

MP-IDSA *Commentary*

IRSA 1.0 and India's Indigenous SDR Communications Architecture

Rahul Wankhede

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S*ummary*

The release of the Indian Radio Software Architecture standard marks an important step in India's evolving approach to defence communication technologies.

Introduction

In October 2025, the Defence Research and Development Organisation, in collaboration with the Integrated Defence Staff and the three Services, released the Indian Radio Software Architecture (IRSA) Standard 1.0. The IRSA is India’s first national specification for software-defined radio (SDR) systems. The standard defines a common software framework for military radios through standardised interfaces, application programming interfaces (APIs), execution environments and mechanisms that allow communication waveforms to operate across different radio platforms. This development represents an important step in India’s defence technology ecosystem.

The SDRs perform core radio functions such as modulation, networking and signal processing. In an SDR, compared to traditional radios, these functions are implemented through software rather than fixed hardware. Therefore, SDR sovereignty becomes central to contemporary military communications.

However, SDR technology introduces a structural challenge. Radios produced by different manufacturers often rely on proprietary software architectures, making it difficult to share communication protocols or ‘waveforms’ across multiple platforms. This fragmentation undermines interoperability within the armed forces and may complicate joint operations. The IRSA attempts to address this problem by creating a standardised software architecture that makes waveforms portable across different SDR hardware platforms.

Broadly speaking, this initiative reflects a shift in India’s defence technology ecosystem from focusing solely on individual platforms, to building digital architectures and software ecosystems that support long-term operational capability.

Software-Defined Radios and the Interoperability Challenge

The growing reliance on digital communications has transformed the role of military radios in modern warfare. Traditional military radios were largely hardware-bound. Once deployed, their communication protocols and signal processing characteristics were difficult to modify without replacing or redesigning the hardware itself. Software-defined radios fundamentally change this model because many of these functions are implemented through software waveforms rather than fixed circuitry.¹

¹ Frant H.P. Fitzek, Patrick Seeling, Thomas Höschel and Bruno Jacobfeuerborn, “[On the Need of Computing in Future Communication Networks](#)”, in *Computing in Communication Networks: From Theory to Practice*, Academic Press, 2020, pp. 3–45.

Unlike conventional radios that work around fixed hardware configurations, software-defined radio systems implement multiple communication functions through software. Their core features, such as modulation schemes, encryption mechanisms, networking protocols and anti-jamming techniques, are encapsulated in a digital format—also known as waveforms.² This allows a single radio platform to support multiple communication modes simply by loading different waveform software.

In practical terms, this means a single radio can support multiple communication roles simultaneously. For example, it can function as a tactical voice network for ground units, a data link for sensor feeds, a secure command network, or a relay link for unmanned systems. Each of these can operate as separate waveform modules within the same radio platform. The same platform can also utilise high-bandwidth data links, low-probability-of-intercept tactical links and long-range communication channels. Traditionally, different radios or specialised communication systems were needed to support each of these roles.

This is one of the key technological foundations of network-centric warfare, where platforms and units share information across interconnected digital networks.³ This flexibility has made SDRs a key enabler of modern command, control and information-sharing systems associated with network-centric warfare. It supports seamless data exchange among sensors, combat platforms and command centres, which is essential for maintaining situational awareness and enabling coordinated operations across domains.⁴

However, the shift towards software-based communication architectures has also created interoperability challenges. If the military or any armed force purchases radios from multiple vendors, interoperability is hampered. This is because each vendor uses different proprietary software frameworks and system interfaces. Even when radios possess similar hardware capabilities, the underlying software package, access control and user interface may differ substantially.⁵

As a result, the digital waveforms developed for one radio platform may not readily operate on another without extensive modification. Bridging this interoperability gap may require additional gateways, protocol translators, or dedicated communication nodes, but it ultimately increases system complexity and operational vulnerability.

² Ibid.

³ David Alberts et.al., [“Network Centric Warfare”](#), DoD C4ISR Cooperative Research Program, February 2000.

⁴ [“Network Centric Operations: Background and Oversight Issues for Congress”](#), CRS Reports, 15 March 2007.

⁵ E. Casini, M. Street, P. Vigneron and R. Barfoot, [“SDR Ready Standardized Waveforms for Tactical VHF and UHF Communications for NATO”](#), National Technical Reports Library (NTRL), U.S. Department of Commerce, 2010.

