



INTEGRATED SENSING AND COMMUNICATIONS

Five questions about integrated sensing

A mobile network that senses is a radar, and a weak one beside a purpose-built radar: a metre and a half of range resolution against the metre the standard asks for, and echoes that fade with the fourth power of distance. It remains the most discussed 6G feature, and it is paid for in airtime a carrier has already bought at auction. Read the five parts to find out:

1. how finely a network can see, band by band, against what 3GPP asks of it
2. what the standard has agreed, what is still study and what is decided next
3. what sensing costs in airtime, power, timing and sites, and what that airtime is worth
4. how far a base station can see a drone, a person or a car
5. who is paying for sensing today and whether a mobile licence lets a carrier sell it

About this ebook

This ebook collects the five parts of *Integrated Sensing and Communications*, published by Blue Prysm at www.blueprysm.com/analysis/.

The website carries the current edition. Where a figure here differs from the website, the website is the later version.

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PART 1 3GPP specifications and reports as published to September 2026, FCC and IEEE records, read 7 Oct 2026

PART 2 3GPP archive, RAN#113 and SA#113 (September 2026) documents, ITU-R, ETSI and IEEE records, read 7 Oct 2026

PART 3 TR 38.765 V20.0.0 and RAN1#124 evaluation files, FCC auction records, read 7 Oct 2026

PART 4 3GPP reports, eCFR as of 1 Oct 2026, preprints and releases as read 7 Oct 2026

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What can a cellular network resolve at each band, and what does the standard ask of it?

The widest 5G carrier below 7.125 GHz is **100 MHz**, which separates objects about **1.5 m** apart in distance. Four of the seven categories in TS 22.137 require a metre or finer, which takes 150 to 400 MHz in a single channel. The **400 MHz** channels planned for 6G around 7 GHz, and already optional in millimetre wave, resolve 0.375 m. Angular resolution is far coarser: a standard eight-column macro panel at 500 m cannot separate two objects less than about **125 m** apart.

PART 02

What the standard has agreed

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What is normative, what is still study, and what is decided next?

The only cellular sensing product in normative work is **a base station detecting drones with its own echo**. It rests on TS 23.137, approved at SA#113 in September 2026, and the RAN work item RP-261566, revised as RP-261901, whose four new specifications are due for approval at RAN#115 in March 2027. On privacy, TR 33.777 concluded that **“no solution will be specified”**. Whether the base station reports points or objects stays open until **RAN#114 in December 2026**.

PART 03

What sensing costs

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What does sensing take from the network, and what is that worth?

In 3GPP’s own evaluation, drone sensing met every objective from a single site in only **3 of 11** sources, and from several sites fused in **9 of 10**. Companies reported sensing taking from 1.43% to 28% of the carrier’s resources, with a median of 7.14%. Listening while transmitting caps power at 52 dBm with 80 dB of isolation. At the C-band’s **\$0.852 per MHz-POP**, each 1% of a national 100 MHz carrier is **\$290M** of licence value, so the median share is worth \$2.07B.

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How far can a base station see a drone, a person or a car, and which uses survive?

On thermal noise alone, an n77 macro would see a small drone of **-12.8 dBsm** at 1.1 km with a 5 W wide beam and at 7.6 km with 52 dBm in a narrow one. Measured single-site detection stops at **500 m to 1 km**. Five constraints the noise budget leaves out (a wide search beam, target fluctuation, one building’s clutter, residual self-interference and the receive window) take the 7.6 km down to about **1.4 km** before elevation coverage is counted. What survives is drone tracking in dense grids with several sites fused, and the protection of named sites.

PART 05

Who pays for sensing

Who is paying for network sensing, and who is allowed to sell it?

No carrier anywhere discloses sensing revenue. The FY2025 10-Ks and second-quarter 2026 10-Qs of AT&T, Verizon and T-Mobile never mention sensing, drones or radar, and China Mobile’s filings describe only trial networks. The first paid US offer is Lockheed Martin’s **NetSense** on Verizon, a subscription due for general availability in **2027**. A Part

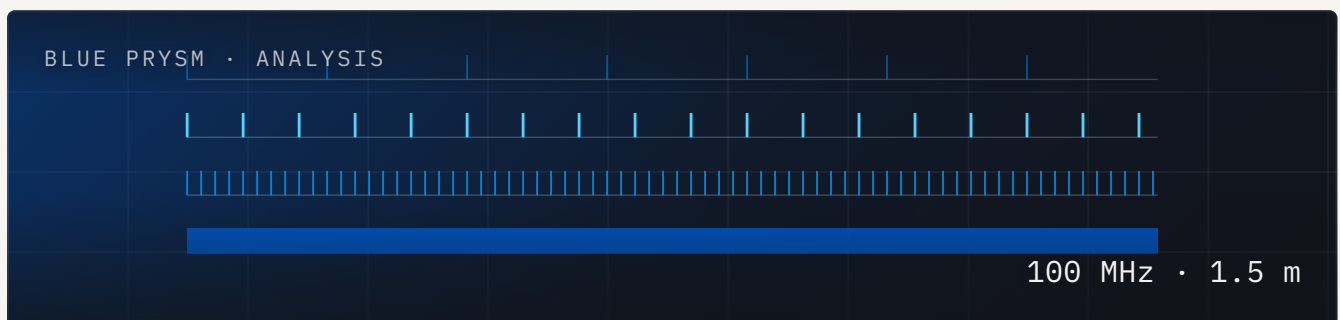
27 or Part 30 licensee may provide only the services its band is allocated, which means fixed and mobile, and the FCC has opened **no proceeding** on network sensing.

Work with Blue Prysm

What a network can see

What can a cellular network resolve at each band, and what does the standard ask of it?

A mobile network that senses is a radar, and a radar separates objects by distance only as finely as its channel width allows. No 5G carrier below 7.125 GHz is wider than 100 MHz, which works out at about 1.5 m. 3GPP asks for a metre or better in four of the seven performance categories it has written down.



IN BRIEF

- Every 5G band below 7.125 GHz, from n41 to n104, is limited to a 100 MHz carrier, which gives a range resolution of **1.5 m**. The trial Verizon and Samsung ran in September 2026 used 40 MHz, which gives 3.75 m.
- 3GPP's service requirements ask for 1 m or finer in four of their seven categories, which takes 150 to 400 MHz in one channel. The targets the industry is building to are looser, at about 10 m, in both 3GPP's Release 20 evaluation and China Mobile's commercial requirement.
- Angular resolution is the weakest dimension. An eight-column panel at 4 GHz resolves roughly 14 degrees, which at 500 m is a cell **125 m** wide and only 1.5 m deep.
- Car radar resolves 3.75 cm and Wi-Fi 7 sensing 0.47 m, both finer than a single 5G carrier. 5G sensing is best treated as a 10 m product that works outdoors and at height; anything finer waits for the 400 MHz channel at 7 GHz.

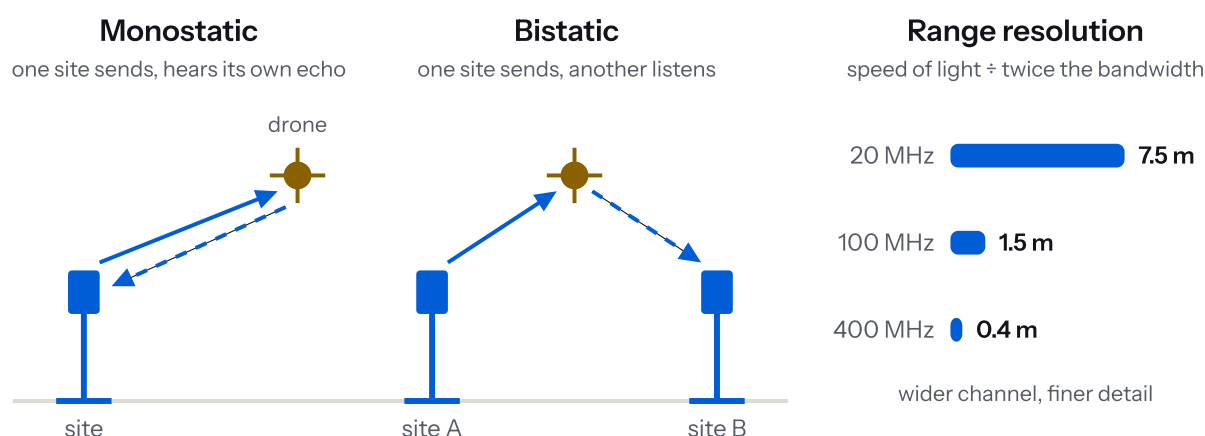
Three properties of the signal set what a radar can separate

it lies. Each has a resolution, meaning the smallest difference the system can tell apart, and each resolution is set by a different property of the signal (Exhibit 1).

- **Range.** Distance comes from the delay of the echo. To separate two objects at slightly different distances, the signal has to be short enough in time that their two echoes do not merge, and a short pulse is the same thing as a wide channel. The formula is the speed of light divided by twice the bandwidth. For a 100 MHz carrier that comes to 1.5 m.
- **Speed.** Speed comes from the frequency shift in the echo. The longer the radar observes, the smaller the shift it can see, so velocity resolution is the wavelength divided by twice the observation time.
- **Direction.** Direction comes from the antenna. An array resolves an angle of roughly one wavelength divided by its own width, and two objects side by side are separated only if the gap between them is more than that angle multiplied by their distance. A larger panel resolves a smaller angle.

