SATELLITE DIRECT-TO-CELL · THE STANDARD, THE SPECTRUM AND THE DEVICE

Three gates between SpaceX and the phone in your pocket

SpaceX can design, build and orbit a constellation in less time than a standards body takes to agree one feature. Direct-to-cell tests the limit of that advantage, because the customer at the far end of the link already carries a phone it did not make: the modem comes from a chipset supplier, the cellular features from a handset maker, the service from an operator, and the frequencies from whatever a regulator has authorized. Three gates stand between a satellite and that handset: an interoperable specification, lawful spectrum use, and commercial devices and networks that implement the capability. This report follows all three through the official record.

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Figure 1. Where a direct-to-cell connection has to hold, stage by stage



A satellite link fails at its weakest stage. The first two are engineering SpaceX controls. The third is a device it does not make, the fourth a network it does not own, and the fifth a permission a regulator grants. This report follows the three it does not control.

The link runs from a satellite moving at orbital speed to a handset designed for a stationary tower. The first two stages are engineering SpaceX controls outright. The remaining stages involve a device it does not manufacture, a network it does not operate, and a permission a regulator grants, and those are where this report spends its attention. Spectrum licensing sets the legal conditions on radio operation, so it is drawn as an authorization layer across the service link.

Scope. Stages are the functional elements any satellite-to-handset service must satisfy. The figure describes the architecture of the problem and carries no claim about any particular operator's implementation.

Launch cadence puts capacity in orbit. Reaching an ordinary handset with it requires three further conditions: a 3GPP specification, a spectrum authorization, and operators and chipset vendors that ship the capability. This report follows all three from the public record. SpaceX closed its June 2026 offering at 638,888,888 Class A shares, recording net proceeds of 85,675 million dollars after 575 million in underwriting commissions and offering costs; it has committed approximately 20 billion dollars to EchoStar's AWS-4, H-block and AWS-3 licenses and a further sum to 800 MHz spectrum, and has selected Qualcomm's Dragonwing platforms for a terrestrial network planned from 2027. Three findings follow. The spectrum purchases move the company out of a tenancy: the United States supplemental-coverage framework reaches ordinary handsets only where a terrestrial licensee leases its rights, and AWS-4 lies outside that framework with a mobile-satellite allocation of its own. Permission and capability sit about eighteen months apart, because the Commission approved the EchoStar transfer in May 2026 while the licenses rest in a trust until a closing targeted for November 2027. On 3GPP's own work item register, SpaceX holds the rapporteur role on two Release 20 band items, while the compensation work item that would let unmodified handsets share a satellite cell is carried by Qualcomm, GNSS resilience by Thales and the guard band by Sony. The record of the September plenary is sharper still. SpaceX arrived in Madrid with ten co-sources behind its own compensation work item, among them Apple, MediaTek and Qualcomm; that proposal was not pursued, Qualcomm was appointed to moderate the discussion about it, and the work item approved in its place was Qualcomm's own, carried in the plenary's words as approved unseen. The register records that it is a study until December 2026, which makes the Boston plenary of 7 to 10 December the next checkpoint written into the record by the people maintaining it.

1 WHERE AN ESTABLISHED HANDSET CHANGES THE BUSINESS MODEL

Vertical integration has carried SpaceX this far. It makes the rocket, the engine, the satellite, the ground station and the user terminal, and when a supplier has been slow or expensive the usual answer has been to bring the part in house. That method is why the company moves at a speed its competitors find difficult to match, and launch cadence is its physical expression.

Direct-to-cell extends the method into a much larger installed base, and that is where its limits appear. The device at the far end of the link already exists, in a pocket, bought for terrestrial service and often years before a satellite provider began planning a particular feature. SpaceX did not design it, does not supply its modem, did not write the software that decides which networks it will attach to, and cannot update it. For the service to work, that handset has to behave, unmodified, as though a satellite several hundred kilometers away were an ordinary tower a few kilometers down the road. A satellite payload can be redesigned in months; millions of handsets already sold cannot.

A successful connection therefore needs five elements working together, and Figure 1 maps them: the satellite payload, the radio link through space, the handset modem and software, the operator's service and core network, and the applicable frequency rights. The payload and the space link sit inside the satellite operator's own engineering program. The other three require cooperation and approvals outside the organization: a published standard under which handset makers and chipset vendors build the behavior into devices, which is work that happens at 3GPP; an authorization to transmit in bands that handsets already listen to, which in the United States is the Federal Communications Commission and elsewhere the national regulator; and operators willing to carry the service across a device population that ships the capability.

The gaps between those milestones carry the commercial risk, and they explain a change in SpaceX's behavior that is otherwise puzzling. A company whose advantage lies in refusing to wait has spent 2026 participating in the most consensus-bound institution in telecommunications, bringing proposals, taking rapporteur positions and building topic-by-topic support inside the 3GPP process. It does so because the installed base of ordinary handsets is reachable along that path. A standardized feature can wait for chipsets and certification; an authorized frequency can wait for equipment and network deployment; a satellite already in orbit can wait for both. This report follows the three gates in the order a reader needs them: the market and corporate position SpaceX has assembled, the regulatory permission it holds, and then, at greater length, what 3GPP is deciding and what the

December plenary in Boston will and will not settle.

