Defence Communications Systems

SELFNET® IP WAVEFORMS SUITE COMMUNICATING ON SDR RADIOS

Leonardo offers a comprehensive portfolio of SDR Waveforms, providing the forces in land and naval domain with both National/Nato Standard and New Generation IP Networking waveforms; this allows the defence administrations to interoperate with the already fielded former conventional, non-reconfigurable and non-SDR Radio Platforms, as well as to instantiate the same SDR reconfigurable platform with the newest emerging waveforms for fulfilling the commitment of specific advanced mission scenarios.

Our SDR Waveform portfolio is commonly delivered as a Software Suite package composed by executable files, support kit software and user manuals. Leonardo also delivers off-the-shelf product solutions as all the waveforms are natively provided as 'mission-ready' on our SWAVE® native SDR Platforms family.

SelfNET New Generation of IP Networking Waveforms is a suite of modern IP protocol based communications Waveform delivered for all the Swave SDR Radios. Generally, SelfNET suite provides secure wireless networking services for mobile and stationary forces to voice, data and video.

KEY BENEFITS

- Comprehensive support of C4ISR critical and multi-services MANET in meshed topologies communication scenarios:
  – Wideband Communications for dismounted squad
  – Tactical-Edge enabled waveforms
  – Single Nation or Coalition for Light multirole and/or armoured vehicles at Backbone level
  – Customized throughput versus coverage narrowband communications scenario
  – Support of Big networks with hundreds of nodes.
- Delivered Off-the-Shelf onto Leonardo Swave® radios
- Suitably customized SelfNET® Suite may be loaded on each reconfigurable Software-Defined-Radio that is conformant with JTNEC SCA 2.2/ESSOR SCA and evolutions
- Availability of WIDE Factory for international market.

LEONARDO

SELFNET® IP WAVEFORMS

SelfNET® products satisfy the requirements of the modern battlefield basically delivering agile meshed-topology communications schemes at any order of the military hierarchy in land and maritime domain. Coordination amongst network nodes along with agility in maintaining network topology on-the-move, makes of these waveforms the essential factor to turn around the support of a real information superiority of the forces in the battlefield.

SelfNET® networking waveforms product suite is composed by Soldier Broadband Waveform (SBW), NarrowBand Adaptive Waveform (NBAW), Essor HDR, S-HCDR, Personal Role Radio Waveform (PRR) and Enhanced Antijam System II (EASY-2).

SBW is a VHF/UHF wideband self-forming/self-healing meshed topology network operating soldier/vehicle waveform for up to 64 nodes. SBW maintains up to 500kbps throughput connectivity at 130km/h.

NBAW is a VHF/UHF narrowband self-forming/self-healing meshed topology network operating at soldier/vehicle level for up to 32 nodes. SBW and NBAW are advanced solutions for a military Combat Net Radios.

ESSOR High Data Rate WF (HDR) is VHF/UHF running on a Nx1.25 Mhz bandwidth (N=1,..,4) self-forming/self-healing wideband meshed network operating at brigade/battalion/company/platoon level for up to 200 nodes. Supported services are C2SA IP data and multipoint VoIP conferences/communications.

S-HCDR is the WF version for SDR/SCA radios, for Italian Army adoption, of the widely market adopted HCDR radio.

PRR WF is an individual soldier-level WF highly at LoW Probability of Interception and Detection and operates as a meshed MANET.

EASY-2 WF is a narrowband ECCM Waveform supporting Point-to-Multipoint communications in a Fast-Frequency_hopping scheme.