EXHIBIT 1

A sensing network is a radar in one of two shapes, and in both the channel width sets the range cell



Specified so far (Release 20, RP-261566)

Base-station monostatic sensing, drones only, no change to phones.

Required of 6G: drones, people, vehicles and AGVs; the modes and signals are open.

Source: 3GPP RP-240799 for the sensing modes; RP-261566 and TS 23.137 for what Release 20 specifies; TR 38.914 for the 6G requirement (Filed). Note: resolution is $c/2B$ (Calculated).

Two terms are often used interchangeably and should not be. Accuracy is how close a measured position is to the true one. Resolution is whether two objects can be told apart at all. [TS 22.137](#) defines them separately, as “closeness ... to its true position” and as “the minimum difference in the measured magnitude ... to be allowed to detect objects in different magnitude”, and the distinction matters when reading any sensing claim. 3GPP’s own drone evaluations in [TR 38.765](#) ran on 100 MHz carriers, whose finest range cell is 1.5 m. Horizontal accuracy at the 90th percentile ranged from 0.26 m to 11.1 m, and the figure moved mostly with

whether one site or several were combined. A strong echo can be placed quite precisely inside its cell. Whether two drones flying close together show up as two is a question of resolution, which processing does not change.

Every 5G carrier below 7.125 GHz stops at a metre and a half

The maximum channel width is written into the 3GPP specifications band by band, and the number is the same throughout FR1. From n41 at 2.5 GHz to n104 in the upper 6 GHz band, a single carrier is at most 100 MHz wide, so range resolution stops at 1.5 m (Exhibit 2).

EXHIBIT 2

Every 5G band below 7.125 GHz stops at 100 MHz and 1.5 m; the step to 400 MHz comes with millimetre wave and with 6G around 7 GHz

BAND	RANGE	WIDEST CHANNEL	RANGE RESOLUTION	STATUS
n48 (CBRS)	3.55 to 3.7 GHz	100 MHz; the Verizon trial used 40 MHz	1.5 m ; 3.75 m at 40 MHz	Specified; shared spectrum
n77, n78 (C-band, 3.45 GHz)	3.3 to 4.2 GHz	100 MHz	1.5 m	Specified; licensed by Auctions 107 and 110
n41, n79, n104 (upper 6 GHz)	2.5 to 2.69, 4.4 to 5.0, 6.425 to 7.125 GHz	100 MHz	1.5 m	Specified
6G around 7 GHz	around 7 GHz	400 MHz network side; 400 down, 200 up for devices	0.375 m	RAN1 conclusion, June 2026; value as reported
n257, n258, n260, n261	24.25 to 40 GHz	400 MHz (optional)	0.375 m	Specified
n263	57 to 71 GHz	2,000 MHz at 960 kHz spacing (optional)	7.5 cm	Specified; unlicensed
Automotive radar	76 to 81 GHz	4 GHz (short range)	3.75 cm	FCC 17-94, 2017
Spectrum Horizons	116 to 123 GHz	7 GHz block	2.1 cm	FCC 19-19, unlicensed; outside the 6G study

A 100 MHz NR carrier at 30 kHz spacing occupies 3,276 subcarriers, or 98.28 MHz, which is the figure TR 38.765 evaluates with; its range cell is 1.53 m. The 400 MHz width in n257 to n261 and the widths above 400 MHz in n263 are optional in Release 19. The 6G study (RP-251881) excludes everything above 52.6 GHz.

Source: TS 38.101-1 V19.7.0 and TS 38.101-2 V19.5.0, Table 5.3.5-1; TR 38.914 V20.0.0; RP-261238, with the 7 GHz value as Qualcomm reports it (RCR Wireless, 1 July 2026); FCC 17-94 and FCC 19-19 (Filed and Reported). Note: resolution is $c/2B$ (Calculated).

In principle, two or more adjacent carriers in the same band could be processed as a single wide signal to go finer within FR1. Nothing in the Release 20 work item provides for it, although some operators hold the

spectrum. In [Auction 107](#) Verizon won 160 MHz of contiguous C-band in the New York area, from 3.70 to 3.86 GHz; AT&T took 80 MHz there and T-Mobile 40 MHz. Processed as one channel, Verizon’s block would resolve 0.94 m.

The trials so far have run on much less than that. When Samsung and Verizon measured crowd density in Dallas in September 2026, they used a CBRS radio on a 40 MHz carrier, which gives a 3.75 m range cell. China Mobile’s field data, reported to 3GPP in [RP-261227](#), show a range resolution of 7.5 m, which implies an effective bandwidth of only about 20 MHz. The contribution does not say which band was used.

The step to 400 MHz comes in two places. In millimetre wave it already exists as an optional carrier width in Release 19. Around 7 GHz it is what 6G is being designed for. [TR 38.914](#) says the 6G requirement for aggregated system bandwidth, which may span more than one carrier, is “at least 400 MHz”, and in June RAN1 told RAN#112 that the maximum channel bandwidth around 7 GHz “has been concluded”. The slide does not record the number, but Qualcomm puts it at up to 400 MHz on the network side and Ericsson gives 400 MHz as the top of the 6G system bandwidth. In the United States the 7 GHz range is still federal spectrum, which has to be identified and auctioned first; [part 2 of the 6G series](#) covers that process. The 400 MHz sensing channel arrives with that spectrum.

The standard asks for more than a 5G carrier can give

TS 22.137 sets out what a sensing service shall deliver. 3GPP approved it for Release 19 in December 2023, and its Table 6.2-1 defines seven categories of performance. Four of them call for a range resolution that no carrier in FR1 can provide (Exhibit 3).

EXHIBIT 3						
Four of the seven TS 22.137 categories need 150 to 400 MHz in one channel, and one 5G carrier in FR1 meets none of them						
CATEGORY	USE	RANGE RESOLUTION	VELOCITY RESOLUTION	POSITION ACCURACY, H / V	BANDWIDTH NEEDED	ONE FR1 CARRIER?
1	Detection and tracking, e.g. human, UAV	10 m	5 m/s	10 m / 10 m	15 MHz	Yes
2	Outdoor detection and tracking	1 m	1 m/s	2 m / 5 m	150 MHz	No
3	Indoor and outdoor; human, animal, UAV	1 m	1 m/s	1 m / 1 m	150 MHz	No
4	Indoor and outdoor, including AGVs and vehicles	0.5 m	0.5 m/s in factories	0.5 m / 0.5 m	300 MHz	No

5	Environment monitoring, e.g. rainfall, flooding	n/a	n/a	10 m / 0.2 m	none set	n/a
6	Motion monitoring, human activity	n/a	n/a	n/a	none set	n/a
7	Hand gestures	0.375 m	0.3 m/s	0.2 m / 0.2 m	400 MHz	No

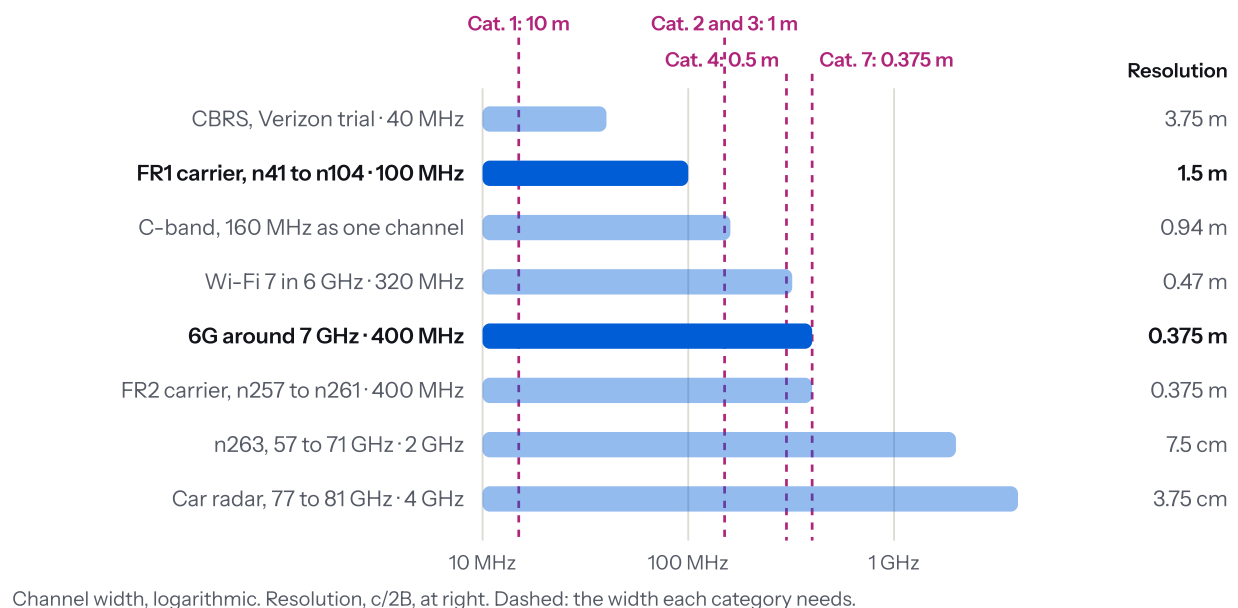
Confidence is 95% in every category except category 4, which asks 99% for public safety. Refresh rates run from 1 s in category 1 to 0.2 s in category 2, 0.1 s in categories 4 and 7 and as little as 0.05 s in category 3, and 60 s or more for environment and motion monitoring. The bandwidth column is $c/2\Delta R$ divided by twice the range resolution.