2 A GROWING BUSINESS, MEASURED SEVERAL DIFFERENT WAYS

SpaceX entered 2026 as a private company and leaves it as one of the largest listed companies in the world. It priced 555,555,555 Class A shares at 135 dollars on 11 June 2026 and began trading the following day on Nasdaq and Nasdaq Texas [1]. The offering closed on 15 June at an aggregate 638,888,888 shares, after the underwriters exercised their option on a further 83,333,333 in full [2]. Its September quarterly report states net proceeds of 85,675 million dollars, after deducting 575 million in underwriting commissions and offering costs; at the offering price, the share count implies gross proceeds of 86,250 million [3]. The figure of approximately 74.4 billion dollars that circulated at listing describes the prospectus estimate of net proceeds before the option was exercised, and the completed transaction is the appropriate figure to carry [4]. The company reincorporated in Texas on 14 February 2024 and is now a quarterly filer, so the satellite-to-phone business can be followed through public reporting [5].

For the nine months to 30 September 2026 SpaceX reported consolidated revenue of 27,083 million dollars, a figure that covers the whole company and should not be read as the revenue of its Connectivity segment [3]. It reported 13.6 million Starlink consumer subscribers at the close of that period, against 7.2 million a year earlier and 12.0 million at the end of June 2026, which is an 88.9 per cent increase year on year and 13.3 per cent in the latest quarter on the disclosed period-end figures. The count covers consumer service lines and excludes managed enterprise and government customers [6]. Figure 2 plots the three disclosures.

The direct-to-cell business is measured on its own terms, and its terms are different. As of 31 March 2026 SpaceX described a dedicated satellite-to-mobile constellation of approximately 650 V1 Mobile satellites and approximately 7.4 million monthly unique devices across approximately 30 countries, through partnerships with approximately 30 mobile operators on six continents [4]. A monthly unique connection can be brief, and a device that connects is not thereby a paying subscriber. The two populations stay separate throughout this report. VEON's disclosure that more than 11 million unique customers had connected at least once by 19 October 2026 is a cumulative operator figure over selected markets, and adding it to a monthly device count would combine different denominators over different periods [7].

What customers can actually do differs substantially by market. Operators launched messaging first, then selected application data, while fuller voice and broadband capabilities remain attached to future satellites, equipment, plans and deployments. Table 1 records the launch date and the functions available at launch for each operator, and reserves the description of a commercially available service for one an operator has announced as launched. KDDI signed on 10 August 2026 for the next satellite generation, aiming at broadband and voice calling in non-terrestrial areas by the end of 2027 [8]. The capability SpaceX sells today is, in its own description, light data, text messaging and over-the-top voice [4].

A customer-count headline reveals less than the question underneath it: which combinations of device model, carrier plan, licensed band, geography and satellite generation enable each service tier. That compatibility matrix is the measure of the addressable market, and it also shows the investment distance between a user who can send an emergency message and a user who can place an ordinary voice call or sustain a broadband session.

3 BUYING THE HOUSE, AND THE NEIGHBORS WHO COME WITH IT

The United States framework that makes satellite-to-phone service lawful is called supplemental coverage from space. It was established in a report and order adopted at the Commission's open meeting of 14 March 2024, released the following day in two dockets, with the rules effective 30 May 2024 [13]. Its design is the thing to understand. It creates a secondary mobile-satellite allocation inside eight segments of terrestrial spectrum between 614 and 2000 MHz, and it permits a satellite operator to use that allocation where the terrestrial licensee leases its rights across defined geographic areas [13]. The framework also sets the figure every coexistence argument in this field returns to: the aggregate of all space station emissions outside the operator's own band may not exceed a power flux density of minus 120 decibel-watts per square meter per megahertz, measured 1.5 meters above ground level [13].

Read that structure beside the commercial record and the strategy becomes legible. Under supplemental coverage, SpaceX serves T-Mobile's customers on T-Mobile's spectrum, under T-Mobile's license, by lease. The arrangement is workable and it is the basis of the service selling today, on partner operators' spectrum between 1.6 and 2.7 GHz [14]. It also makes the satellite operator a tenant in each market it enters, with its reach bounded by whichever licensee is willing to lease and on what terms. A company whose method is to own the whole stack would be expected to find that uncomfortable, and the record shows it did: SpaceX petitioned the Commission to reconsider parts of the framework within three months of its release [15].

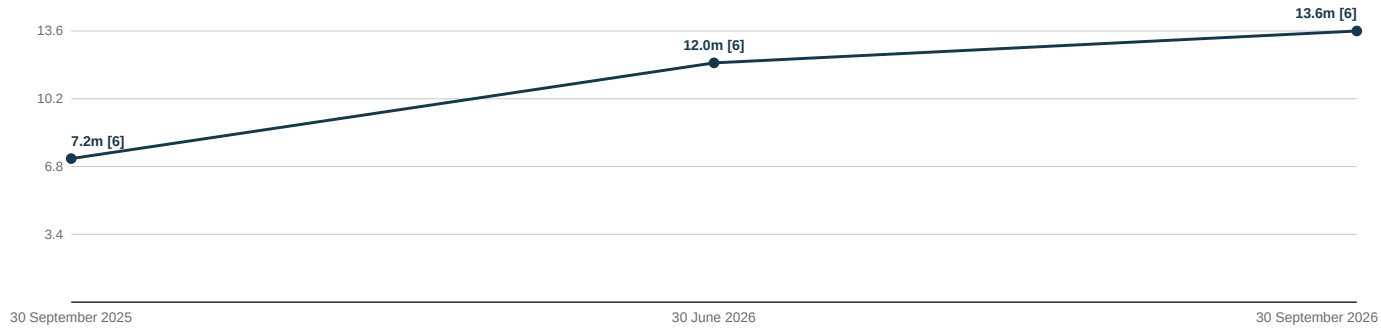
The EchoStar purchase answers that discomfort, and the band plan shows how. The agreement first struck in September 2025 for the AWS-4 and H-block licenses at approximately 17 billion dollars was amended to add 15 MHz of AWS-3 spectrum at 1695 to 1710 MHz and restated at approximately 20 billion, of which up to 11 billion is payable in roughly 261.8 million SpaceX shares [16, 17]. The H-block at 1915 to 1920 and 1995 to 2000 MHz sits inside the designated supplemental-coverage segments. AWS-4, at 2000 to 2020 and 2180 to 2200 MHz, sits outside them and already carries a mobile-satellite allocation of its own [13, 17]. Buying AWS-4 therefore does something a lease cannot: it moves SpaceX from operating on another party's terrestrial license by permission to holding mobile-satellite rights in its own name. Approximately 20 billion dollars is a large sum for spectrum, and it becomes a more defensible one understood as the price of ceasing to be a tenant.