Apart from this operational challenge, the end-user force must remain dependent on the foreign vendor for each upgrade and modification of the radio throughout its entire life-cycle. For armed forces operating across land, maritime and air domains, such fragmentation can limit the effectiveness of joint operations.

The IRSA standard seeks to address these challenges by defining a common software architecture for SDR systems in India.⁶ By separating the waveform applications from the underlying radio hardware through standardised interfaces and APIs, it aims to enable waveform portability across platforms developed by different manufacturers.⁷ In principle, this allows communication capabilities developed for one IRSA-compliant radio to be deployed on another with significantly reduced integration effort. Official sources indicate that, in the future, made-in-India SDRs can also be exported to friendly countries.⁸

The Indian Radio Software Architecture

The Indian Radio Software Architecture (IRSA) seeks to establish a common software framework that will enable interoperability across software-defined radio platforms used by the armed forces.⁹

At the core of IRSA is the principle of separating waveform software from the underlying radio hardware. This architecture introduces a layered framework in which waveform applications interact with the radio platform through standardised interfaces and application programming interfaces (APIs). These interfaces allow waveform software to access radio resources, such as transmission and receive functions, signal processing components, timing systems and networking services.

This will not require any direct interaction with vendor-specific hardware implementations. The IRSA also defines a common execution environment that manages waveform applications and communication components within the radio system.¹⁰ Through this environment, the waveform modules responsible for modulation, coding, encryption and network management can operate as interoperable software components.

⁶ [“DRDO Releases the Indian Radio Software Architecture Standard 1.0 to Enable Interoperability in Military Communication”](#), Press Information Bureau, Ministry of Defence, Government of India, 7 October 2025.

⁷ Ibid.

⁸ [“DRDO Releases Indian Radio Software Architecture Standard 1.0 to Boost Interoperability in Military Communications”](#), *DD News*, 7 October 2025.

⁹ [“DRDO and Tri-Services unveil IRSA 1.0 to Standardize Military Communication”](#), *NewsOnAir*, 7 October 2025.

¹⁰ [“DRDO Releases Indian Radio Software Architecture Standard for Military Communication”](#), *The Print*, 7 October 2025.

Another important feature of IRSA is its emphasis on waveform portability.¹¹ By standardising the software interface between waveform applications and the radio platform, the architecture allows waveforms developed for one IRSA-compliant radio to be ported to another platform with limited or no modification. This significantly reduces the need to redesign communication protocols each time a new radio platform is introduced. The specification also outlines mechanisms for certification and conformance.¹²

This is to ensure that the SDR platforms and waveform implementations adhere to the defined architecture. This certification process is essential for maintaining interoperability across systems developed by different manufacturers. Taken together, these elements aim to create a common software foundation for India’s future military communication systems. If widely adopted, the architecture could allow multiple vendors, including defence public sector undertakings and Indian private industry, to develop radios compatible with the same waveform ecosystem.

Implications for India’s Defence Communication Ecosystem

The significance of IRSA lies not only in improving interoperability within the armed forces but also in its potential to shape India’s long-term defence communication ecosystem. Modern military capability demands the ability to manage secure and resilient information networks. Globally, many militaries already operate such standards.¹³ The United States, for instance, developed the Software Communications Architecture under the Joint Tactical Radio System programme to enable interoperability among SDR platforms across its armed services.¹⁴ The ESSOR programme developed in Europe seeks to enhance interoperability among participating European armed forces by developing SDR terminals and waveforms based on a common architecture and methodology.¹⁵ NATO has also adopted its High Data Rate waveform as STANAG 5651.¹⁶

In this context, the IRSA can be seen as an effort to establish a comparable national architecture for military communications. This approach also supports India’s

¹¹ [“DRDO Unveils National Software Architecture Standard to Advance Military Radio Interoperability”](#), *The Policy Edge*, 7 October 2025.

¹² [“DRDO Releases the Indian Radio Software Architecture Standard 1.0 to Enable Interoperability in Military Communication”](#), no. 6.

¹³ Amit Vaid, [“Explained: DRDO’s IRSA 1.0: India’s Defence Communication”](#), *ABC Live*, 8 October 2025.