Source: TS 22.137 V21.0.0 (September 2026), Table 6.2-1, identical to V19.1.0 (March 2024) (Filed); bandwidth $c/2\Delta R$ (Calculated).

Category 1, detection and tracking to 10 m, needs only 15 MHz, and any 5G carrier clears it on width alone. Categories 2 and 3 require a metre, which takes 150 MHz. Category 4 requires half a metre, which takes 300 MHz. Category 7, hand gestures at 0.375 m, is exactly the resolution of a 400 MHz channel, the width that 6G and millimetre wave carry and FR1 does not (Exhibit 4).

EXHIBIT 4

No carrier below 7.125 GHz reaches the 1 m categories; 400 MHz at 7 GHz or in FR2 reaches all seven



Source: TS 38.101-1 V19.7.0 and TS 38.101-2 V19.5.0, Table 5.3.5-1 (400 MHz in n257 to n261 and n263 widths above 400 MHz optional); the RAN1 conclusion for 6G around 7 GHz as Qualcomm reports it; the Wi-Fi Alliance; FCC 17-94; TS 22.137 Table 6.2-1 (Filed and Reported). Note: the 160 MHz row is Verizon's contiguous New York C-band holding from Auction 107, 3.70 to 3.86 GHz, which no specification processes as one channel. Resolution is $c/2B$ (Calculated).

The requirements the industry is building to are looser than the service table. Three documents set them. 3GPP's own Release 20 evaluation, in Table 4.2-1 of TR 38.765, targets 10 m of horizontal and vertical position accuracy and 5 m/s of velocity accuracy at the 90th percentile, and it tolerates 5% missed detections and 5% false alarms. China Mobile's "Commercial Requirements of 5G-A", in RP-261227, ask for a range resolution of 10 m or better and a position accuracy within 20 m. The 6G minimums in TR 38.914, Table 5.1.17-1, ask for 5 m horizontally, 8 m vertically and 4 m/s in an urban macro deployment, tightening to 2 m and 2 m/s for an indoor factory. The draft IMT-2030 requirements that ITU-R Working Party 5D finished in February 2026 carry the same values, according to Samsung Research, and go to Study Group 5 for approval in December 2026.

Two sets of numbers are in circulation. The commercial requirement and 3GPP's evaluation target sit around 10 m, which any 5G carrier meets on bandwidth. The finer categories in the service requirement, a metre and below, need 150 to 400 MHz in one channel, and nothing in FR1 offers that. It arrives with 6G around 7 GHz, or with millimetre wave.

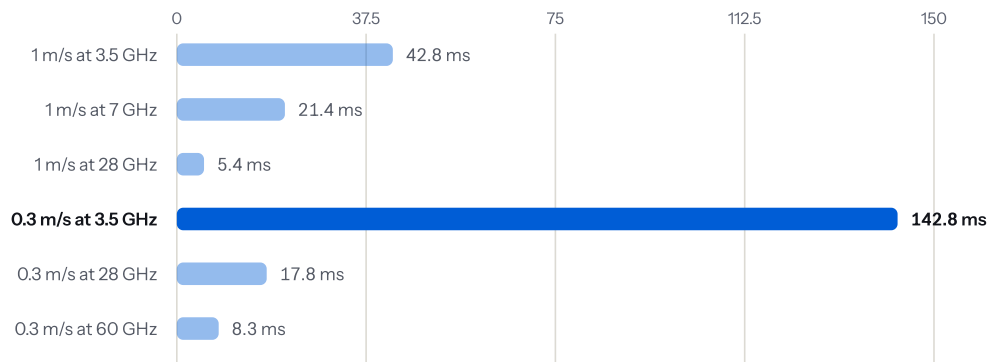
Observation time and antenna size set the other two resolutions

Bandwidth sets the range cell only. Velocity resolution depends on how long the radar observes, and angular resolution on the size of the antenna. Both run into limits unrelated to channel width.

At 3.5 GHz the wavelength is 8.57 cm, so to tell apart two objects whose speeds differ by 1 m/s the radar has to observe for 42.8 ms. At 7 GHz the time halves to 21.4 ms, and at 28 GHz it falls to 5.4 ms. The constraint bites hardest in the gesture category. Category 7 asks for 0.3 m/s, and at 3.5 GHz that takes 142.8 ms of observation, nearly three times the category's own latency limit of 5 to 50 ms. At 28 GHz the same measurement takes 17.8 ms and at 60 GHz 8.3 ms. We therefore read the gesture category as a millimetre-wave case rather than a macro one (Exhibit 5).

EXHIBIT 5

Resolving 0.3 m/s at 3.5 GHz takes 143 ms of observation, nearly three times the gesture category's 50 ms latency limit



Source: $\lambda/2T$ at the stated frequencies; 1 m/s is TS 22.137 categories 2 and 3 and 0.3 m/s is category 7, whose latency limit is 5 to 50 ms (Calculated from Filed).

Observation time has a second constraint. The fastest speed a radar can measure without ambiguity is $\lambda/4T_s$, where T_s is the interval between sensing symbols. At 3.5 GHz, one symbol every 2.5 ms caps unambiguous speed at 8.6 m/s; one every 0.25 ms raises the cap to 85.7 m/s. The drones in 3GPP's evaluations fly at up to 180 km/h, which is 50 m/s. The spacing of the sensing signal therefore sets the fastest speed the radar can track, as well as how much airtime sensing consumes, which is the subject of [part 3](#). A vivo prototype that reused a reference signal transmitted every 20 ms at 3.6 GHz added no overhead, but by the same formula it could not have measured anything moving faster than about 1 m/s, which is enough for breathing and too slow for a drone.

Angular resolution is where a macro site is coarsest. The baseline array in TR 38.765 has eight columns at half-wavelength spacing, which at 4 GHz makes a panel about 30 cm across and resolves about 14.3 degrees. At 200 m two objects need to be 50 m apart to be separated; at 500 m, 125 m. The optional sixteen-column array halves that, to 62 m at 500 m. The cell a 100 MHz macro site resolves at 500 m is therefore about 1.5 m deep and 125 m wide, a thin arc rather than a box. 3GPP's evaluations rely on fusing several sites that see the same object from different angles for that reason, and most of the accuracy comes from the fusion.

125 m

The width of the cell an eight-column panel resolves at 500 m and 4 GHz. On a 100 MHz carrier the same cell is 1.5 m deep.

Frequency helps here in a way it cannot help with range. A panel of a given physical size holds twice as many half-wavelength elements at 7 GHz as at 3.5 GHz, and so resolves half the angle. TR 38.914's

deployment scenarios assume base stations with up to 2,304 transmit and receive elements around 7 GHz. On an existing site footprint, the move to 7 GHz improves sensing at least as much through aperture as through bandwidth.

Car radar and Wi-Fi sensing already see finer

Car radar and Wi-Fi sensing each have a published standard and products on sale, and each sets a benchmark the network has to be measured against (Exhibit 6).

EXHIBIT 6				
Car radar resolves 3.75 cm and Wi-Fi 7 sensing 0.47 m, both finer than any single 5G carrier				
TECHNOLOGY	STANDARD OR RULE	SPECTRUM AND WIDEST CHANNEL	RANGE RESOLUTION	TYPICAL USE
5G cellular, FR1	TS 38.101-1, Release 19; sensing work item RP-261566	Licensed, 2.5 to 7.125 GHz; 100 MHz	1.5 m	Outdoors from macro sites; drones first
6G around 7 GHz; 5G FR2	RAN1 conclusion, June 2026; TS 38.101-2, optional width	Licensed, around 7 GHz and 24.25 to 40 GHz; 400 MHz	0.375 m	US 7 GHz spectrum still to be sold; small cells
Wi-Fi sensing	IEEE 802.11bf-2025, approved 28 May 2025, published 26 Sep 2025	Licence-exempt, 1 to 7.125 GHz and above 45 GHz; 320 MHz in Wi-Fi 7	0.47 m	Presence, smart buildings, wellness; indoors
Automotive radar	FCC 17-94, July 2017	Licence-exempt, 76 to 81 GHz; 4 GHz short range, up to 1 GHz long range	3.75 cm; about 0.5 m long range	Vehicles
The IEEE and NIST summaries of 802.11bf set no numeric accuracy target. 5GAA expects 3GPP-based sensing to complement conventional automotive sensors.				
Source: TS 38.101-1 and TS 38.101-2 Table 5.3.5-1; RP-261238 and Qualcomm; IEEE 802.11bf-2025 record; NIST overview; Wi-Fi Alliance Wi-Fi 7 page; FCC 17-94; Texas Instruments SPYY005A; 5GAA via part 8 of the 6G series (Filed and Reported). Note: resolution is c/2B (Calculated).				

