Technologies Identified by Electronics and Communication Systems Cluster of DRDO (DLRL, LRDE, DEAL, CASDIC, IRDE & CHESS) and Area of expertise required from academia

DLRL

A. List of Technologies Proposed through CoEs

Sr.	Broad Area/application	Name of the Technology	Description of Technology	PDC (Month, Year)	Targeted Product
1	EW Antenna	Broadband Blade Monopole and Dipole Antennas, 30-6000 MHz	Broadband Blade Monopole and Dipole Antennas covering 30-6000 MHz can be used in Monitoring and direction finding (DF) systems of COMINT EW system. As the Blade antennas are thin in one plane and aerodynamically shaped, they are suitable for airborne applications. Blade monopoles can be used with metallic platforms while Blade dipoles are to be used with non-metallic platforms such as UAVs which have a composite material body.	June 2028	Broadband Blade Monopole and Dipole Antennas, 30-6000 MHz

2	EW Antenna	HF DF Loop Array Active Antenna, 1-30MHz	The HF DF Loop Array Active Antenna covering 1-30MHz consists of two Loop antennas placed at an angular spacing of 90^0 with respect to their planes. These two Loops provide Sine and Cosine radiation patterns required for DF in Watson-Watt technique. Two crossed loops and a Monopole antenna are used to get omnidirectional radiation patterns for ambiguity resolution.The antenna with integrated LNA (Low Noise Amplifier) will provide better gain and will improve the DF system sensitivity. There will be an option to use the antenna system with or without LNA, based on available signal strength in the environment by provision of a RF switch.	Dec 2028	HF DF Loop Array Active Antenna, 1-30MHz
3	EW Antenna	Sectoral Horn BLI Array, 18 - 40 GHz	This BLI antenna array comprises of 4 nos of Sectoral Horn antenna in 18-40 GHz. The sectoral horn antenna has inline feed to meet the inter element spacing constraints of phase comparison DF technique.	June 2028	Sectoral Horn BLI Array, 18 - 40 GHz
4	EW Antenna	Active VHF/UHF Antenna, 20-3000 MHz	The Active Antenna is broadband electrically small antenna with small form factor, designed to meet the requirements of DF and Monitoring applications of a COMINT System. A passive DF Antenna subsystem typically has lower antenna	June 2028	Active VHF/UHF Antenna, 20-3000 MHz

			efficiency at lower frequencies of the band resulting in poor sensitivity. The proposed Active antenna will cover 20-3000 MHz with miniature size and higher efficiency/gain		
5	EW Antenna	Polarisation Agile Sinuous Antenna, 0.5-4 GHz	Sinuous antenna is Polarization agile antenna. This single antenna can provide both types of Circular Polarization (LHCP and RHCP).It can be used for Direction Finding application..	Dec 2028	Polarisation Agile Sinuous Antenna, 0.5-4 GHz
6	COMINT Technologies/ ESM Receiver	Search, Monitoring, Analysis, Recording/Replay & Demodulation/Decoding (SMARD) System	Interception, Detection, Analysis & Information Extraction from communication Signals	June 2028	Search, Monitoring, Analysis, Recording/Replay & Demodulation/Decoding (SMARD) System
7	COMINT Technologies	Wider Bandwidth COMINT DF System with Signal Classification	COMINT DF with Signal Classification into FH, Burst and Fixed Frequency helps in Geolocation of Radios irrespective of COMSEC and TRANSEC. Objective is to develop System with Wider Instantaneous BW (160 or 240 MHz) for maximizing Probability of Intercept and also do Signal Classification using Image Processing and Deep Learning	June 2028	Wider Bandwidth COMINT DF System with Signal Classification