The timing inside that sequence is the clearest illustration in this report of the distance between capability and permission. The Commission approved the EchoStar transaction on 12 May 2026. Ten days later the licenses moved into a trust, and the closing at which SpaceX itself takes them is targeted for 30 November 2027 [17]. A second transaction followed on 8 October 2026 for a nationwide portfolio of up to 14 MHz of paired 800 MHz spectrum, expected to close in the first half of 2027 [6]. Qualcomm announced on 4 November that SpaceX had selected its Dragonwing infrastructure platforms for a nationwide United States 5G network across tens of thousands of sites, with rollout planned from 2027 [18]. Three things therefore remain separate questions: regulatory consent to transfer licenses, completed title to them, and authority to operate a specific satellite service. The transaction should not be described as immediate, unrestricted commercial permission across the acquired frequencies.

Consider the neighbor before the house. Spectrum is the house, and it can be bought: the licenses, the band plan and the consideration are all matters of record. The neighbors come with it, and they are not for sale. An incumbent terrestrial operator has sunk capital into a network engineered around a known interference floor, and a satellite admitted to the same band changes the assumption that capital was spent on. A handset already in service carries a fixed idea of what a cell looks like, and silicon shipped years ago cannot be renegotiated. A national regulator holds the allocation itself, which is an instrument of sovereignty before it is an instrument of policy, and no purchase reaches it. The transaction settles the address; the terms of living there are set by everyone already on the street, and Section 6 records what happened when SpaceX put that proposition to the industry in September. Two further proceedings stood at the proposal stage at the research cut-off, a distinction this report keeps because the difference decides what an operator may actually do. At its meeting of 29 October 2026 the Commission considered a notice of proposed rulemaking which, in its own description, would make an additional 482 megahertz available for supplemental coverage, remove requirements it describes as burdensome, and consider harmonizing the supplemental-coverage and mobile-satellite rules [19]. A separate notice adopted in August proposes to let unlicensed devices communicate with satellites [20]. Operative obligations depend on later agency action, so neither changes a band list or a power limit today. Underneath both sits the

Figure 2. Starlink consumer subscribers at each disclosed period end

Starlink consumer subscribers at period end (millions)



Consumer service lines at period end. The increase is 88.9 per cent year on year and 13.3 per cent in the latest quarter.

Consumer broadband is growing quickly, and it measures a different population from satellite-to-handset service. These are consumer service lines, excluding managed enterprise and government customers. A direct-to-cell device count answers a separate question and belongs on a separate axis.

Scope. Period-end figures as disclosed in the company's third-quarter 2026 results release. The series carries no claim about direct-to-cell adoption, paying satellite-to-handset users, or revenue per subscriber.

Table 1. The commercial record: what each operator has launched, and what it carries

Each entry is taken from the operator's own announcement or a regulatory filing. The sequence in the right-hand column runs the same way everywhere: messaging first, application data next, and fuller voice and broadband still ahead.

Operator and market	First launched	What it carried at launch	Where it stands
One NZ, New Zealand	19 December 2024	Text messaging only	A nationwide service of its kind, on eligible handsets and plans [9]
Telstra, Australia	7 June 2025	Text messaging only	Described by the operator as Australia's first, delivered with Starlink Direct to Cell [10]
T-Mobile, United States	23 July 2025	Messaging, with application data from 1 October 2025	Application data over more than 650 satellites, included in one plan tier or at 10 dollars a month [11]
KDDI, Japan	28 August 2025	Messaging, then application data	Signed on 10 August 2026 for the next satellite generation, targeting broadband and voice calling by the end of 2027 [8]
Rogers, Canada	July 2025 as a free trial	Text messaging and text to emergency services	Paid service from 9 December 2025 at 15 dollars a month, with application voice and video [12]
VEON, three markets	September and October 2026	Messaging, with selected applications	Kazakhstan, Bangladesh and Ukraine; more than 11 million unique customers had connected at least once by 19 October 2026, on a cumulative basis [7]

SpaceX names further operator partners, including Optus, Salt, Entel and Virgin Media O2, in its prospectus. A partnership and a launched commercial service are different states, and only launches the operator or a filing has announced are listed here.

restored auction authority Congress granted in July 2025, which runs to 2034 and covers the frequencies between 1.3 and 10.5 gigahertz, the range in which the licenses discussed here fall [21]. The 2027 World Radiocommunication Conference runs on the longest clock of all, carrying a dedicated agenda item that invites studies on possible new mobile-satellite allocations for direct connectivity between space stations and the user equipment of international mobile telecommunications networks [22]. Whether the eventual international answer is a dedicated allocation will shape what a satellite operator owns, and what it continues to rent, in every market at once.

4 THE TECHNICAL PROBLEM IN UNITS ENGINEERS CAN TEST

A satellite in low orbit travels at an orbital speed on the order of 7.5 kilometers a second, and two consequences follow for any handset trying to talk to it. The distance changes continuously, so the propagation delay varies and a transmission timed correctly for one moment arrives at the wrong moment seconds later. The relative motion along the line of sight shifts the received carrier frequency through the Doppler effect, so a receiver tuned to one channel finds the signal beside it. A terrestrial network meets neither problem at this scale, because a base station does not move and the timing correction a handset applies to reach one is small and changes slowly.