Automotive radar has had five contiguous gigahertz at 76 to 81 GHz since [FCC 17-94](#) in July 2017. The Commission’s order records that short-range radars “require an operating bandwidth of four gigahertz”, and [Texas Instruments](#) gives the result as a range resolution of 3.75 cm. That is forty times finer than a 100 MHz carrier in n77, and even a 400 MHz channel at 7 GHz or in millimetre wave is ten times coarser. The car industry’s own association, 5GAA, expects 3GPP-based sensing to complement the sensors on the vehicle rather than replace them, and on these numbers it could hardly do otherwise ([part 8 of the 6G series](#) has more).

Wi-Fi sensing has its own published standard, [IEEE 802.11bf-2025](#). NIST’s overview describes a sensing procedure that “supports bistatic and multistatic” operation, and the Wi-Fi Alliance describes “320 MHz channels available in the 6 GHz band” for Wi-Fi 7. A 320 MHz channel resolves 0.47 m, finer than any single

5G carrier, and it is achieved inside the home and the office on equipment the building owner was going to buy anyway.

Set side by side, the car's radar is forty times finer and the building's Wi-Fi about three times finer, so the network will not compete on resolution. It has four advantages the other two lack.

- **Spectrum.** The network's spectrum is licensed and exclusive, and there is an operator with the right to use it.
- **Height.** Its radios sit on rooftops and towers, above the clutter that defeats a sensor at ground level.
- **Reach.** It already covers a city, from radios that are already there.
- **Accountability.** There is a single operator responsible for the system.

Those four count for most outdoors, at height and at distance, where drones fly, which is why the standard chose that use first, as [part 2](#) explains.

Key terms

- **Range resolution.** The smallest difference in distance at which two objects are seen as two. It is the speed of light divided by twice the bandwidth, and it is a property of the signal rather than of the processing.
- **Velocity resolution.** The smallest difference in radial speed the radar can separate: the wavelength divided by twice the observation time, which radar engineers call the coherent processing interval.
- **FR1 and FR2.** 3GPP's two frequency ranges for 5G. FR1 runs up to 7.125 GHz, where the widest carrier is 100 MHz; FR2 starts at 24.25 GHz, where it is 400 MHz.
- **Monostatic and bistatic.** In monostatic sensing one site transmits and listens for its own echo. In bistatic sensing one site transmits and another listens.
- **TS 22.137.** 3GPP's normative service requirements for sensing, with the seven-category performance table. It says what the system shall deliver and leaves the design to the technical specifications.

Implications

CARRIER STRATEGIST

Sell 5G sensing as a category 1 product: detect and track to about 10 m. A single FR1 carrier gives you 1.5 m in range and about 125 m across at 500 m, and the commercial requirement asks for 10 m, so that is a product you can deliver. Work out what your own contiguous C-band holding would resolve if processed as one channel; Verizon's 160 MHz in New York would come in just under a metre. Anything finer than that starts with a 400 MHz carrier at 7 GHz.

INVESTOR

When a sensing claim is quoted in centimetres, ask which band it was measured in and how wide the channel was. A 100 MHz FR1 carrier resolves 1.5 m in range and about 125 m across at 500 m. Anything finer from a macro site has to come from wider spectrum, from fusing several sites or from millimetre wave, and each of those carries a cost that part 3 sets out.

VENDOR

Every FR1 carrier stops at 100 MHz, so the places to differentiate are aperture and processing. The number of columns sets the cross-range cell: eight give 125 m at 500 m, sixteen give 62 m. The spacing of the sensing signal sets the fastest speed you can report, 8.6 m/s at one symbol every 2.5 ms. Publish both numbers alongside any accuracy claim.

Method and limits

HOW THIS WAS BUILT

The channel widths are the maximum per-carrier bandwidths in Table 5.3.5-1 of TS 38.101-1 for FR1 and TS 38.101-2 for FR2, Release 19. For the 6G width around 7 GHz we use the figure Qualcomm reports for the RAN1 conclusion, since the RAN1 slide records the conclusion but not the number; it agrees with the 400 MHz that Ericsson gives as the top of the 6G system bandwidth. The requirements are Table 6.2-1 of TS 22.137, which reads the same in V19.1.0 and V21.0.0.

The resolutions come from three standard radar results. Range resolution is $c/2B$ for a bandwidth B . Velocity resolution is $\lambda/2T$ for a wavelength λ and an observation time T . Angular resolution is λ/D for an aperture D , and the cross-range cell is the distance multiplied by that angle. The array dimensions are those of the evaluation configurations in TR 38.765. Where a requirement is said to “need” a certain bandwidth, that is the first formula run backwards.

WHAT IT DOES NOT SHOW

Resolution is the smallest separation at which two objects can be told apart, and it is not the same thing as accuracy; 3GPP’s own simulations show accuracy comfortably beating the resolution cell once several sites are fused. Wider effective channels are possible in principle by aggregating carriers and processing them together, but no specification so far provides for that in sensing, so it is not assumed here. The IEEE 802.11bf material sets no numeric accuracy target. Nothing here measures any vendor’s product.

Data as of: 3GPP specifications and reports as published to September 2026, FCC and IEEE records, read 7 Oct 2026 · Method version 1.0.

Sources. 3GPP TS 22.137 V21.0.0 (September 2026), Table 6.2-1, checked against V19.1.0; TS 38.101-1 V19.7.0 and TS 38.101-2 V19.5.0, Table 5.3.5-1; TR 38.765 V20.0.0, Annex A and clause 6.3; TR 38.914 V20.0.0, clauses 5.1.13 and 5.1.17; the RAN1 report to RAN#112, RP-261238; China Mobile and others, RP-261227; Qualcomm’s Juan Montojo in RCR Wireless (1 July 2026) for the 7 GHz channel width and Ericsson’s 6G note (12 June 2026) for the 6G system bandwidth; the FCC’s Auction 107 results, its assignment results by licence and the sub-block plan in FCC 20-22; FCC 17-94 on 76 to 81 GHz radar and Texas Instruments’ SPYY005A; the IEEE 802.11bf-2025 record, the TGBf status page, NIST’s 802.11bf overview and the Wi-Fi Alliance’s Wi-Fi 7 page; Samsung’s Verizon trial release (14 September 2026). Read 7 Oct 2026.

What the standard has agreed

What is normative, what is still study, and what is decided next?

Five standards bodies have taken up integrated sensing since 2020, and almost all of what they have published is study. The part that binds anyone is narrow: a base station listening for its own echo to detect drones, with nothing changed on the phone and a new core network function to pass the results to an authorised application. On the privacy of the people under the beam, 3GPP's security group concluded that it would specify no solution.



IN BRIEF

- Of sixteen sensing documents across 3GPP, ITU-R, ETSI, IEEE and CEPT, **five bind**. Four are cellular, and only two of those describe a product: TS 23.137, approved at SA#113 in September 2026, and the RAN work item RP-261566. Both are confined to a base station detecting drones.
- The work item changes nothing on the phone and nothing in the waveform. Its four new interface specifications, provisionally numbered TS 38.480 to 38.483, go to RAN#114 for information in December 2026 and to RAN#115 for approval in **March 2027**.
- One decision is still open: whether the base station reports the points it detects (Level C, agreed) or the objects it has tracked (Level D, conditional on privacy). Level C puts the radar processing in the core; Level D keeps it inside the radio vendor's base station.
- SA3's privacy study, TR 33.777, ends with the words "**no solution will be specified**". CEPT opened the first regulatory file on sensing in June 2026, for 3.4 to 3.8 GHz. Carriers should plan to the drone interface and keep RAN#114, on 7 to 10 December 2026, in view.

Of sixteen documents, five bind and two describe a product

short on specification, and the specification is about drones (Exhibit 1).

EXHIBIT 1

Of sixteen sensing documents, five bind, and the two that specify a product cover only base-station drone detection

DOCUMENT	BODY	WHAT IT COVERS	STATUS	APPROVED
TS 22.137, Rel-19	3GPP SA1	Service requirements; the seven-category performance table	Normative , stage 1	SA#102, Dec 2023
TS 22.137, Rel-21	3GPP SA1	New 6G clause: 5G functional requirements apply; no 6G KPI table	Normative , stage 1	SA#113, Sep 2026
TS 23.137	3GPP SA2	Sensing Function; aerial objects only; base-station sensing only	Normative , stage 2	SA#113, Sep 2026
RP-261566, revised as RP-261901	3GPP RAN, RAN3 lead	Base-station monostatic drone sensing, no device impact; four new specifications	Normative work item	RAN#112, Jun 2026; revised RAN#113
IEEE 802.11bf-2025	IEEE 802.11	WLAN sensing procedure, licence-exempt bands	Standard	Approved May 2025; published Sep 2025
TR 22.837	3GPP SA1	32 use cases	Study	SA#100, Jun 2023
TR 38.901, clause 7.9	3GPP RAN1	Channel model for sensing, six modes, five target types	Study; evaluation tool	RAN#108, Jun 2025
TR 23.700-14	3GPP SA2	Architecture study	Study	SA#111, Mar 2026
TR 22.870, clause 7	3GPP SA1	25 6G sensing use cases	Study	SA#111, Mar 2026
TR 38.765	3GPP RAN1	Evaluation of base-station drone sensing	Study	RAN#112, Jun 2026
TR 38.914	3GPP RAN	6G requirements, including sensing minimums	Study	RAN#112, Jun 2026
TR 33.777	3GPP SA3	Security and privacy; privacy “no solution”	Study	SA#113, Sep 2026
Rec. ITU-R M.2160	ITU-R	Sensing as an IMT-2030 usage scenario; no numeric target	Framework	Nov 2023
Draft IMT-2030 requirements	ITU-R WP 5D	Sensing minimums matching TR 38.914, as reported	Draft	To SG 5, Dec 2026
GR ISC 001 to 004	ETSI ISG ISAC	Use cases, channel model, architecture, security and privacy	Informative	Mar 2025 to Feb 2026
ECC work item, 3.4 to 3.8 GHz	CEPT ECC	Harmonised conditions for base stations detecting flying objects	Regulatory study	Created Jun 2026

Approval dates are the plenary at which each document was approved or raised to its current version. TR 38.901's sensing clause entered V19.0.0 at RAN#108 and was amended at each plenary to RAN#113 (V19.5.0).

