, connects this to an antenna and a power supply, and records a sequence of plain text on a cassette recorder, which is plugged into the microphone jack of the transceiver. At a predetermined time, the person transmitting the signal keys to a transmitter at, say, 7.2 MHz, and plays the recorded sequence at a speed much higher than at which it was recorded, requiring a transmission time of perhaps 2 sec.

Of course, there’s no guarantee that the recipient will hear it owing to the aforementioned propagation unpredictability, but there is at least a reasonable chance that it will be. This is possible because although unpredictable, propagation characteristics at a specific frequency don’t change much on a day-to-day basis (except when they do). And even if the first

attempt is unsuccessful, it can be repeated the same day or the next one. Add the element of surprise into the scenario, as well as a directional antenna that doubles or triples the output of the transmitter and dramatically reduces beamwidth thus reducing the likelihood of detection by direction finding, and it's easy to see why HF is a highly useful refuge.

As for HF communications intelligence, it's significantly different from, and more difficult than, at higher frequencies because there is generally always an extraordinary level of atmospheric and electrical noise, along with many broadcast stations and other emitters, whose signals can be detected over vast distances. In short, detection is as difficult or more so for those attempting to intercept it, as it is for the intended recipient.

Geolocating an emitter in the HF band is even more difficult because of ionospheric polarization rotation, multipath-induced signal fading, multiple angles-of-arrival and other propagation effects. Huge antenna arrays have been required – a full wavelength at 7 MHz, for example, is about 80 ft. – and geolocation requires resources at multiple locations. Even then, detection and pinpointing the location of a signal like the one described above is far from a certainty. Finally, as the target's equipment is small(ish) and portable, a transmit-and-run approach is easy to achieve.

Taken together, it's arguable that increased attention to HF SIGINT hasn't come a moment too soon. The new equipment resulting from these SIGINT efforts includes high-dynamic-range receivers, adaptive signal processing and ionospheric ray path prediction and modeling to accurately determine the state of the ionosphere in near real time. It will also result in deployment of much smaller and less-expensive antenna arrays that can be placed in far more locations. In short, HF SIGINT is back, finally in a big way.

In the survey table, the first column provides the product name or model number. This survey included complete HF SIGINT and/or DF systems, as well as dedicated HF SIGINT and DF receivers. The second column indicates the receiver type, followed by its operating frequency range, instantaneous bandwidth, installed sensitivity and dynamic range. The next column describes the types of signals the system can process. The following column indicates if the system can perform direction finding and how many channels the system features. The remaining columns describe power, size weight and platform types. ♦

Click here to view the complete survey table. For the best viewing experience, open in PDF viewer and select "Two Page View" in Page Display settings.

If you enjoyed this article, please share. If you would like to read more articles like this one, we encourage you to join the AOC to receive a copy of *JED* every month.