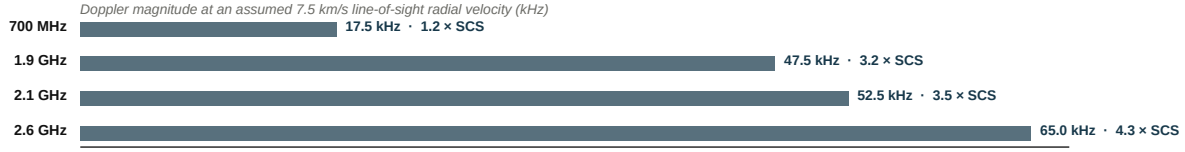
The answer already in the standard puts the work in the device. A handset built to the non-terrestrial profile establishes its own position from a satellite navigation fix, learns the satellite's position from information the network broadcasts, computes the delay and the frequency shift from the two, and applies both corrections before it transmits. That is uplink pre-compensation, and it is why a conventional satellite-capable device is one built on purpose, with the profile designed in from the start.

The installed base creates the difficulty. Most handsets in service were built for terrestrial networks alone. They carry no non-terrestrial profile, compute no satellite geometry, and transmit as though the tower were stationary and close. A network that wants to serve them absorbs the correction on its own side, and that is what network-side downlink compensation names: the network transmits so that an uncorrected device receives something close to what it already expects, leaving a capable device to remove whatever error remains for its particular position within the beam. The consequence is commercial as much as technical, because it decides whether satellite coverage becomes a feature of the handsets people already own.

The scale of the correction can be made visible without claiming a network benchmark. Using the first-order relation in which Doppler magnitude equals carrier frequency times radial velocity divided by the speed of light, and setting the line-of-sight radial velocity to an illustrative 7.5 kilometers a second, the magnitudes come to approximately 17.5 kHz at 700 MHz, 47.5 kHz at 1.9 GHz, 52.5 kHz at 2.1 GHz and 65.0 kHz at 2.6 GHz. Figure 3 draws them. These are model envelopes under a stated assumption: real radial speed varies with elevation, orbit, beam geometry and Earth rotation, the 7.5 kilometers a second figure is an orbital-speed scale used here as the radial component, which a measured line-of-sight speed would refine, and compensation reduces the residual error a receiver actually sees. The numbers describe neither measured interference, nor modem tolerance, nor delivered throughput.

From that follows the architectural question the current work turns on, and Figure 4 sets out both candidate architectures side by side. A network can place the two device classes in separate cells on the same satellite and the same carrier, each cell carrying the assumptions its own devices were

Figure 3. Doppler magnitude scales with carrier frequency, at one stated assumption



Computed, with no document cited: Doppler magnitude is carrier frequency times radial velocity divided by the speed of light. SCS is a 15 kHz subcarrier spacing. The 7.5 km/s figure is an orbital-speed scale used here as the radial component, so these are illustrative magnitudes before compensation, and not measurements, modem tolerances or residual errors.

For the same assumed radial velocity, Doppler magnitude scales linearly with carrier frequency, and the 2.6 GHz example reaches about 4.3 times a 15 kHz subcarrier spacing before compensation. The chart gives the time and frequency correction problem an engineering scale, and leaves feasibility to link-budget, synchronization and conformance studies.

Scope. Computed from the first-order Doppler relation with the line-of-sight radial velocity set to 7.5 kilometers a second and the speed of light at 299,792,458 meters a second. Values are illustrative magnitudes before compensation, and are not measurements, tolerances or residual errors.

built for. That approach works with what exists today, and its cost is that the common channels each cell must broadcast are carried twice on one carrier. Alternatively the network can serve both classes in one shared cell, applying a common correction and leaving each capable device to trim the residue. That approach spends engineering complexity in place of spectrum: a wider tolerance on random access, new signaling to tell the network what correction a device still needs, and a bound on how large a residual timing and frequency error may be across a footprint.

Both approaches carry a cost, and the useful form of the question is where the two cross. Separate cells spend capacity in proportion to how much of the carrier the common channels occupy and how many cells a satellite must run. A shared cell recovers that and spends it again on precision, on capability signaling, on conformance testing, and on whatever a device predating the feature does when it meets a cell designed around it. The comparison becomes testable once a specific document supplies values: define net capacity gain as the duplicated common-channel resources saved minus the extra signaling and processing resources consumed, holding bandwidth, cell footprint, device mix, subcarrier spacing and traffic assumptions the same in both cases. Each term needs a source before a numerical advantage is published. The work item approved in September is, in substance, an instruction to find where the crossing point lies before the industry commits to either side, which is why its study phase matters more than its title.

5 WHAT HOLDING THE RAPPORTEUR ROLE SIGNIFIES

A working group's contribution list measures participation. The work item register offers a more institutional lens, because each work item has a rapporteur: the party responsible for coordinating the technical description, carrying the text through the working groups and reporting progress to the plenary. The role confers visibility and coordination duties, and it does not let its holder dictate the group's technical conclusions. On that register SpaceX is rapporteur of two Release 20 work items, the introduction of a new NR FDD band for the United States 1900 MHz allocation and the corresponding LTE FDD band [23, 24]. The performance building block of the NR item records a named rapporteur, Anatoliy Ioffe of SpaceX, with RAN4 as the responsible group [25]. A launch company holds the pen on introducing a cellular band.

