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Volume 22, Issue 4

Turning Next-Generation Wireless into Reality

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Wireless technology evolves at the intersection of ambition and practicality. Each new generation promises transformational capabilities, but only succeeds when it becomes deployable, scalable, and economically viable. As the industry moves from large-scale 5G deployment into 5G-Advanced, we are reaching an inflection point that will define the foundations of 6G. The choices made now will determine whether next-generation wireless becomes merely more capable or fundamentally more valuable.

Our perspective is shaped by long-term research and daily participation in standards, particularly 3GPP and ETSI. A clear narrative is emerging: 5G-Advanced is about extracting tangible value from 5G investments, while 6G is about redefining the role of the network itself—expanding beyond connectivity to become a scalable, intelligent platform for industries and society.

The State of 5G-Advanced Deployment

5G-Advanced is actively shaping operator roadmaps worldwide. Enhancements such as advanced MIMO and multi-TRP transmission, improved mobility, network slicing evolution, extended reality support, reduced-capability devices, improved positioning, and non-terrestrial network (NTN) integrations are moving from specifications into deployments. These capabilities target field constraints—coverage, energy efficiency, reliability, and operational cost—rather than chasing peak data rates.

Just as importantly, 5G-Advanced represents the industry's first meaningful step toward intent-based and semi-autonomous networks. AI and machine learning are being introduced to improve beam management, positioning accuracy, energy savings, and network operations. While incremental, these changes are foundational: they prepare networks to scale in complexity without scaling operational burden. They also push the ecosystem to develop the disciplines automation requires, including data governance, model lifecycle practices, and clear human-in-the-loop controls for operational risk.

Lessons Learned from 5G

5G reinforced a hard truth: technical innovation alone does not guarantee commercial success. Despite major performance gains, many operators have struggled to justify return on investment relative to the cost and complexity of infrastructure upgrades. Revenue growth has been driven primarily by enhanced mobile broadband, while enterprise and vertical use cases expected to unlock new monetization paths progressed more slowly than anticipated.

A recurring root cause was deployment challenges. The transition from non-standalone to standalone architecture was complex, optional feature sets multiplied integration paths, and end-to-end performance often depended on multi-vendor alignment that took time to mature. For enterprises, "using 5G" too often meant acquiring deep telecom expertise, accepting bespoke integration, and tolerating long deployment cycles—driving some to Wi-Fi or proprietary solutions that were simpler to adopt. The takeaway shaping 6G is straightforward: future generations must prioritize simplicity, clarity, and business viability as first-order design objectives.

The Scope and Ambition of 6G

6G is being shaped with those lessons firmly in mind, and the priorities are already visible in early 3GPP planning for the 6G study phase. Unlike previous generations, 6G is not defined by a race toward maximum peak performance. The more consequential ambition is to deliver a single, streamlined, standalone architecture that minimizes configuration complexity, limits excessive optionality, and produces predictable behavior across devices, vendors, and deployments. This will demand an aligned spectrum strategy, realistic device complexity, and measurable energy sustainability targets.

In practical terms, 6G needs to be less ambiguous. Flexibility remains essential, but it should be delivered through disciplined extensibility rather than proliferating parallel mechanisms. A globally aligned minimum feature set—with clearer baseline behaviors and fewer branching implementation paths—can reduce the operational uncertainty that slowed 5G standalone adoption. The design target is a platform that scales across deployment models, from national macro networks to private industrial systems, without forcing each use case to become a bespoke telecom project.

Equally important, 6G is envisioned as an extensible platform rather than a collection of tightly coupled vertical solutions. The aim is to establish a harmonized baseline spanning radio, core, and service exposure, so that industries can build applications and domain specifications without fundamental changes to the underlying network. Modular capability exposure through APIs, consistent operation across terrestrial and non-terrestrial networks, and scalable device classes—from high-end XR to ultra-low-complexity sensors—are central to this approach.

AI as a Foundational Pillar of 6G

Artificial intelligence will be a defining element of 6G, but not as an overlay added after deployment. 6G is being designed to be AI-enabled from the outset, with intelligence embedded across the radio access network, core, and edge. This implies standardized frameworks for data collection and sharing, model lifecycle management, distributed learning, and policy-driven control loops that remain interoperable across vendors and

operators. AI-embedded networks enable closed-loop automation: predicting traffic demand, optimizing resources, managing energy consumption, and adapting to changing radio environments in near real time. Beyond operational efficiency, AI enables new service classes, including intent-driven exposure of network capabilities, context-aware quality guarantees, and agentic services that can request and orchestrate resources on behalf of applications. The discipline learned in 5G—avoiding complexity that stalls deployment—applies directly: AI must be standardized in a way that is testable, secure, and operable at scale.