¹⁴ Ibid.

¹⁵ [“ESSOR - EUROPEAN SECURE SOFTWARE DEFINED RADIO”](#), Organisation for Joint Armament Cooperation, 2026.

¹⁶ [“A4ESSOR Welcomes NATO’s Decision to Adopt the ESSOR High Data Rate Waveform as Interoperability Standard”](#), Thales Group, 23 November 2023.

broader objective of strengthening domestic defence manufacturing capabilities. Enabling Indian companies to develop SDR hardware compatible with the same waveform ecosystem could reduce technological fragmentation and foster competition and innovation in the defence communication sector.

The IRSA will also have implications for India’s defence export ambitions. Modern defence platforms increasingly require integrated communication networks for command, control and data sharing. If widely adopted within Indian military systems, the IRSA-compliant radios and waveform technologies could eventually form a part of an integrated communication package. This package can be offered alongside Indian defence platforms in the international market.

The IRSA specification also introduces quantitative indicators, such as the Waveform Portability Index and the Platform Hospitality Index, to evaluate interoperability across SDR platforms.¹⁷ This could influence future procurement decisions. Most SDR standards claim interoperability but never define measurable indicators. IRSA, on the other hand, is developing engineering metrics for portability to help evaluate radios during procurement.

The IRSA aims to bring SDR development in India at par with global standards. Since no single universally accepted definition for standardising different SDR components is available, IRSA aims to bring maturity to the Indian SDR ecosystem.¹⁸ This will enable their deployment across multiple radios. This is important because the waveforms are the real intellectual property in SDR systems. They define the radio's anti-jamming capability, encryption, integration, networking behaviour, and spectrum efficiency. Once a large waveform library is built, every new radio can use it.

If adversaries employ electronic warfare systems to jam, intercept, or disrupt communication networks, thereby degrading command-and-control capabilities, the ability to rapidly modify communication protocols becomes an important operational advantage. A standardised architecture such as IRSA thus potentially allows armed forces to modify, update, or replace communication waveforms through software updates, without requiring new radio hardware. This is particularly relevant in electronic warfare scenarios where adversaries attempt to exploit or jam known communication protocols.

IRSA also introduces a framework in which waveform components operate through standardised interfaces and shared system services such as timing and

¹⁷ “[Indian Radio Software Architecture \(IRSA\) Specification](#)”, Directorate of Standardization (DoS), Department of Defence Production (DDP), Ministry of Defence, Government of India, May 2025, pp. 232.

¹⁸ Ibid.

synchronisation, resource management, networking functions and hardware abstraction layers. Because these services are provided by the architecture rather than individual waveform software, multiple waveforms can theoretically operate together without conflicting over system resources. This capability is critical for building multi-role radios that operate across different communication networks. If implemented properly, this architecture could enable the development of unified tactical radios that support multiple operational networks simultaneously. That would simplify communication equipment across the armed forces while improving the integration of different battlefield systems.

From this perspective, the long-term significance of IRSA lies not only in improving interoperability across India’s military radios but also in enabling a more adaptable and resilient communication architecture.

Conclusion

The release of the Indian Radio Software Architecture standard marks an important step in India’s evolving approach to defence communication technologies. By focusing on software architecture and interoperability, the initiative recognises that modern military effectiveness depends not only on physical platforms but also on the digital networks that connect them. In an operational environment increasingly characterised by data-driven decision-making and multi-domain coordination, secure and interoperable communication systems form a critical backbone of military capability.

At the same time, the long-term impact of IRSA will depend on the extent to which it is adopted across the armed forces and integrated into future procurement programmes. Standards alone do not guarantee interoperability unless they are consistently implemented across platforms and supported by sustained waveform development. Building a robust ecosystem around the IRSA will therefore require continued collaboration among research institutions, industry and end-user services.

If successfully implemented, the architecture could help reduce technological fragmentation in military communications while supporting the development of indigenous waveform technologies and SDR platforms. Over time, such an ecosystem will strengthen India’s capacity to design, deploy and export secure communication systems suited to the operational requirements of modern network-enabled warfare.

About the Author



Mr. Rahul Wankhede is Research Analyst at the Manohar Parrikar Institute for Defence Studies and Analyses, New Delhi.

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