WFs	Types of Tactical Scenario					
	Soldier		Ship, Vehicle Deployed Area		MANET	BAND
	Edge	Non Edge	Edge	Non Edge		
SBW	✓	✓	✓	✓	Yes, 64	V/U
NBAW	✓	✓	✓	✓	Yes, 32	V/U
HDR			✓	✓	Yes, 200	V/U
HCDR			✓	✓	Yes, 200	V/U
PRR	✓	✓	✓	✓	Yes, Squad	V/U
EASY II	✓		✓		PtomP	V/U

Benefits came through specific market and design experience paths whose main cornerstones are:
- Leonardo Swave® Land and Naval Platforms are fully reconfigurable
- Leonardo Swave® Land and Naval Platforms are based on JTNEC SCA 2.2 / ESSOR SCA and evolutions
- Leonardo SDR HF/VHF/UHF Standard and SelfNET® WFs portfolio supports manifold operational scenarios
- Leonardo successfully ported WFs on the Swave Platforms through a well-defined process and methodology
- The purpose is to seize the opportunity of the manifold communication schemes as a win-win factor for customers, manufacturers and all the stakeholders
- Leonardo is willing to provide the same methodology and tools for being used by the customers
- As the business challenge of porting the national waveforms is achieved, increased interoperability is, beyond Capex saving and technology modernization, the expected final goal of this process.

LEONARDO WIDE

Waveform Integrated Development Environment WIDE is the Leonardo Waveform Development Environment to allow the porting of Customised Waveforms onto Leonardo's SDR Radio. WIDE is for those users, Defence Administrations and Appointed Companies, who want to develop and deploy their National Communications Solutions for a variety of applications (Land, Naval, Maritime, other) onto Leonardo's SDR Platforms.

WIDE allows to implement all the design and development phases of a Waveform, from the emulation of the Waveform components in an Synthetic Environment up to the integration, functional and performance testing on real time platforms. This capabilities span up to the definition of the security features of the Waveforms, as defined in accordance with the National operational requirements and the applicable certification processes.

WIDE assumes the same basic approach of the well proven concept of Base Waveform and Target Waveform standardized by NATO and experienced mainly in, SCA compliant, ESSOR program.
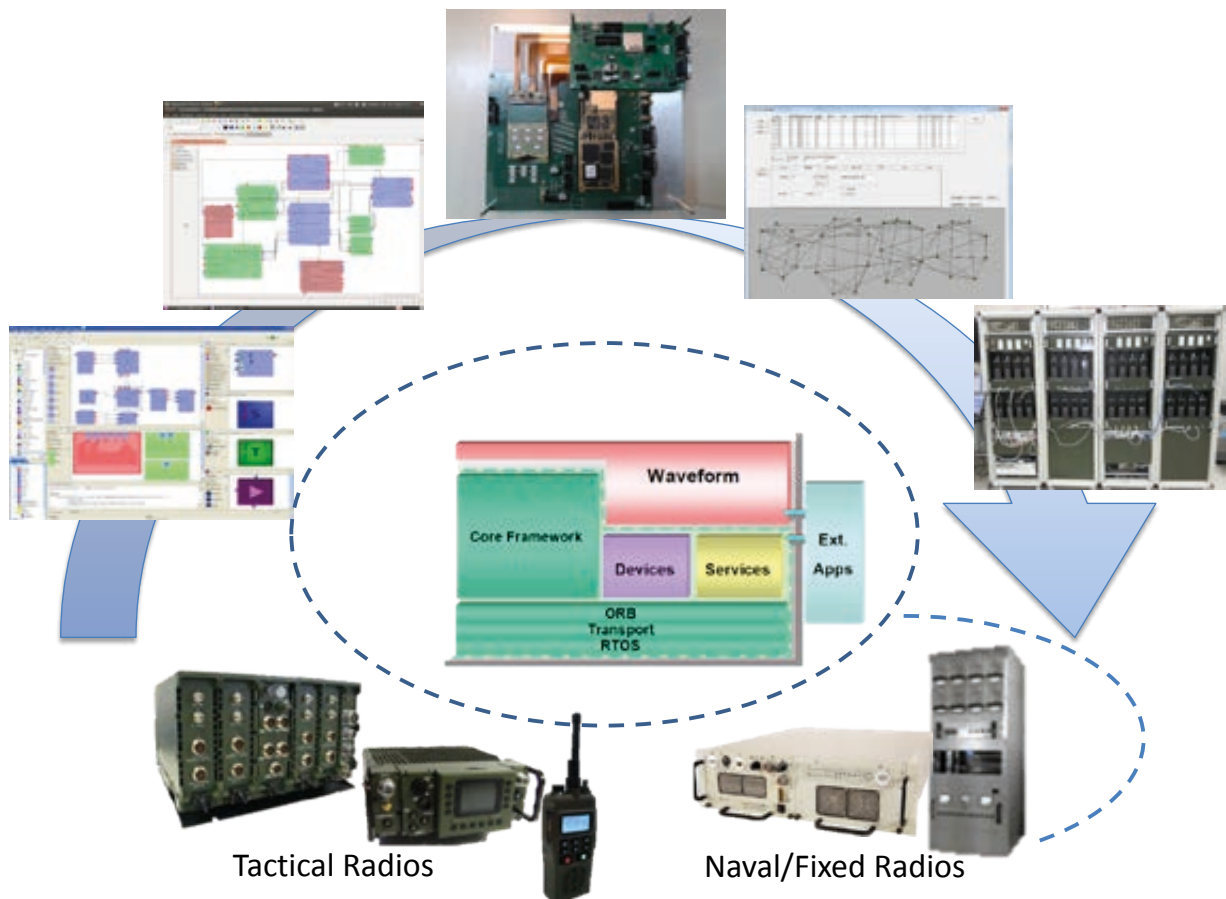
The Base Waveform is independent from the target radio platform; it cames as Waveform specifications or functional modeling in the early stage for new ones or it can be derived from a not SDR radio already fielded.