The register also answers a question the business coverage tends to get backwards. The work item on NR non-terrestrial networks using downlink compensation, the one that carries the device-compatibility question this report is about, records its rapporteur as Qualcomm [26]. The two other Release 20 non-terrestrial items approved in June record Thales for GNSS-resilient operation and Sony for the extended guard band [27, 28]. Table 2 sets the five out together, and Figure 5 shows how the five roles distribute. The pattern is worth sitting with: the satellite operator holds the band items, a chipset vendor holds the compatibility item, a defense and space supplier holds the resilience item, and a component maker holds the guard band. Responsibility across this body of work is distributed over four industries, and it is a compact picture of how many technical parties must coordinate before direct-to-cell can operate at scale.

One detail separates a sourced account from a repeated one. All four non-terrestrial and band work items were approved at the June plenary under documents numbered in the RP-2615xx range. All four now carry a work item description with a September number, uploaded to the Madrid meeting folder in the days before it opened, and the register logged the substitutions together on 28 September 2026 [27, 23, 24, 28, 31, 32]. A reader given only the June numbers would be pointed at superseded documents, and this report cites the current ones.

The compensation work item carries one further field worth printing in full. Alongside a start date of 9 September 2026 and an end date of 9 September 2027, its register entry records the remark that the whole work item is a study until December 2026, and the work item description itself was uploaded to the Madrid folder on 17 September [26, 33]. That is housekeeping text, which carries no decision of any meeting and should not be read as one. What it establishes is that the December plenary is a checkpoint written into the record by the people maintaining it, on a date this report had no hand in choosing. The core building block is held by RAN1 and runs to March 2027; the performance block is held by RAN4 and runs to September 2027 [29, 30].

6 ELEVEN HANDS IN MADRID, AND WHERE THE PEN WENT

SpaceX's 2026 contributions turn on two connected constraints: which bands a satellite network may use, and which handsets can actually operate on them. The first depends on spectrum rights, radio specifications and interference protection. The second turns on capabilities already installed in handsets, on network-side compensation, and on interoperability across vendors. Each decision below is identified by the document that carries it, the status that changed, and the consequence that follows. Read in sequence, they describe a company learning the price of admission to a process it cannot direct.

Singapore moved the band agenda forward. RAN#112 approved new NR and LTE work for the United States 1900 MHz allocation, with SpaceX serving as rapporteur on the relevant items, which gives the company a defined role in shaping how those bands enter the cellular specification ecosystem [23, 24]. Separate initiatives on GNSS resilience and extended guard bands were carried by other rapporteurs, which shows how satellite service depends on positioning resilience, radio-frequency behavior and coexistence together [27, 28]. The commercial question that follows is specific: when a band appears in handset modems, radio front ends, conformance tests and operators' production networks. Work item approval opens that engineering path and does not complete it.

Madrid is where the method met the institution. One hand cannot clap, and SpaceX arrived having assembled many: its work item on enhanced time and frequency compensation, RP-262170, carried eleven source organizations, among them Apple, Boost Mobile Network, Charter, EchoStar, KDDI, LG Electronics, MediaTek, Qualcomm, Rogers and Telstra [34, 35]. The objection from the floor was immediate and technical: the proposal would leave devices built to the three preceding releases outside its scope. That objection carries commercial weight because those devices are already sold, and a standard that strands them transfers the cost of the upgrade to whoever sold them. The chair sent the question to an offline discussion over the coffee breaks and appointed Qualcomm to moderate it [36]. What came back from that room reset the terms. The moderator's summary records concerns from Amazon about fragmenting the device ecosystem, and from ZTE and CSCN that the work would not guarantee

Figure 4. One cell or two: the two candidate architectures, and what each still has to settle

	Synchronization	Random access	Broadcast and common channels	Capability and access control
Architecture A: separate cells	**Each cell serves one device class; each class keeps its own assumption**	**Conventional preamble for pre-compensating devices; a separate configuration for the rest**	**Common channels are carried once in each cell, on the same carrier**	**Access restriction keeps a device in the cell that matches it**
Architecture B: shared cell	**The network applies a common correction; the capable device removes what is left**	**One preamble configuration has to tolerate a wider residual error**	**Common channels are carried once for both device classes**	**The network has to know which correction each device still needs**
What has to be settled	**How large a residual timing and frequency error may be, and over what footprint**	**Detection and false-alarm performance across a mixed device population**	**Whether the saving is large enough to pay for the complexity**	**New signaling, and what a device that predates it does**
What each choice costs	*the residual error bounds the footprint*	*a wider tolerance spends detection margin*	*the duplicated broadcast is the whole saving*	*new signaling, and what older devices do*

Both architectures serve a handset that pre-compensates and one that does not. The first keeps them apart and pays for the separation in duplicated common channels. The second puts them together and pays in network precision and new signaling. The third row lists the questions a study phase exists to answer.

Scope. The rows describe the functions any serving architecture must provide. Entries state what each approach requires, and record no view on which the standards process will adopt.

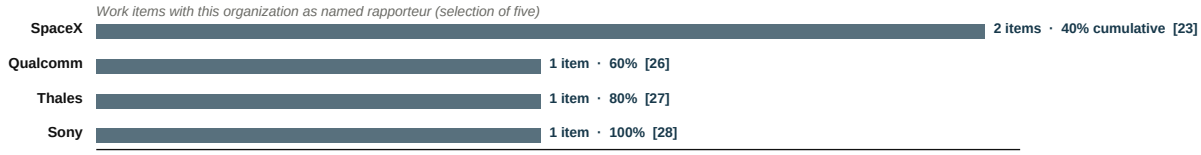
Table 2. Who holds the pen: rapporteurs on the Release 20 non-terrestrial and band work items

Each field below is printed on 3GPP's own work item register. The rapporteur is the party responsible for carrying a work item's text, which makes this the most direct public measure of institutional position available.