Source: the 3GPP specification archive, the RAN#112 and RAN#113 TDoc lists, the ITU-R IMT-2030 page, the ETSI ISG ISAC page and the IEEE 802.11bf-2025 record (Compiled).

Five rows bind, four of them cellular, and only two of those describe a product. TS 22.137 says what a 5G system shall deliver, and [part 1](#) reads it band by band, but a service requirement is not a design. The design is in TS 23.137 and in the work item, and both confine themselves to a base station detecting and tracking aerial objects. Everything else in the table is study, including the channel model and the 6G requirements. Sensing was first agreed in 3GPP in December 2023. The date that matters for anyone making a plan is March 2027, when RAN#115 is due to approve the first product specifications.

Release 20 specifies one product: a base station detecting drones

The work item that turns the study into specifications is a short document, and what it leaves out defines the product as much as what it puts in.

[RP-261566](#) was approved at RAN#112 in Singapore, which ran from 8 to 11 June 2026. The moderator was the RAN vice chair from T-Mobile USA, and the lead working group is RAN3, which writes interfaces, with a rapporteur from China Telecom. The objective is to “specify gNB-based mono-static sensing for UAV sensing target use cases ... There will be no UE impacts”. It allows that intra-gNB bistatic sensing “may be considered”. Forty-six companies put their names to it, among them AT&T, T-Mobile USA, Verizon and FirstNet. At RAN#113 in Madrid three months later, 14 to 17 September, the revision [RP-261901](#) named four new specifications for the new interface and suggested the numbers TS 38.480 to 38.483. They cover general aspects, layer 1, signalling transport and a new application protocol, and they go to RAN#114 for information and to RAN#115 for approval.

The study behind the work item, [RP-253246](#), had already drawn four lines around it.

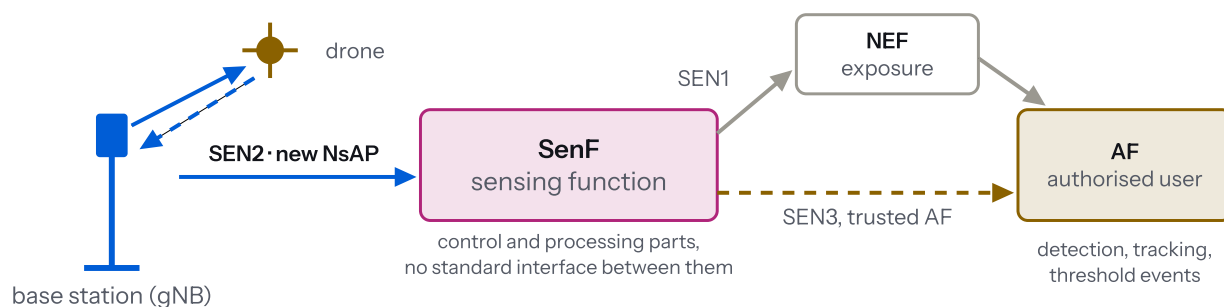
- **Waveform.** The study used the “existing DL NR waveform and DL NR reference signals”. There is no new sensing signal.
- **Band.** FR1 was given priority.
- **Coordination.** “No inter-gNB coordination will be studied.” Base stations do not cooperate with each other at the radio layer.
- **Device.** “There will be no UE impacts.” The phone is untouched.

The first cellular sensing product is therefore a software and interface feature running on radios already in the field, which makes it commercially near and technically modest.

The core network side is [TS 23.137](#), approved at SA#113 in September 2026. Its scope is “only focusing on aerial object (e.g. drone) detection and tracking use case”, and “only gNB-based sensing is supported”. It adds a Sensing Function, SenF, split into a control part and a processing part with “no standardized interface between” them. The SenF talks to the base station, to the network exposure function and to a trusted application function (Exhibit 2). That application function is the only consumer. It asks for “Object Detection” or “Object Tracking” and gets back one-time, periodic or event-triggered reports, such as when the “number of Aerial objects exceeded a certain threshold”. Several editor’s notes are still open, so some of the detail may yet move.

EXHIBIT 2

Release 20 routes sensing results from the base station through a new core function to an authorised application, and leaves open where the radar processing happens



Where the radar processing sits, by what the base station reports

Level A raw samples	gNB sends raw channel samples: not supported	1.29 to 116 Gb per report
Level C points	gNB: extract points SenF: cluster, fuse, track	7.2 to 57.6 kb agreed
Level D objects	gNB: detect, track, fuse its sites SenF: fuse	1.7 to 5.1 kb if privacy resolved

Level C or Level D: open after SA3's reply; next decision at RAN#114, December 2026

Source: 3GPP TS 23.137 V20.0.0 (SA#113, September 2026) for the Sensing Function and its reference points; RP-261901 (RAN#113) for the new application protocol; TR 38.765 V20.0.0 clauses 5.1, 5.4 and 9 for the levels (Filed); report sizes from its formulas (Calculated). Note: Level B, profiles, is excluded from the work item and not drawn.

Read as a product rather than an architecture, the diagram names the customer. The output goes to an authorised application through an exposure interface, never to a subscriber's phone, so the first sensing product is an interface sold to an organisation that watches airspace: an airport, a venue or a security agency. [Part 5](#) covers who those buyers are.

The open decision is whether the base station reports points or objects

TR 38.765 defined four levels at which a base station can hand its sensing measurements to the core. The choice between the last two is the only decision of substance still open, and it is less technical than it looks (Exhibit 3).

EXHIBIT 3

The agreed Level C report is kilobits where a raw sample report is gigabits, and the Level D object report is smaller again

LEVEL	WHAT THE BASE STATION SENDS	SIZE OF ONE REPORT	STATUS
A	Raw channel samples, per antenna port, symbol and site	1.29 to 116 Gb	Not supported
B	Delay, Doppler and angle profiles	0.06 to 286 Gb	Excluded from the work item
C	Measurements per detected path or point	7.2 to 57.6 kb	Agreed
D	Objects, with position and velocity	1.7 to 5.1 kb	Conditional on privacy and security

Sizes are the minimum to maximum of TR 38.765's clause 5.4 formulas with its Table 5.4-1 assumptions: 3,276 subcarriers, 64 to 320 symbols, up to 9 transmit and 64 receive ports, three transmission points, 30 to 120 paths, 15 objects. At ten reports a second, the medium Level A case is about 129 Gb/s per base station and the largest Level C case 0.58 Mb/s.

Source: TR 38.765 V20.0.0, clauses 5.1, 5.4 and 9 and Table 7.4-1 (Filed); sizes from the clause 5.4 formulas (Calculated).

The study ruled out Level A “Due to its higher transport capacity requirement”: a single raw report at the study's largest assumptions is 116 Gb, more than a 100 Gb/s link moves in a second. It agreed Level C and made Level D conditional on “the resolution of potential privacy and security issues”. RAN put the question to SA3 in June. SA3's reply, [S3-263445](#) from its August meeting in Prague, said it had “considered the sensing measurements/data without any distinctions or dependencies on the level C/level D”. It pointed back to its own report, and the question returned to RAN unanswered.

- **Level C.** The base station extracts points. The sensing function in the core clusters them, fuses the sites, detects and tracks. The core vendor does the radar processing and can, in principle, buy points from any radio vendor.
- **Level D.** The base station detects, tracks and fuses for its own sites, and the core receives finished objects. The radio vendor does the processing and owns the answer.

The companies have split along exactly that line (Exhibit 4). China Mobile, with twelve co-signatories, and Ericsson in a paper of its own, want Level D; Huawei asked for Level C alone. Neither the SA3 reply nor RAN#113 settled it. The next decision point is RAN#114 in Boston, 7 to 10 December 2026, when the four specifications arrive for information.

Operators with sensing in the field and the two European radio vendors back Level D; Huawei asked for Level C alone

COMPANY	PAPER AND MEETING	POSITION, IN THE COMPANY'S WORDS
China Mobile and twelve co-signatories, among them ZTE, Ericsson and Nokia	RP-261227, RAN#112 (noted)	"adopting Measurement level C for data reporting from gNB to SenF is not feasible. In a cross-vendor deployment ... hard for troubleshooting"; Level D "has already been implemented in operators' gNBs in current commercial deployments"
Ericsson	RP-262003, RAN#113 (noted)	"Level D is always compliant"; RAN3 should "down-prioritizes Level C"
Huawei	RP-261152, RAN#112	"Specify only measurement level C"
Nokia	RP-261356, RAN#112	Include Level D
ZTE; China Mobile	RP-262117; RP-261869, RAN#113 (not treated)	No privacy stopper for Level D
TNO	RP-261321, RAN#112	Level C as agreed "does not capture the micro-doppler information", which makes classifying objects in the sensing function difficult: a drone from a bird, for instance

A company paper states that company's position; only the plenary agrees. Status is from the TDoc list where it records one.