Following the desing, simulation and functional convalidation of Base Waveform, the resulting source codes are encapsulated in the Target Waveforms source codes (C/C++ and RTL).

Target Waveform benefits of standard SCA/ESSOR Operative Environment APIs compiled for a Real Time Emulator hardware and ready to be used at customer premises during Target Waveform execution and testing.

The final Target WF executable manufacture is ready then to be loaded onto Leonardo SDR radios for onfield validation. WIDE is offered along with a comprehensive set of Services from Leonardo, including:
- Support and Consultancy in Waveform Design, Development, Deployment and Validation Phases;
- Support and Consultancy for Waveforms Security Specific aspects, as viable considering the National and Industrial Intellectual Property and information confidentiality restrictions. This option includes the possibility to assist in setting-up a specific Security Lab
- Support and Consultancy for the implemention of a consistent Certification Process, including the possibility, as viable, to provide the necessary technical evidences for its successful completion.

Tactical Radios   Naval/Fixed Radios

SELFNET® IP WAVEFORMS

VHF/UHF Waveforms
Ground: STANAG 4204/4205, Sincgars, Easy II
New IP : SelfNET SBW, NBAW, HCDR, Essor HDR
GAG : Sincgars , HQ, Saturn
SAT : Satcom DAMA

HF Waveforms
HF DATA MIL-STD-188-110B
HF ALE 2G MIL-STD 188-141B
HF ALE 3G STANAG 4538
HF STANAG 4285, 4529, 4538
STANAG 5066, STANAG 4444
WB HF MIL-STD-188-110C

SELFNET® SBW

Soldier Broadband Waveform

Frequency Band	VHF/UHF : 30-512MHz
	1.3MHz bandwidth
Modulation	SC_FDMA/QPSK
Supported Scenarios	Edge and Non-Edge Soldier scenarios, Ship/ Vehicle and Deployed Area Scenarios
Security	Native Type 3 COMSEC, National Custom-Made Crypto, TRANSEC, Radio Silence
Provided Services	CNR-Voice service
	IP Situation Awareness Data
	Images and Video Transfer
Maximum User throughput	500Kbps
Link Coverage	Typical 2Kms
Network Size	MANET, Up to 64 nodes
Synchronization	With and without GNSS
IP Traffic	Unicast, Multicast, Broadcast
QoS	4 priorities level, Voice preemption

SBW is a a top of state-of-art secure waveform solution for self-forming and self-healing wideband meshed networking, for being used in mobile sub-segment of tactical communications market.

SBW is a perfect communication asset for soldiers' roles from rifleman to support logistic in military squad as well as demonstrated to have capabilities to suitably perform in wider networks, at platoon, company and brigade level, within land armored or lighter vehicles.