8	Mobile EW Technology	Technologies for 5G Interception and Denial of Service	5G interception system will be used for deriving intelligence from 5G mobile communications through detection, interception, deriving movement patterns as well as Denial of Service for 5G Target Mobiles	Dec 2028	Technologies for 5G Interception and Denial of Service
9	Radar ESM Technologies	Wide Band Digital Receiver using Nyquist Folding Technique	A Nyquist Folding Receiver (NYFR) is a novel ultra-wideband (UWB) receiver architecture, which can realize with fewer components. The NYFR significantly under samples input signals causing them to alias that original frequencies would normally be lost, but the NYFR encodes the original frequency using auxiliary channel to estimate the Nyquist Zone. Compressive Sensing (CS) provides a potential low data rate and low power solution in environments where only a small portion of wide spectrum monitored is in use at one time, through sub-Nyquist sampling at information rate. The NYFR is one such promising CS architecture	June 2028	Wide Band Digital Receiver using Nyquist Folding Technique
10	Radar ESM Technologies	Wide Band Digital Receiver using Direct Sampling Technique	In general, wide-open receivers for ES application employ either zero-IF (DC) or low-IF homodyne technique where limitations of time-domain processing, e.g., limited sensitivity, processing of time-overlapped signal and few others persist. Employing digital techniques in such	Dec 2028	Wide Band Digital Receiver using Direct Sampling Technique

			wideband requires exorbitantly high sampling rate as bandwidth coverage is in terms of tens of GHz. To alleviate the same, sub-Nyquist sampling techniques may be potential solution providing advantages of digital processing maintain wide bandwidth of tens of GHz in case of wide-open receiver. These wide-open receivers are applicable to ELINT operations mainly, recce, surveillance and radar warning		
11	Radar ESM Technologies	Finger Printing System for Mode-agile threat Radars	Mode-agile threat emitters are capable of deploying new operational modes that do not conform to the predefined parameters in the threat library. These new operational modes may include new operating frequencies, new modulation techniques, new pulse repetition intervals and/or new hopping schemes. Since the threat detector cannot match these new operational modes against the static database of known modes, ES system has no method in the library to counter this threat. Finger printing systems becomes crucial for identifying Mode-agile threat Radars	June 2028	Finger Printing System for Mode-agile threat Radars
12	ESM Receiver	Conformal Passive Homing Head Receiver (cPHH) Receiver	Design & Development of next generation Passive Homing Head with conformal antennas and AI/ML aided with conformal array signal processing technique.	Dec 2028	Seeker for Anti Radiation Missile

13	Electronic Counter Measure	Smart Jamming against SDR & Cognitive Radio based Military Communication Radios	Development of Smart Look-through Receivers and ECM Chains for quick response against the SDR & Cognitive Radio based Military Communication Radios	Dec 2028	Smart Jamming against SDR & Cognitive Radio based Military Communication Radios
14	AI / ML based threat identification	AI / ML based threat identification	In Integrated EW System, Control centre collates data from heterogeneous sensors (Com, radar, Satellite, Cellular and UAV intercepts). Data across multiple IEWS are proposed to be collated and analysis is required to be carried out for threat identification and prioritisation. The AI augmented Mission Planning tool shall suggest ES & EA Plan based on the analysis carried out on the archived mission data	June 2028	AI / ML based threat identification
15	Photonic EW Receiver	Photonic EW Receiver for Radar ESM	Performing mixing, down conversion, filtering in photonic bands and achieve Wideband IBW with sensitivity in par with NB Rx and in light weight	2027	Photonic EW Receiver for Radar ESM
16	Application of adaptive and Cognitive Techniques in Design of Sub Systems of EW	Application of adaptive and Cognitive Techniques in	-	2028	-

17	Satellite based Communication Intelligence Payload	Application of adaptive and Cognitive Techniques in		2028	-
18	EW Antenna	Integrated Stacked Band Biconical Antenna (1-40 GHz)	This stacked bi-conical antenna covers entire frequency band of 1-40 GHz. It provides slant linear polarization and omni directional coverage which makes is most suitable candidate for ES monitoring application.	June 2028	Integrated Stacked Band Biconical Antenna (1-40 GHz)
19	RF & Microwaves	T/R Module based Planar Array Transmitter & Receiver	5 - 18 GHz Electronically steerable Planar Transmit/Receive Array to effectively handle Multiple Threats in the dense Threat Scenario. This will Enable shared Aperture concept for using same Array for ESM and ECM functions	Dec 2028	T/R Module based Planar Array Transmitter & Receiver
20	Adaptive Radar Counter Measures	----	----	----	----
21	AI / ML Techniques	AI / ML support for Command and Control Applications			
22	Photonics Technologies	Light weight compact Broadband Microwave Rx with Narrow band Rx			

		specifications using photonics principles			
23	Cognitive Technologies	Application of adaptive and Cognitive Techniques in Design of Sub systems of EW.			
24	Technologies for Space EW	Satellite based Communication Intelligence Pay load			