Integrated Sensing and Communications as another main Pillar

6G's ambition is not only higher-capacity connectivity, but turning the network into a platform that can also sense the physical world. Integrated Sensing and Communications (ISAC) uses radio signals to detect and characterize objects and environments—embedding radar-like capability into cellular infrastructure and devices—while still delivering communications services. ISAC can enable environmental mapping, occupancy and movement detection, tracking, and safety services such as collision avoidance, alongside communications.

What makes ISAC materially different in this cycle is the maturity of the pathway from research into interoperable standards. InterDigital is advancing this transition through leadership in ETSI, where the ETSI ISAC Industry Specification Group (ISG) is chartered to establish a robust technical foundation for ISAC development and standardization in 6G. Its work spans prioritized use cases, channel models and measurement methodologies, system and RAN architecture frameworks, and essential considerations such as privacy, security, and trustworthiness.

This effort is intentionally structured to bridge into 3GPP. ISAC use cases and requirements are being aligned with the 3GPP SA1 methodology, and contributions are feeding ongoing 3GPP 6G service requirement studies, including TR 22.870. In parallel, ETSI channel modelling and evaluation deliverables are positioned to inform RAN studies and performance assessment. The strategic outcome is to accelerate time-to-standard by ensuring that pre-standard groundwork is coherent, measurable, and ready to be adopted into global cellular specifications.

ISAC also reinforces the central lesson from 5G: optionality can become the enemy of deployability. Sensing capabilities must be standardized with disciplined baselines—clear operating modes, measurable performance metrics, and interoperable interfaces—so that early implementations do not fragment into incompatible solutions. By addressing evaluation methods and architecture frameworks early, ISAC standardization can avoid the trap of impressive prototypes that are difficult to productize and certify.

From Study Items to Specifications: the 3GPP Path to 6G

Turning 6G ambition into deployable reality will be determined as much by process as by technology. In 3GPP, the near-term emphasis is to establish a coherent 6G foundation through Release 20 study items, followed by a first normative 6G release where the ecosystem converges on implementable specifications.

In RAN, current planning positions Release 20 as the core 6G study cycle with RAN1 study work, which started in August 2025, RAN2/3/4 study work that started in October 2025, and a study checkpoint around June 2026. Completion targets extend to March 2027 for RAN1 and June 2027 for RAN2/3/4. This sequencing reflects the reality that early PHY/MAC evaluation frameworks must stabilize before higher-layer procedures, architecture decisions, and RF requirements can fully converge.

In SA, 6G solutions and study items are progressing across the working groups that define services, architecture, and system aspects. Recent SA plenary outcomes show coordinated activity across SA2 (architecture), SA4 (media), and SA6 (application enablement), with a completion target aligned to March 2027. In parallel, SA1 frames service requirements, providing top-down constraints that keep RAN and core decisions coherent across industries and use cases.

Looking ahead, Release 21 is expected to become the first major normative 6G release, and its timeline is a key indicator for commercial readiness. Planning discussions have highlighted an ASN.1 and OpenAPI freeze “no earlier than March 2029,” signaling an intent to avoid multiple fragmented drops and instead converge on a single major specification milestone. Taken together, these signals suggest a first commercially implementable 6G release in the 2029–2030 timeframe, with implementation and certification following typical ecosystem cycles.

Turning Vision into Reality

The transition from 5G-Advanced to 6G is not about pursuing complexity for its own sake. It is about making disciplined choices: prioritizing deployability over exhaustiveness, scalability over specialization, and intelligence over brute-force performance. By applying the lessons of 5G—especially around optionality, operational friction, and time-to-value—the industry will build a 6G platform that is not only more advanced, but more usable and more economically sustainable.

Two proof points already stand out. First, AI is moving from add-on optimization toward an architectural foundation for automation and service exposure. Second, ISAC is advancing from research novelty to a structured standards pipeline, supported by ETSI leadership and designed to feed into 3GPP study and specification work. With a disciplined roadmap in SA and RAN, 6G can become the generation where ambition and practicality converge—and where next-generation wireless becomes reality at scale.