In Maritime domain, SBW is the ideal companion waveform for short-range ship-to-ship or ship-ashore wideband communications whenever big situation awareness data have to be urgently moved to centralized data centers.

SBW delivers simultaneous multi-hop CNR-like secure voice and data services with user-priority classifications. The mission configurable voice and data user groups allow a spectral efficient communication on a single frequency channel. The high wideband throughput makes it ideal for present and future tactical needs.

Management of communications in mobility is advanced : link establishment and performances are guaranteed up to 130 km/h in Line-Of-Sight and 70 km/h in Near-Line-Of-Sight of Relative speed.

The multi-hop capability ensures reliable communications, among up to 64 nodes, in urban, suburban and rural areas and extends the overall network size.

SBW Network is Self-synchronized either or without, even partly, GNSS receiver : no master node presence is required.

SELFNET® NBAW

NarrowBand Adaptive Waveform

Frequency Band	VHF/UHF: 30-512MHz
	25/50KHz bandwidth
Modulation	DQPSK, D8PSK
Supported Scenarios	Edge and Non-Edge Soldier scenarios, Ship/
	Vehicle and Deployed Area Scenarios
Security	Native Type 3 COMSEC, National Custom-Made
	Crypto, TRANSEC, Radio Silence
Provided Services	CNR-Voice service
	IP Situation Awareness Data
	Images Transfer, Embedded PLI
Maximum User throughput	32Kbps
Link Coverage	Typical 5 Kms, Maximum 50Kms
Network Size	MANET, Up to 32 nodes
Synchronization	With and Without GNSS
IP Traffic	Unicast, Multicast, Broadcast
QoS	2 priority level, Voice preemption

NBAW is a market-emerging waveform solution for self-forming and self-healing narrowband meshed networking for being mainly used in mobile sub-segment of tactical communications market regardless of soldier, land vehicles or maritime vessels communications scenarios.

A wide set of mission parameters and configuration options enables NBAW for most of the thought missions and, jointly with the peculiar aspect to inherently waste few spectrum, boosts simultaneous NB-AW networks coexistence in battlefield.

This very high inherent versatility makes NBAW the convenient candidate for upgrading former communications and replacing fielded legacy radios.

Major factor of success of NBAW is the potential capability to trade coverage versus throughput, dependent by the operating domain, scenario and user traffic needs. NBAW holds an appealing and adaptive mechanism to manage the TDM framing for coping with harsh radio propagation condition by the inclusion of a Frequency Diversity Mode enabling very long ranges, up to 50km.

NBAW delivers simultaneous multi-hop CNR-like secure voice and narrowband data services with priority classification. The mission configurable voice and data user groups allow a very spectral efficient communication on a single frequency channel.

Management of communications in mobility is advanced : link establishment and performances are guaranteed up to 130 km/h in Line-Of-Sight and 70 km/h in Near-Line-Of-Sight of Relative speed.

The multi-hop capability ensures reliable communications, among up to 32 nodes, in urban, suburban and rural areas and extends the overall network size. NBAW Network is Self-synchronized either or without, even partly, GNSS receiver: no master node presence is required.

SELFNET® IP WAVEFORMS

SELFNET® HDR

European Secure Software Radio High Data Rate Waveform

Frequency Band	VHF/UHF: 30-512MHz
	Nx1,25 MHz bandwidth (N=1,2,3,4)
Modulation	BPSK, QPSK
Supported Scenarios	Land Vehicles and Ships, Deployed Area, Edge and Non-Edge – Coalition Use
Security	COMSEC : National & Coalition Custom-Made Crypto Type1/ Type3: NETSEC, TRANSEC; Radio Silence Capable
Provided Services	IP Situation Awareness Data
	Images and Video Transfer; VoIP; CNR PTT Voice Capable
Max User throughput	750Kb/s
Link Coverage	Typical 3/4 Kms, Maximum 40Kms
Network Size	MANET, Up to 200 nodes
Synchronization	With and Without GNSS
IP Traffic	Unicast, Optimized Multicast, Broadcast
QoS	User priorities; Traffic classification from IP header

HDR WF is a challenging secure waveform solution for self-forming and self-healing wideband meshed networking, for being used in mobile sub-segment of tactical communications market on armoured or logistic vehicles or in deployed area.