Work item	Rapporteur	Release and status	Runs to	Description of record
NR NTN using Downlink Compensation	Qualcomm	Release 20, approved at RAN#113	September 2027, with the core part to March 2027	RP-262263, carrying the remark that the whole work item is a study until December 2026 [26, 29, 30]
GNSS-resilient NR-NTN operation	Thales	Release 20, approved at RAN#112	September 2027	RP-261631, replacing the June document [27]
Extended guard band for NR NTN and IoT NTN	Sony	Release 20, approved at RAN#112	March 2027	RP-261969; a core part with no performance part [28]
New NR FDD band, US 1900 MHz allocation	SpaceX	Release 20, approved at RAN#112	September 2027	RP-261910, with Anatoliy Ioffe of SpaceX named on the performance part [23, 25]
New LTE FDD band, US 1900 MHz allocation	SpaceX	Release 20, approved at RAN#112	September 2027	RP-261912, replacing the June document [24]

Status is the word 3GPP's register prints, which for all five is approved following ratification. A rapporteur is responsible for the text and does not decide what the groups agree. The description of record is the current work item description; in each of the four June items it carries a September document number, because the original June document was superseded.

Figure 5. Rapporteur roles across the five work items in this selection



The population is the five named Release 20 work items in Table 2, so N = 5. Cumulative share is read down the bars in descending order. A census of 3GPP submissions would need the complete document record, de-duplicated by meeting and document number, with source organizations normalized; this selection supports no such claim.

Within this five-item selection SpaceX holds two rapporteur roles and Qualcomm, Thales and Sony hold one each, giving cumulative shares of 40, 60, 80 and 100 per cent. The useful reading is that the band initiatives and the technical supporting initiatives have different leads.

Scope. A selection of five named Release 20 work items, so the population is five. The chart cannot support a claim about the concentration of 3GPP submissions as a whole, about technical influence, or about industry-wide decisions. A full-population version requires the complete document record, de-duplicated by meeting and document number, with source organizations normalized.

service to the installed base of satellite-capable handsets without loss of performance. The positions are legible from where each party sits. A chipset vendor sells into every handset line, so fragmentation is its risk before it is anyone else's. A vendor with its own satellite program reads a compensation scheme written around another constellation as a specification of someone else's geometry. An operator that has already shipped non-terrestrial devices is protecting a base it has sold. Its conclusion was to draft a work item carrying a study phase, with a checkpoint at the next plenary on whether to proceed to normative work [37]. SpaceX's own proposal was not pursued. The item that was approved, RP-262263, came from Qualcomm, drafted out of that summary; the secretariat noted on the floor that it arrived with no normative objectives and no supporting companies, the RAN chair asked that supporting companies be added, and the plenary's own report records the conclusion in two words: approved unseen [36, 33]. Eleven hands had been raised, and the pen that emerged belonged to the moderator.

The same week tested the other half of the strategy, and Table 3 sets the week out as the record left it. Three proposals asked 3GPP to bring terrestrial bands into non-terrestrial use: a PCS band for the United States, a band for Australia, a 2 GHz allocation for Japan. Their source lists read like a census of the industry — eleven organizations on the first, seventeen on the second, with Ericsson, Nokia, Sony, Meta, BMW and Toyota ITC among the names, and the operators who would carry the service on all three [38, 39, 40]. SpaceX moderated the discussion itself and summarized it in RP-262246. No consensus was reached, and none of the three was pursued [41, 36]. The reason the long lists did not carry is visible in what they were asking for. A new satellite band in terrestrial spectrum is a national allocation decision before it is a radio specification, and the operators whose licenses would host it were signing as supporters of a study, not as parties consenting to share. In the same room, in the same week, the two work items SpaceX brought with no co-sources at all — the revised descriptions for the United States 1900 MHz NR and LTE bands, on spectrum whose licenses it is acquiring in its own name — were approved [36, 23, 24]. The inversion is the most instructive fact in the 2026 record: where the company asked only for its own house to be put in order, the plenary agreed; where it asked the industry to open terrestrial bands to satellites, a coalition of seventeen moved nothing. Existing terrestrial networks need protection against aggregate interference, and permitted use of spectrum depends on national allocations, license conditions and operational authorizations [13, 17, 19, 22]. Those are the neighbors, and they were not persuaded in September.

Calgary is an evidence test, and at this report's cut-off it was still running. The radio and system working groups met there from 16 to 20 November

Table 3. One week in Madrid: what was asked, who asked it, and what the plenary did

Every entry is the decision 3GPP's own meeting report records against the document, with the source organizations as the document lists them. Read the right-hand column against the one beside it: the proposals carrying the most names are the ones that moved least.

Document	What it asked for	Source organizations as listed	What the plenary decided
RP-262170	A work item on NR NTN using enhanced time and frequency compensation	SpaceX, Apple, Boost Mobile Network, Charter, EchoStar, KDDI, LG Electronics, MediaTek, Qualcomm, Rogers, Telstra	Not pursued [35, 36]
RP-262224	The moderator's summary of the offline discussion on that question	Qualcomm, appointed moderator by the chair	Noted, concluding that a work item be drafted with a study phase and a checkpoint at RAN#114 [37, 36]
RP-262263	The work item drafted from that summary	Qualcomm	Approved; the register records it as a study until December 2026 [33, 26]
RP-261832	A PCS band for non-terrestrial use in the United States	T-Mobile USA, Rogers, Telstra, Qualcomm, Ericsson, Nokia, SpaceX, Apple, KDDI, Meta, MediaTek	Not pursued [38, 36]
RP-261845	A non-terrestrial band for Australia	Seventeen organizations, among them Telstra, T-Mobile USA, KDDI, Rogers, SpaceX, Apple, MediaTek, Qualcomm, Ericsson, BMW, Toyota ITC, Sony, Cohere, Ofinno and Meta	Not pursued [39, 36]
RP-261959	A 2 GHz non-terrestrial allocation for Japan	KDDI, SpaceX, T-Mobile USA, Rogers, Telstra, Ericsson	Not pursued [40, 36]
RP-262246	The summary of the offline discussion on satellites in terrestrial bands	SpaceX, appointed moderator by the chair	Noted; no consensus was reached [41, 36]
RP-261910, RP-261912	Revised descriptions of the United States 1900 MHz NR and LTE bands	SpaceX	Approved [36, 23, 24]