Source: RAN#112 and RAN#113 document folders and TDoc lists (Reported positions; Filed status).

The Level C or Level D decision allocates the radar processing between vendors. Level C puts detection and tracking in the core's sensing function, which makes a multi-vendor network possible on paper. Level D keeps them in the base station, which is how the operators that have deployed sensing run it today and is the arrangement Ericsson and Nokia support. Privacy is the stated reason for the dispute, and SA3 has declined to settle it.

SA3 decided not to specify a privacy solution

SA3's study, [TR 33.777](#), was approved at SA#113 in September 2026. On privacy, it records a decision to specify nothing.

WHAT TR 33.777 SAYS ON PRIVACY

The conclusion opens: “It is agreed that no solution will be specified for this key issue.” What follows is recorded “only for information”.

On collection, the system “has to minimize the collection of incidental or implicit information beyond the intended sensing purpose. It is not guaranteed that any mechanisms will effectively realize data minimization”.

On mistakes: “If non-aerial objects are incorrectly reported as aerial objects, this can result in information related to non-aerial objects being exposed. This issue is not addressed in the present document.”

Against echo spoofing, “No prevention and detection mechanisms are specified”; passive eavesdropping “cannot be prevented”. Authentication and transport security reuse existing 5G mechanisms.

The service requirements had already pointed the question outward. TS 22.137 requires sensing KPIs “for both situations where consent can be obtained, and where it cannot”, and allows that “Subject to regulation and user consent” the network “may be able to link sensing results with 3GPP subscriber identity”. Between the two documents, the privacy of the people in the beam is left to regulators and to each operator’s own policy. The first regulator to give an answer was Germany’s data-protection conference in June 2026; [part 5](#) sets out its position.

The 6G requirements and the first regulatory file

For 6G, 3GPP has agreed the requirements and the starting points, while the waveform, the reference signals and the sensing modes remain open. Outside 3GPP, CEPT has become the first regulator to treat a network’s sensing transmissions as needing conditions of their own.

TR 38.914, approved at RAN#112, sets the 6G requirement. The radio and architecture “shall at least support use cases of detection and/or tracking of passive objects, at least including UAVs, human, vehicles and AGVs [and] communication assistance”. The minimum performance figures are in [part 1](#). RAN1 has agreed to start from the 6G communication frame structure, cyclic prefix and subcarrier spacing for sensing, and lists the sensing frame structure and numerologies as open. TS 22.137 gained a 6G clause at SA#113 under which the 5G functional requirements “apply analogously to the 6G system”, with no 6G performance table. Companies are already staking out positions. T-Mobile USA and Nokia asked for bistatic and multistatic sensing and for service layers that “expose APIs for third-party applications” (RP-260887, noted). Ericsson, Jio, T-Mobile USA, China Telecom and others wrote that “5G ISAC functionality can be considered as a subset of 6G functionality” (RP-261416).

Outside 3GPP the record is thinner. [Rec. ITU-R M.2160](#) names integrated sensing as one of six IMT-2030 usage scenarios and says sensing “could be measured in terms of accuracy, resolution, detection rate, false alarm rate, etc.”, without putting a number on any of them. The draft requirements go to Study Group 5 in December 2026, and candidate technologies are accepted from February 2027. ETSI’s industry group has

published four informative reports, of which the first lists 18 use cases and the fourth 19 key issues. The only sensing standard in force anywhere is IEEE 802.11bf, which is for Wi-Fi.

The first regulator to act is European. At its 70th plenary in June 2026, CEPT's Electronic Communications Committee agreed to create a work item on harmonised technical and operational conditions for sensing in 3.4 to 3.8 GHz. It is answering a European Commission mandate for "the sensing use case of detecting and tracking flying objects (in particular aerial drones or balloons)", limited to base stations and "with the objective to facilitate the identification of such unlawfully flying objects". Its liaison of 11 September 2026, logged at RAN#113 as [RP-262217](#), asks 3GPP for four parameters of a sensing base station, for both monostatic and base-station-to-base-station bistatic modes. They are the power spectral density of the sensing signal, the channel bandwidth, the activity factor and a block-edge mask. The dates that decide what happens next run from December 2026 to December 2028 (Exhibit 5).

EXHIBIT 5

The first sensing specifications are due in March 2027, and everything wider waits for the Release 21 freeze in December 2028



Source: RP-261901; the [3GPP RAN meeting calendar](#); the ITU-R IMT-2030 page; ECC PT1(26)155 Annex 04 (RP-262217); the 3GPP Release 21 timeline as dated in [part 1 of the 6G series](#) (Filed).

3GPP and the European regulator have arrived at the same first product from different directions: base stations detecting drones in mid-band spectrum. Everything wider, which means people, vehicles, phones as sensors and bistatic networks, waits for Release 21 and its freeze in December 2028.

Key terms

- **Normative and study.** A technical specification (TS) or an approved work item binds products; a technical report (TR) binds nothing.
- **gNB.** The 5G base station. “gNB-based mono-static sensing” means the base station transmits and receives its own echo.
- **SenF.** The Sensing Function in the 5G core that TS 23.137 adds; it controls sensing, processes reports and exposes results.
- **Measurement level.** How much processing the base station does before it reports: raw samples (A), profiles (B), points (C) or objects (D).
- **AF and NEF.** The application function is the authorised outside consumer; the network exposure function is the gateway it reaches the core through.

Implications

CARRIER STRATEGIST

Plan to the product you will be able to specify against in 5G-Advanced: a drone-detection interface from your base stations to an authorised application, with detection, tracking and threshold events. Keep RAN#114, on 7 to 10 December 2026, in view. Level D keeps the processing with your radio vendor and Level C lets you buy it separately, so the outcome changes how you procure.

INVESTOR

Sort every sensing claim you hear into Exhibit 1. The only normative cellular product is drone detection by a base station, with specifications due for approval in March 2027. A claim about people, vehicles or phones as sensors is a claim about Release 21, which freezes in December 2028, or about a proprietary system.

VENDOR

Decide which side of the Level C or Level D line your product sits on before December 2026, when the four specifications arrive for information. Radio vendors gain from Level D, which keeps detection and tracking in the base station; core and analytics vendors gain from Level C. If you sell at Level C, close the micro-Doppler gap TNO raised, because it decides whether the core can tell a drone from a bird.

Method and limits

HOW THIS WAS BUILT

We class each document by what it is rather than by what it says. A 3GPP technical specification or an approved work item is normative. A technical report is a study, even where it records agreements. ITU-R Recommendations set frameworks, ETSI group reports are informative by definition, and an IEEE amendment is a standard. The dates are the plenary or approval dates recorded in each document's history or in the meeting TDoc list.

The positions on the open question are quoted from the company papers submitted to the plenaries, with their status (approved, noted or not treated) taken from the TDoc list. The report sizes for each measurement level are our own calculation from the formulas and assumptions in clause 5.4 of TR 38.765.

WHAT IT DOES NOT SHOW

A company paper states that company's position on the 3GPP record; only the plenary agrees anything. The draft IMT-2030 sensing values are as Samsung Research reports them, because the ITU-R document itself is restricted, and they become formal only when Study Group 5 approves them. Editor's notes remain open in TS 23.137 and may change the detail. We do not judge whether any design choice is technically the better one.

Data as of: 3GPP archive, RAN#113 and SA#113 (September 2026) documents, ITU-R, ETSI and IEEE records, read 7 Oct 2026 · Method version 1.0.

Sources. 3GPP specifications from the 3GPP archive: TS 22.137 V19.1.0 and V21.0.0, TR 22.837 V19.4.0, TR 22.870 V20.0.0, TR 38.901 V19.5.0, TR 38.765 V20.0.0, TR 38.914 V20.0.0, TS 23.137 V20.0.0, TR 23.700-14 V20.0.0 and TR 33.777 V20.0.0; plenary documents RP-242348, RP-253246, RP-261566, RP-261901, RP-261615 (SA3's reply) and RP-261238, and the company papers RP-261227, RP-261152, RP-261356, RP-261321, RP-260887 and RP-261416 at RAN#112 and RP-262003, RP-261869 and RP-262117 at RAN#113, with each meeting's TDoc list for their status; the CEPT ECC PT1 liaison logged as RP-262217; Rec. ITU-R M.2160 and the ITU-R IMT-2030 page, with Samsung Research's account of the draft requirements; the ETSI ISG ISAC page and GR ISC 001 to 004; IEEE 802.11bf-2025. Read 7 Oct 2026.

What sensing costs

What does sensing take from the network, and what is that worth?

No price for cellular sensing has been published, but the costs can be counted. Sensing is paid for in four resources a carrier already measures: airtime, transmit power, timing and transport. 3GPP's own evaluation puts numbers on the first two and on how many sites a detection needs, and the C-band auction puts a value on the airtime. At \$0.852 per MHz-POP, every 1% of a national 100 MHz carrier given to sensing is about \$290 million of licence value.