1) DLRL Requirements in Cellular Interception Technologies

- Localization/Location fixing of Mobile Users
- Localization/Location fixing of Mobile Base Station/Tower
- Explore precise Location of Mobile Users using GPS
- Estimate Mobile Base Station/Tower to Mobile User distance
- Target Following of Mobile User
- Denial of Service for Mobile Communications up to 20 Km
- Smart Jamming Techniques for Mobile Communications up to 20 Km
- Interception of 4G and 5G voice (including volte , voip) and data
- Passive A5/3 Decryption for 2G
- Metadata Extraction from 4G and 5G communication for users identification and linking to permanent identities (IMSI, IMEI).
- Denial of service of 5G and 6G

FUTURISTIC TECHNOLOGIES - DLRL -EW Antenna

a) Detailed specifications for Integrated Stacked Biconical Antenna, D – K Band

S. No.	Parameters	Specifications
1.	Type of Antenna	Integrated Stacked Biconical Antenna
2.	Frequency Band	D-K
3.	VSWR (max)	3:1
4.	Coverage	Azimuth: 360° , Elevation > 20°
5.	Gain	≥ - 2dBi
6.	Omni Variation	± 3 dB
7.	Polarization	Slant 45°
8.	Connector	SMA (Jack) & K (Jack)

9.	Radome	Overall radome for stacked Biconical Antenna (A Sandwich)
10.	Overall Size (Dia x Ht) approx	250 mm Dia X 350 mm(Approx)
11.	Weight (approx)	<5 Kg

b) Detailed specifications for Polarisation Agile Sinuous Antenna, C-F Band

S. No.	Parameters	Specifications
1.	Type of Antenna	Polarization Agile Sinuous Antenna
2.	Frequency Band	C-F
3.	VSWR (max)	2:1
4.	Coverage	100°- 60°
5.	Gain	-6 to 2 dBiL

6.	Axial ratio	On Axis: 3 dB	Off Axis (@±45°): 4 dB
7.	Amplitude matching (Set of 5 Antennas)	On Axis: ±1 dB	Off Axis (@±45°): ±1.5 dB
8.	Phase matching (Set of 5 Antennas)	On Axis: ±10°	Off Axis (@±45°): ±15°
9.	Squint	±10°	
10.	Polarization	Dual Circular Polarization	
11.	Connector	SMA (Jack)	
12.	Radome	Overall thin wall radome	
13.	Overall Size (Dia(Φ) x Ht) approx	Φ =25 mm, Ht: 12 mm	
14.	Weight approx	2 Kg	

c) Detailed specifications for Sectoral Horn BLI Array, J-K Band

S. No.	Parameters	Specifications	
1.	Type of Antenna	Inline fed H- Plane Sectoral Horn Antenna	
2.	Frequency Band	J-K	
3.	VSWR (max)	3:1	
4.	Coverage	Azimuth: 140°- 60° Elevation: 24°-45°	
5.	Gain	6 to 12 dBi	
6.	Amplitude matching (Set of 4 Antennas)	On Axis: ±1 dB	Off Axis (@±45°): ±1.5 dB
7.	Phase matching (Set of 4 Antennas)	On Axis: ±10 °	Off Axis (@±45°): ±15 °
8.	Inter Element Spacing (mm)	20:75:25	

9.	Polarization	Slant Linear Polarization
10.	Connector	K type (Jack)
11.	Radome	Overall thin wall radome
12.	Overall Size (WxLxH) approx	130 X 200 X 100
13.	Weight approx	700 ams