The HDR WF is a Multi-hop Mobile Ad-hoc Network guaranteeing performances up to 130 km/h of movement of each node. HDR WF network dynamically adapts itself to the surrounding environment in term of propagation, node density, higher ground nodes, congested states and traffic profiles. Embedded Topology Control drives effectiveness in communication resources management as frequencies, slots and dwells using Spatial Division Multiple Access.

HDR WF may interwork any type of IP traffic with pre-existing IP networks of the tactical battlefield.

Design and development of HDRWF has been carried out within the ESSOR consortium on behalf of OCCAR/EDA Authority enabling interoperability amongst coalition forces governed by nation-level allocated resources in common frameworks. The member nations of the ESSOR consortium are currently extending the capability level of the HDR WF by the new ESSOR OC1 program.

SELFNET® S-HCDR

Frequency Band	VHF/UHF: 30-512MHz
	Nx4 MHz bandwidth (N ≥3)
Modulation	BPSK, SQBL-MSK (DSS)
Supported Scenarios	Land Vehicles and Ships, Deployed Area, Edge and Non-Edge
Security	COMSEC: National e Crypto Type1/Type3: NETSEC, TRANSEC; Radio Silence Capable
Provided Services	IP Situation Awareness Data
	Images and Video Transfer; VoIP;
Max User throughput	490Kb/s (per 4MHz ch.)
Link Coverage	Typical 3/4 Kms, Maximum 20Kms
Network Size	MANET, Up to 200 nodes
Synchronization	With and Without GNSS
IP Traffic	Unicast, Optimized Multicast, Broadcast
QoS	User priorities; Traffic classification from IP header

The High Capacity Data Rate (HCDR) WF is a secure, highly survivable tactical waveform providing a communications backbone designed for mission critical, on-the-move operations featuring Mobile Ad-Hoc Networking (MANET).

HCDR WF is designed to reliably operate in an hostile tactical Radio Frequency (RF) environment, while providing low RF signature and low probability for interception. A hierarchical networking concept streamlines design, operation and management and allows the network to scale to in excess of 200 nodes.

SELFNET® PRR

Personal Role Radio WF

Frequency Band	VHF/UHF: 30-512Mhz
	Channel Width: 1.3Mhz
Modulation	DS Spread Spectrum
Supported Scenarios	Edge and Non-Edge Soldier scenarios
Security	COMSEC AES128, TRANSEC, LPI/LPD
Provided Services	CNR Voice and Data Communications
Max User throughput	16kbits
Link Coverage	Typical 4Kms
Network Size	Soldier Squad-Level MANET
Synchronization	With and Without GNSS
IP Traffic	Unicast, Optimized Multicast, Broadcast
QoS	User priorities; Traffic classification from IP header

Personal Role Radio (PRR) WF is the internationally-proven and breakthrough soldier WF of the SEIfNET® family. PRR WF significantly improves combat effectiveness by providing informed communications to front line soldiers.

PRR WF uses VHF/UHF 30-512 Mhz spectrum in a channel width of 1.3 Mhz by using a spread spectrum technology innovatively packaged.

PRR WF enables secure voice and data communications by the adoption of AES128 encryption scheme, DSSS native TRANSEC and Low Probability of Interception and Detection.
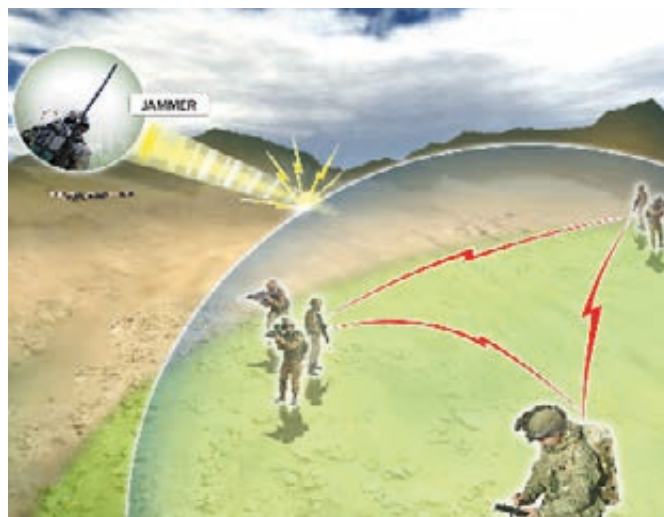
SELFNET® EASY II WAVEFORM