IN BRIEF

- In TR 38.765, 3GPP's evaluation of base-station drone sensing, **9 of 10** sources met every objective once several sites were fused, and only **3 of 11** managed it from a single site at the high-power baseline. The unit of sensing is the cluster rather than the site.
- Across 43 results, companies reported sensing taking **1.43% to 28%** of the carrier's resources, with a median of 7.14%. Duty-cycled to a 40 ms look once a second, the median falls to 0.29%.
- At the C-band's \$0.852 per MHz-POP, a national 100 MHz carrier carries \$28.98B of licence value. Each 1% given to sensing is **\$290M**, and the median share works out at \$2.07B, or about \$242M a year at an assumed 8% cost of capital over 15 years.
- 3GPP capped monostatic transmit power at 52 dBm, or 158 W, against radios in service of 200 to 480 W, because a receiver saturates at -28 dBm with 80 dB of isolation. Carriers should price sensing on the sectors and hours it runs, and ask vendors for isolation and site-count figures before any trial.

Drone sensing passed with several sites fused and mostly failed from one

TR 38.765 is the only evaluation of cellular sensing in which many companies ran the same test under one set of rules. It tested the product Release 20 specifies: a base station watching for small drones with its own echo.

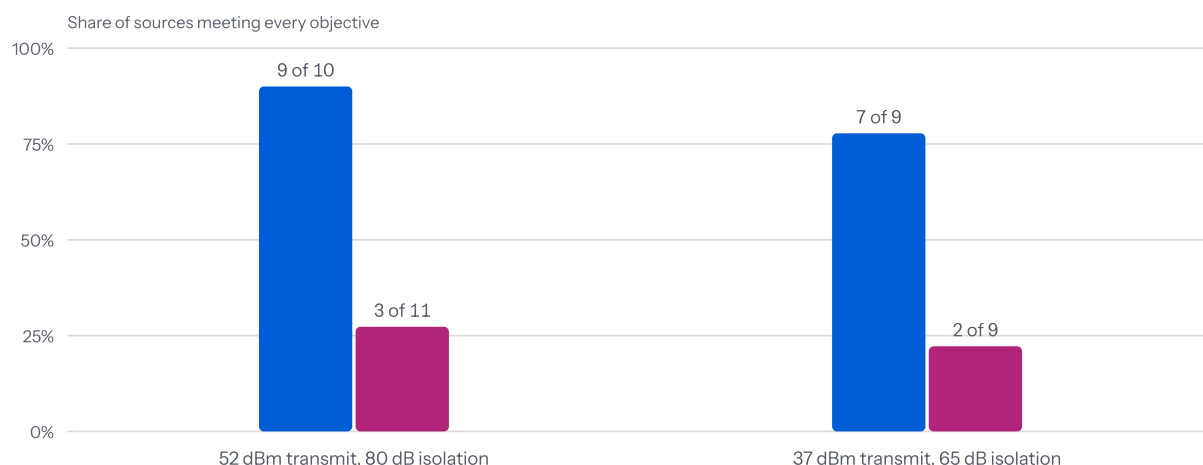
- **Grid.** Sites 500 m apart at 4 or 4.9 GHz with 100 MHz carriers, plus a rural case with sites 1,732 m apart.
- **Target.** A drone measuring 0.3 by 0.4 by 0.2 m, flying at 25 to 300 m and at up to 180 km/h.
- **Objectives.** Miss no more than 5% of drones, raise no more than 5% false alarms, and place 90% of detections within 10 m and 5 m/s.
- **Power.** Two baselines: 52 dBm with 80 dB of isolation between the transmit and receive antennas, and 37 dBm with 65 dB.

Each company reported whether it met every objective using one site's measurements alone, or with several sites fused together. At the high-power baseline, 9 of 10 sources passed with several sites and 3 of 11 with one; at the low-power baseline the counts were 7 of 9 and 2 of 9 (Exhibit 1). The single-site results that failed did not fail narrowly. Some missed up to 35% of drones and, even without moving clutter, reported false alarms of up to 36.41%; one result with moving clutter put false alarms at 91%. The rural case was harder still. At 37 dBm with simultaneous transmit and receive, 16.4% to 29.0% of drones were missed, and the rural results that did pass, all from one source, relied on extra transmissions at 56 dBm made while the receiver was off.

EXHIBIT 1

Nine of ten sources met every objective with several sites fused; three of eleven did so from one site

■ Several sites fused ■ One site



Source: TR 38.765 V20.0.0, clause 9 conclusions and clause 6.3 results, approved at RAN#112, June 2026 (Filed). Note: urban macro, sites 500 m apart, small drone; the objectives are 5% missed detection, 5% false alarm, 10 m and 5 m/s at the 90th percentile.

Two costs follow. The first is that the unit of sensing is the cluster rather than the site: one site at 500 m spacing mostly fails and three or more fused together mostly succeed, so every site within reach of a protected area has to sense, and something in the network has to fuse what they see. The second is that power and isolation move the result more than anything else in the evaluation, so the receiver's tolerance of its own transmitter is the hardware cost that matters.

Reported sensing shares ran from 1.4% to 28% with a median of 7.1%

A sensing signal occupies symbols and subcarriers that would otherwise carry traffic, so the first cost is airtime. 3GPP measured the share as the sensing resource ratio, and when the companies reported their figures the answers spread twentyfold (Exhibit 2).

EXHIBIT 2

Reported sensing shares ran from 1.43% to 28% of the carrier, and the median result was one symbol in fourteen

COMPANY	SHARE OF RESOURCES	MET EVERY OBJECTIVE	PATTERN, IN THE COMPANY'S WORDS
Qualcomm	1.43% to 5.72%	Yes, several sites	two symbols, sent within an 80 ms window in each 480 ms
vivo	2.06%	Yes, several sites	averaged over a 1 s refresh and a beam sweep
OPPO	5.14%	Yes, one and several sites	"long-term sensing resource ratio is about 5.14%"
Ericsson	5.7%	No (velocity)	"4 symbols per 5 slots"
ZTE	7.14%	Yes, several sites	every fourth subcarrier, beams scanned over two observations
Nokia	7.69%	No (23% missed)	positioning reference signal reused
Huawei	8.57%	Yes, several sites	"6 symbols per 5 slots"
Xiaomi	9.0%	Several sites yes; one site no	"refreshing rate of 5Hz and CPI length of 40ms"
Sony	about 14%	Yes, one site	"2 symbols per slot"
Tiami Networks	25%	No	"every 4th OFDM symbol", all 3,276 subcarriers
NIST	28%	Yes	29% within one observation; "approximately 3.7%" if repeated every second

Selected entries from 43 results at the high-power baseline. Across all 43 the range is 1.43% to 28% and the median 7.14%, one symbol in fourteen. Qualcomm, vivo, OPPO and Xiaomi report a share averaged over a refresh period; the others report the share within one observation. At the low-power baseline the results that met every objective ran from 5.14% to 14.29%. TR 38.765 itself reports the ratio only as at most 10% or above 10%.

Source: R1-2601668, "Evaluation results of NR ISAC", RAN1#124, February 2026, cited in TR 38.765 Annex B; patterns from R1-2601669 and the company papers (Filed); median calculated (Calculated).

The spread is narrower than it looks, because most of those entries are the share within a single observation, whereas a carrier cares about the share over a day. That depends on how often the observation repeats. Qualcomm, vivo, OPPO and Xiaomi built the repetition into their figures; the others did not. The long-run share is the density during the look, multiplied by the length of the look, divided by how often it recurs. A 7.14% look lasting 40 ms once a second is 0.29% of the carrier; the same look every 100 ms is 2.86%; NIST's 29% observation repeated every second is 3.7%. The refresh rate is not a free choice, because TS 22.137 sets it: 1 s for category 1 detection, 0.2 s for category 2 and 0.1 s for categories 4 and 7. The requirement a service is sold against fixes its airtime.

There are ways to spend less, and each has a cost. Sparser symbols save airtime, but they lower the fastest speed the radar can measure without ambiguity, as [part 1](#) explains. Reusing reference signals the network

sends anyway costs nothing extra; the vivo prototype did exactly that with a signal every 20 ms, and the result was a radar that could measure breathing but not drones. In our view a wide-area drone service costs between 1% and 10% of a carrier in the sectors where it runs, and periodic surveillance less than 1%. No field-measured figure has yet been published.