A source organization listed on a document establishes that the organization put its name to that document. It establishes nothing about the position the same organization took on any other question in the same week, which is why this table reads by document, with each outcome quoted from the meeting report in the words it uses.

2026, so the meetings were in session on 19 November and their conclusions are not yet in the record [42, 43, 44]. The report folders hold their skeleton documents, which is the ordinary state of a meeting whose chair's notes are still being assembled, and the Madrid plenary's own report was posted on 12 October, four weeks after that meeting closed, which is the interval a reader should expect before Calgary's outcomes are citable [45, 46, 36]. A report published this week can say which questions went to Calgary, and pre-meeting contributions cannot be treated as final agreements. The useful question for the record when it arrives is whether contributions on the same technical issue converge on comparable results: how large the residual timing and Doppler errors are after network compensation, what happens to random-access detection and false alarms across handset capabilities, and how much common-channel capacity a shared-cell configuration recovers once extra signaling and receiver complexity are counted. Any benchmark should disclose its device mix, frequency band, satellite geometry, bandwidth and baseline configuration.

Boston tests whether feasibility has become an implementable specification plan. The things to look for are an approved revised work item description with normative scope, responsible groups, device-capability requirements, measurable performance conditions and target dates; whether parties with competing proposals converge on the same technical mechanism; and exactly which objections persist if the study continues [26, 29, 30]. The radio plenary sits in Boston from 7 to 10 December 2026 on 3GPP's own meeting calendar [47]. Outcomes on downlink compensation and on terrestrial-band operation need tracking separately, because they face different engineering and authorization tests.

The market implication is concrete. Standards progress can increase the fraction of existing handsets technically able to use a satellite service; spectrum policy and device deployment determine where that capability becomes a commercial product. The most revealing next metrics are therefore the eligible installed device population, the net shared-cell resource efficiency, and the interference or licensing constraints that remain unresolved. Figure 6 reads the three tracks as changes of state, with meeting logistics left out. One framing point belongs here, because it is the error most likely to reach a general reader: this is Release 20 work. 3GPP describes Release 20 as the release whose normative content is 5G-Advanced alone, while the same release carries the studies that prepare the next generation, with Release 21 holding the normative 6G work [48]. Each item in Table 2 is registered in Release 20, and what is being decided over the next year is how the handsets and networks people use now will handle satellite access.

7 HOW TO DESCRIBE A 3GPP DECISION ACCURATELY

Reporting on standards bodies goes wrong in a predictable way, and a reader is better served by knowing the failure mode than by any individual result. The vocabulary of the process is ordered and precise. A contribution is proposed when a company submits it. It is discussed when it reaches an agenda. It is noted when a meeting records its existence without adopting it, which is the usual fate of a moderator's summary. It is agreed when a working group chair writes the agreement into the meeting record. It is approved when a plenary adopts a work item or a change request. It is specified when the text lands in a published specification. Those are six different states, and submitting a document predicts none of them. The meeting report, the work item register and the published specification do different jobs, so each gets cited for the claim it can actually establish.

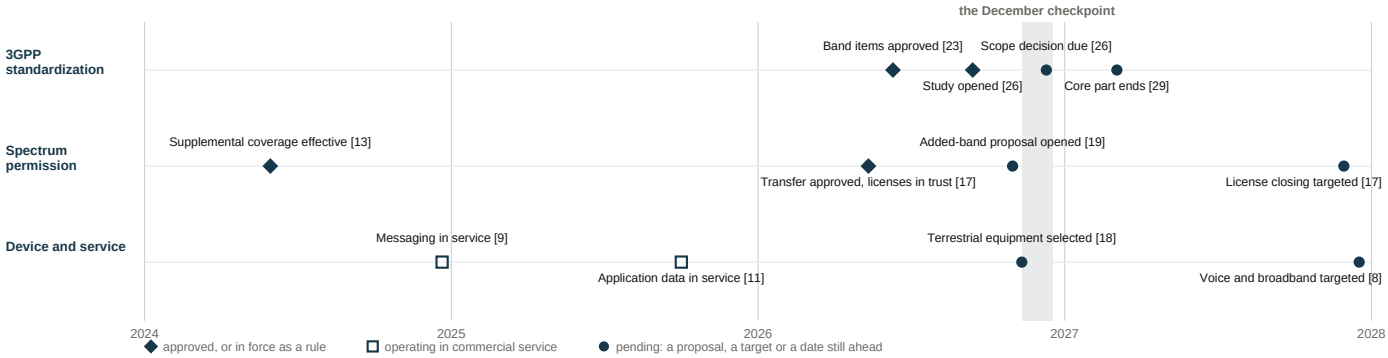
The distinction that matters most for this subject separates standardizing a behavior from being permitted to use it. A work item approved at a plenary instructs engineers to write text. It grants no spectrum, obliges no manufacturer to implement the result, and establishes nothing about whether a regulator will authorize the service the text describes. The three gates in Figure 1 are genuinely independent: a feature can be fully specified and unusable for want of a license, or licensed and unavailable for want of a device. An account that compresses them into a single verdict on whether SpaceX is winning has lost the information a reader needs.