2. LRDE

Sl. No.	Broad Area/application	Name of the Technology	Description of Technology	PDC (Month, Year)	Targeted Product
1	**Radar/Antenna Array**	Field calibration (Without NFTR) for large radars (Including drone-based calibration)	Outdoor Calibration method.	2026	Large Phased array radars which cannot be calibrated indoor.
2	**Radar/Signal Processing**	ML/AI Framework for Radars.	Improved Target Detection in Clutter, Better Tracking performance in multipath, Classification/Identification and Better ECCM Handling, Intelligent Resource Management, Super-resolution and better image quality in SAR, Fault analysis and Improved fault tolerance, Automatic target recognition feature etc.	2026	AI feature in all Radars
3	**Radar/Antenna**	Metamaterial based antenna.	Description: Metamaterial antenna design has size approximately five times smaller with wider bandwidth.	2026	Light weight Radars.

4	**Radar/Waveforms**	Stealth target detection	Early warning and detection of Stealth target and Classification.	2026	Stealth target detection.
5	**Radar/Engineering**	Miniaturized Radars for surveillance and imaging (<5 Kg).	Small radars on-board drones for Homeland Security, Maritime Patrolling, Environmental surveillance etc.	2026	Airborne Radar for Drone/UAVs.
6	**Radar/Antenna**	3D Printing for Antennae with embedded integrated channels.	3D Printing for Antennae.	2026	Radar Performance, band of operation and SWAP.
7	**Radar/Signal Processing**	Space Time Adaptive Processing (STAP) for Radars	Airborne Space Time Adaptive Processing for target detection in clutter and jammer scenarios.	2028	In all Airborne Radars.
8	**Radar**	Distributed Netted Array Radar	Improved positioning accuracies through Netted Radars	2028	Improved performance for all networked Radars.
9	**Radar/Waveforms**	Digital Array Radars with MIMO Technology	Multi-beam non-scanning simultaneous detection and tracking of multiple targets	2028	Improved performance with high resolution and advanced ECCM capability.
10	**Radar/Waveforms:**	Hypersonic target detection with Radar.	Early warning and detection of Hypersonic target and Classification of type of missile.	2028	BM Radars.

11	**Radar**	Dynamically Reconfigurable Antenna Array Based on UAV Clusters.	Swarm of UAV Based Reconfigurable Antenna Array for Radars.	2028	Dynamically Reconfigurable Array Radar.
12	**Radar/Radome**	Frequency Selective surface (FSS) radomes.	FSSs have been widely used as polarizer, filters, sub-reflectors in dual-frequency antennas and absorbers.	2028	Reduced RCS of the enclosed antenna outside the radar operating frequency band.
13	**Radar/Waveforms**	Low Probability of Intercept (LPI) Radars.	Remain undetected by enemy passive detection equipment such as electronic early warning (EW) systems.	2029	All radars.
14	**Radar/Photonics**	Photonic integrated circuits-based Radar architecture.	Photonics can potentially bring to radars a reduction of Size, Weight and Power consumption (SWaP) with EMI/EMC tolerance.	2029	Radar Performance, band of operation and SWAP.
15	**Radar/Photonics**	Photonic oscillators and other components.	Subsystem for Photonic Radar.	2029	Radar Performance, band of operation.
16	**Radar/Photonics**	Quantum Radar.	Conventional radar technology will have severe limitations in detection and tracking of stealth targets. Quantum technology in radars can	2033	Quantum radars are expected to outperform classical radars by