ECCM Enhanced Anti-Jam System II Narrowband Waveform

Frequency Band	Basic Mode (BM) : VHF 118-174MHz, UHF 225-400MHz
	Extended Mode (EM): VHF 30-88MHz, UHF 225-512Mhz
	Channel Width 25Khz
Modulation	MSK, AM (for TOD Exchange)
Supported Scenarios	Mainly Tactical Edge Scenarios
Security	Up to National/NATO Restricted COMSEC; TRANSEC EPM > 1KHop/s
Provided Services	Voice and Data Point-to-Multipoint, Plain/Ciphered Text, Situational Awareness
Maximum User throughput	16Kbps
Link Coverage	>5Kms
Synchronization	With and Without GNSS
IP Protocol Traffic	Data Link protocol compliant to MIL-STD-188-220C
Net Co-location aspects (typical):	VHF BM: 280 Nets – 100Khz Spaced
	UHF BM: 700 nets – 100Khz Spaced
	VHF EM: 8 Nets – 900Khz Spaced
	UHF EM: 16 Nets – 2Mhz Spaced

EASY-2 WF is a narrowband Waveform supporting Point-to-Multipoint communication services in an highly protected ECCM mechanism.

EASY II can cope with the threat of conventional and evolutionary jammers as fixed frequency, partial-band, pulse-type and follower jammers that are typical of the tactical edge scenarios.

EASY II WF operates on V/UHF frequency bands in two operating modes:
- Basic Mode/Full Band:VHF 118-174 MHz,UHF 225-400 MHz
- Extended Mode/Custom Hopset: VHF 30-88 MHz, UHF 225-512 MHz

EASY II allows voice communications by means of the CVSDM (Common Voltage Slope Delta Modulation) algorithm, operating at 16kbps rate. Data at 16kbps, 2.4kbps and 1.2kbps are also supported.

Voice and data are ciphered by an embedded Type-3/Restricted encryption. Additional FEC techniques, interleaving and/or coding, further mitigate jamming effects.

SELFNET® IP WAVEFORMS

READY ON SWAVE® RADIO SET

WAVEFORMS	SWAVE® VQ1 / SWAVE® Naval Radios	SWAVE® MB1	SWAVE® HH-E / PRR
SelfNET SBW Soldier Broadband Waveform	✓	✓	✓
SelfNET NBAW NarrowBand Adaptive Waveform	✓	✓	✓
STANAG 4204/05 VHF-UHF Line of Sight Waveform	✓	✓	✓
SelfNET EASY II Anti-Jam System II Waveform	✓	✓	✓
SelfNET PRR WF Individual Soldier Waveform			✓
MIL 188-220 C VHF/UHF IP Date Link Layer Waveform	✓	✓	✓
HaveQuick I/I NATO ECCM G-A-G Waveform	✓	✓	
SINCGARS MIL-STD G-G/G-A-G Combat Net Radio WF	✓	✓	
SATCOM DAMA MIL-STD Narrowband UHF C41 SAT WF	✓	✓	
SATURN NATO 2nd Generation Anti-Jam UHF Radio	✓		
MIL 188-110B Suite HF - Data Modem Waveform	✓		
MIL-STD-188-141-B Suite HF - Data Modem Waveform	✓		
STANAG 4285 Suite HF - HF Modem Waveform	✓		
STANAG 4538 Suite HF - ALE 3G Waveform	✓		
STANAG 5066 Suite HF - IP over HF Waveform	✓		
MIL 188-110 C Wideband HF - ALE 4G WB Waveform	✓		
ESSOR HDR Essor Coalition High Data Rate Waveform	✓		
S_HCDR WF High Capacity Data Rate	✓		