A second distinction governs how coalitions should be read. Co-authorship of a contribution establishes that companies submitted a document together. It establishes nothing about whether they agree on the features inside it, and the public record of 2026 shows the same firms aligned on one technical question and opposed on the next. Treating a signature list as a bloc produces a tidier story and a less accurate one. Where this report names positions, it names them by issue, and where the record does not establish a company's position on a particular issue it says so, because an unknown position stays unknown, and reading it as neutrality or as opposition would both be inventions.

Applied to December, this yields three readings of the Boston plenary in place of a prediction. If the study converts into normative work with a defined architecture, the correct description is that a concept SpaceX helped initiate has entered specification drafting, with implementation, certification and licensing all still ahead of it. If the study is refined, narrowed or extended, the correct description is that feasibility remains contested, which is an ordinary outcome for a question this large. And if the radio work advances while the separate question of satellite operation in terrestrial bands stays unresolved, the correct description is two tracks moving at different speeds, which is the outcome the record of the year makes most legible. This report commits to none of the three, assigns no probabilities, and sets out in Table 4 what each would look like in the documents themselves.

8 THREE INSTITUTIONS, THREE CLOCKS

Figure 6. Three tracks to a usable handset: standards, spectrum permission and service



Each entry marks a change of state, dated by the organization that recorded it. The tracks are not merged, because a decision on one does not carry a decision on another. A study phase is named in the label, since the three marks distinguish approved, operating and pending only. No meeting logistics appear here.

The same four years read three ways, annotated by change of state. Each entry marks a status that moved: a work item approved or revised, a transfer approved against a license closing completed, a tested capability against a commercial activation. The tracks are deliberately not merged, because a decision on one does not carry a decision on another. The shaded band marks the December checkpoint the work item register itself identifies.

Scope. 3GPP work item records and meeting calendars, Federal Register and company regulatory filings, and operator and company announcements, each current at 19 November 2026. Entries are states, and the figure carries no calendar of meeting logistics.

Table 4. What each December outcome would look like in the record, stated before the meeting

Each row names the document that would settle it and the words that would have to appear in that document. Written in advance, the test cannot be adjusted afterwards to fit whatever happens.

Question	Where it would be settled	What a yes looks like in the document	What continued work looks like
Does downlink compensation become normative work?	The RAN#114 report and a work item description succeeding RP-262263	An approved work item description with normative objectives, responsible groups and stated dates	The study continues, its scope is narrowed, or unresolved assumptions are recorded
Can both device classes share one cell?	Working group agreements and the change requests that follow them	A named mechanism, a device capability that signals it, and the conditions it holds under	Several alternatives remain, or the separate-cell arrangement keeps priority
May satellites operate in terrestrial bands?	A moderator summary succeeding the September one, and the plenary record	A recorded agreement or an approved work item, with documented interference protections	Competing studies remain and the summary is noted without agreement
Is a consistent technical coalition forming?	The source organization fields and minutes for matched topics	Repeated, topic-matched co-sourcing with consistent technical positions	Signatures appear on adjacent but different subjects, or technical preferences diverge
Is there a route to commercial device certification?	Radio working group conformance work and published chipset support	Testable bands and requirements, with conformance procedures a certification body can apply	Feasibility-level design without a deployable verification path

The left column states a question and carries no prediction. The two right columns are written so that a reader can check the outcome against the same standard this report set before the meeting, in place of a description written afterwards.

The three gates open at different speeds, and the mismatch is an operational problem. A standards body works in plenary cycles: contributions arrive before a meeting, working groups meet between plenaries, and a decision that misses one cycle waits for the next. A regulator works in dockets: a proposal is published, comment and reply periods run, and an order issues when the commission votes it. A device ecosystem works in silicon and certification: a modem feature enters a chipset generation, a handset built around that chipset reaches production, and a conformance program has to exist before any of it can be sold as compliant.

Patience is the key to relief, and it is an uncomfortable key for a company whose advantage is speed. A constellation operator's own clock runs faster than all three and answers to none of them. Satellites can be built and launched in batches, and a deployment schedule can be moved by adding flights. The consequence is a recurring asymmetry in which the orbital capability is ready before the permission to use it, the permission before the standard that makes it interoperable, and the standard before the devices that implement it. Each gap is a period in which capital is in orbit and earning nothing from the market the capability was built for.

That asymmetry explains the strategy more economically than any account of competitive positioning. Participating in 3GPP, taking rapporteur positions, and assembling co-sponsors across operators, chipset vendors and handset makers are all ways of operating on the institution's own clock. They are slow, and they reach a handset the company did not build. A proprietary alternative, with bespoke waveforms and purpose-built devices, addresses a smaller market and forgoes the installed base, which is the asset that makes direct-to-cell worth the constellation in the first place. The slower route is the only one that ends at a phone already in someone's pocket; the faster one ends at a phone that has to be manufactured, distributed and sold before it can carry a call. Madrid showed the terms on which that clock is kept by others: a proposal with eleven names behind it set aside, and the pen passed to the party asked to arbitrate it. December 2026 is the next defined checkpoint in a longer sequence of engineering and commercial decisions. If Boston turns the downlink-compensation study into a sharply defined normative path, the result will show that a commercial satellite problem has become an implementable cellular-standardization program. If the work stays open, the outstanding questions will show where technical evidence or multivendor alignment is still needed. Either outcome tells a more useful story than a verdict on whether SpaceX is winning.

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