			potentially facilitate detection & tracking of stealth targets.		a factor of 2 as per literature.
17	**Radar/Signal Processing**	Cognitive Radar.	Knowledge based Radar adapting to surroundings.	2033	Radar Performance improvement.
18	**Radar/Waveforms**	Target Discrimination using scattering matrix and High band waveforms.	Discrimination technology to identify warheads, decoys etc.	2026	Discrimination.
19	**Radar/Tracking**	Algorithms for space object cataloguing.	: Algorithm for orbit determination and maintenance	2026	Long Range/Space situational awareness Radars.
20	**Radar/Antenna**	Shared aperture Antenna.	Radar with multiple bands shared across the same aperture of phased array system.	2028	SWaP optimized sensors on platforms.
21	**Radar/Mechanical**	Development of Rotary joint.	All rotating Radars require multichannel rotary joints (Liquid, Optics, Power etc.)	2028	All rotating radars.
22	**Radar/Mechanical**	Heavy Duty Gimbal System.	Very Large array radars which are rotating require heavy duty Gimbal system for payloads (> 300 Tons).	2028	Very Large array radars.
23	**Radar/Antenna**	Antenna arrays using gap waveguide	Gap waveguide technology.		

		technology for mm wave radar.			
24	**Radar/Antenna**	Reflect Array antennas.	Reflect Array.	2028	Radar Performance, band of operation and SWAP.
25	**Radar**	Foliage Penetration Radar.	Detection of objects, vehicle and other objects inside foliage.	2029	Detection of objects, vehicle and other objects inside foliage.
26	**Radar/Antenna**	Multiband antenna and Reconfigurable (Polarization, Frequency) wideband antenna (L to X etc.) for Multifunction Radars.	Reconfigurable antenna for Multi-Function Radar. Same antenna for search, track and imaging applications across wideband of frequency. A reconfigurable **antenna modifies the antenna's** pattern, polarization, or frequency/bandwidth in some desirable fashion.	2030	Radar Performance improvement and SWAP.
27	**Radar**	Thermal Management of Radar Arrays			

3. Defence Electronics Applications Laboratory (DEAL)

Areas of interests:

- OTFS modulation based waveforms
- Quantum-assisted communications combining quantum signal processing with classical communication channels
- Quantum computing capable Hub for Network Centric Operations.
- Development of Satellite based Quantum Communication Systems
- Quantum communication capability in future military satellite payloads and ground stations will be must
- Development of alternate communication path for controlling satellites and well as command and control transfer to important hub stations.
- Development of Quantum friendly PHY, MAC, Network and Transport Layer protocols
- LEO, MEO & GEO based Development
- Hybrid communication systems development having both quantum communication and classical communication capability

4. CASDIC AI-MSDF Combat Aircraft Systems Development & Integration Centre ...

- CASDIC is currently developing advanced EW systems based on the unified Radar Warner and Jammer architecture for LCA, LCA Mk1A, SU-30, MiG 29 and Jaguar aircrafts.
- Dual Color Missile Approach Warning System (DCMAWS) is also being developed to meet future requirements of the services.
- COGNITIVE EW SYSTEM WITH AI & ML
- RWR Algorithm development using AI/ML and performance analysis over conventional method.
- Jammer Algorithm development using AI/ML and performance analysis over conventional method
- Multiple Sensors Data Fusion Algorithm Development using conventional as well as AI/ML.
- Automatic target recognition Algorithm Development using EO-IR ,SAR Sensors for MSDF Applications
- Pilot Associate Application, general aid for pilot in Navigation, Mission Planning , failure management etc
- Swarm intelligence for UCAVs
- Verification methodologies for AI/ML Algorithms.

5. Instruments Research & Development Establishment – (IRDE)

Development of following technologies for Airborne applications

- Dynamic seals
- Light weight and high strength materials
- Vibration Isolators
- Stabilization Technologies
- Smart Materials
- High Steering Rate System (De-blur mechanism)
- Micro and Nano Science and Technologies
- Thermal Management (-40^{0}C to +55^{0}C Ambient condition)
- Airworthy material
- SWARM Technology

6. Centre for High Energy Systems & Sciences (CHESS)

- Coherent Beam Combining Technologies for Power Scaling of Fiber Lasers
- High Power Fiber Lasers
- Coherent Beam Combination (CBC)
- Optical Phased Array (OPA) Laser
- COE Collaboration on CBC Technologies

NOTE: For any clarification, Please contact The Director, DRDO Industry Academia – Ramanujan Centre of Excellence (DIA-RCoE), IITM, Chennai.

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