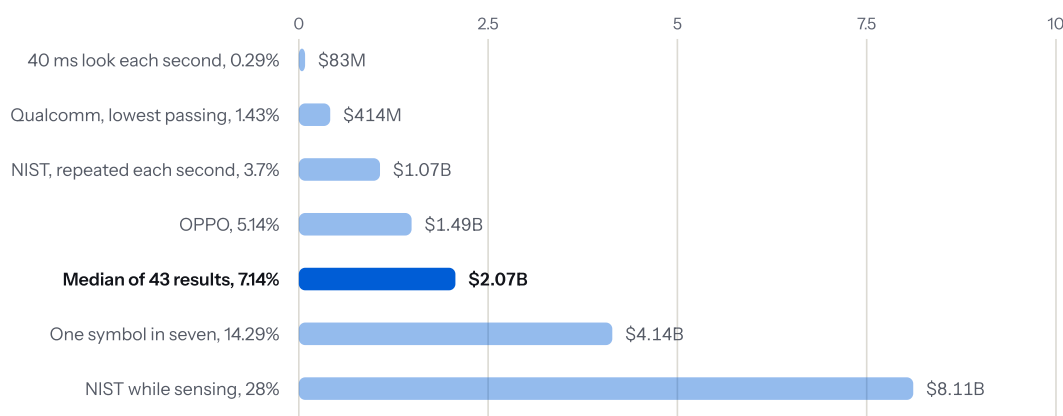
At C-band prices, each 1% of a national carrier is worth \$290 million

The C-band auction put a price on the resource sensing consumes. Auction 107 raised \$81.169B gross for 280 MHz, which on the US Census population of 340,110,988 comes to \$0.852 per MHz-POP. Auction 110 raised \$22.514B for 100 MHz at 3.45 GHz, or \$0.662.

At that price a national 100 MHz C-band carrier represents \$28.98B of licence value, or \$85.20 for each person covered. Each 1% given to sensing is \$290M, or 85 cents a person; at 3.45 GHz prices the same 1% is \$225M. Applied to the evaluation's shares, the range is wide (Exhibit 3). A 40 ms look once a second is \$83M. The median company result, 7.14%, is \$2.07B. NIST's in-observation 28%, held continuously, would be \$8.11B.

EXHIBIT 3

The median sensing share of a national C-band carrier is \$2.07 billion of licence value, and a duty-cycled look is \$83 million



Source: shares from 3GPP R1-2601668 (RAN1#124, February 2026) and the duty-cycle arithmetic in the text; FCC Auction 107 gross proceeds of \$81,168,677,645 for 280 MHz; US Census population 340,110,988 (Filed). Note: value is share × 100 MHz × 340,110,988 people × \$0.852 per MHz-POP; a national 100 MHz carrier is \$28.98B (Calculated).

HOW THE AIRTIME IS PRICED

Licence value of a national 100 MHz carrier: $100 \text{ MHz} \times 340,110,988 \text{ people} \times \$0.852 \text{ per MHz-POP} = \$28.98\text{B}$. Each 1% of that carrier is \$290M.

The median share, 7.14%, is \$2.07B. The lowest passing result, Qualcomm's 1.43%, is \$414M.

An assumed 8% cost of capital over an assumed 15 years gives a capital recovery factor of 0.1168 a year. The median is about \$242M a year and Qualcomm's share about \$48M.

The same arithmetic runs on any band and any holding in our [spectrum cost tool](#), which carries the auction prices used here. [Part 4 of the direct-to-device series](#) prices the recent private transactions.

These figures price a national sensing layer rather than a protected site. Held continuously across a national 100 MHz C-band carrier at the evaluation's median share, sensing occupies \$2.07B of licence value, or about \$242M a year on our assumptions. Duty-cycled to a 40 ms look each second, it occupies \$83M. Confined to the sectors around a stadium or a prison, it rounds to almost nothing. A carrier pricing a sensing contract on airtime should price it on the sectors and hours it uses.

Listening while transmitting caps the power at 52 dBm

Monostatic sensing asks a base station to pick up a faint echo while its own transmitter is running. 3GPP set the evaluation's power from what a receiver can tolerate, and the gap between that and the radio's full power is a hardware problem (Exhibit 4).

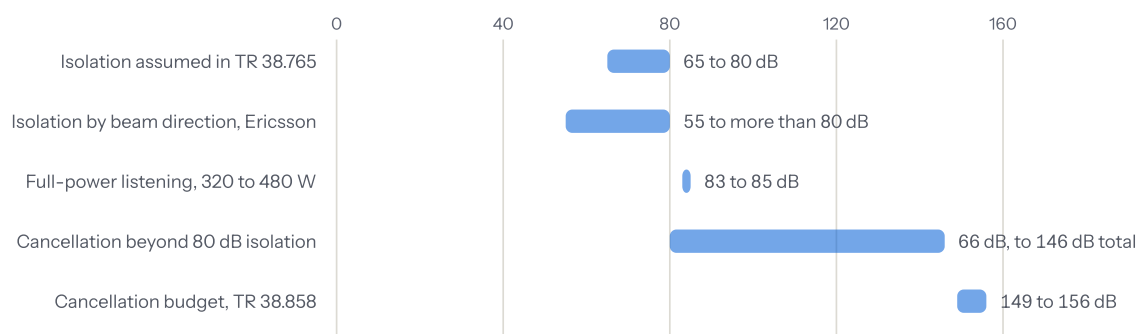
TR 38.765 derived its two power levels from a simple formula: the maximum transmit power is the receiver's saturation level plus the antenna isolation, "assuming the BS Rx saturation power = -28dBm and the antenna isolation = 65dB and 80dB, respectively". That gives 37 dBm, which is 5 W, and 52 dBm, which is 158 W. The radios carriers bought for the C-band are far more powerful. Samsung's C-band massive MIMO radio of 2020 "delivers a 200W output power", Ericsson's AIR 6419 was reported at 320 W, and its current AIR 6494 is listed at 480 W. To run at full power while listening, a 320 W radio would need about 83 dB of isolation and a 480 W radio about 85 dB.

Isolation alone is not enough. To bring a 52 dBm transmitter's leakage down to the thermal noise floor of a 100 MHz receiver, which is -94 dBm, takes 146 dB of suppression in total. Antenna isolation provides 80 dB of that, and the other 66 dB has to come from cancellation in the radio and the baseband. The closest filed evidence on how hard that is comes from 3GPP's Release 18 study of sub-band full duplex, [TR 38.858](#). Companies there reported antenna isolation of 65 to 80 dB, and Ericsson noted that "isolation varies from

around 55dB to more than 80dB depending on beam direction”. They put the total cancellation needed at 149 to 156 dB, and they did not agree on whether it could be done: three companies said the target was achievable and three that it was not, or was challenging. That study separates transmit and receive in frequency, and same-channel sensing has no such separation, so those figures understate the difficulty. Many of the results in TR 38.765 modelled no self-interference at all.

EXHIBIT 4

Antenna isolation covers about half of the suppression that same-channel listening at 52 dBm needs



Source: TR 38.765 Annex A, Table A-1 and NOTE 1; TR 38.858 V18.0.0, Table 9.2.1.1-1 and clause 9.2.1.3 (Filed); radio powers as reported by Samsung (2020), SDxCentral (2021) and Ericsson (Reported); isolation for full power and suppression to the -94 dBm noise floor (Calculated).

Bistatic sensing needs timing nearly a thousand times tighter than 5G keeps today

The obvious way around self-interference is to have one site transmit while another listens, but that brings a synchronisation requirement today’s networks cannot meet (Exhibit 5).

A bistatic receiver measures the whole path from the transmitter to the target and on to itself, so every nanosecond of timing error between the two sites shows up as 30 cm of range error. The 5G requirement is loose by comparison. [TS 38.133](#) requires cell phase synchronisation “better than 3 μ s”, which is 899 m of range error. Even the 65 ns that [TS 38.104](#) allows between one base station’s own antennas for MIMO would be 19.5 m. A 1 m range needs 3.3 ns. Frequency is similar: a wide-area base station may be off by 0.05 parts per million, which reads as a false speed of 15 m/s, while the 1 m/s in TS 22.137 needs 3.3 parts per billion. The timing gap is therefore about three orders of magnitude and the frequency gap a factor of fifteen. The Release 20 study accordingly chose monostatic sensing and wrote that “No inter-gNB coordination will be studied”. Bistatic sensing is a 6G subject. The AT&T and Ericsson demonstration in July 2026 did use “Massive MIMO radios across multiple sites”, but how the timing was solved has not been published.

EXHIBIT 5

5G keeps time between sites to 3 μ s, and a 1 m bistatic range needs 3.3 ns

QUANTITY	5G REQUIREMENT	AS RANGE OR SPEED ERROR	WHAT 1 M OR 1 M/S NEEDS
Cell phase synchronisation between sites	“better than 3 μ s” (TS 38.133)	899 m	3.3 ns
Timing between one base station's antennas, for MIMO	65 ns (TS 38.104)	19.5 m	3.3 ns
Frequency error, wide-area base station	± 0.05 ppm (TS 38.104)	15 m/s of false speed	3.3 ppb

In bistatic sensing 1 ns of timing error between sites is 30 cm of range error. The 1 m and 1 m/s targets are TS 22.137 categories 2 and 3.

Source: TS 38.133 V19.6.0, clause 7.4.2; TS 38.104 V19.6.0, clauses 6.5.1 and 6.5.3; TS 22.137 Table 6.2-1 (Filed); range and speed equivalents (Calculated).

Transport, the fourth resource, is the cheap one, because of the measurement level that [part 2](#) describes. Raw samples at the study's medium assumptions, ten reports a second, would need about 129 Gb/s per base station; points at Level C need at most 0.58 Mb/s. With the agreed levels, transport is a rounding error. Compute is the one cost not yet published. Samsung ran its September 2026 trial with Verizon on a single server with accelerated compute, Lockheed Martin's service on Verizon runs on NVIDIA's AI Aerial platform, and Ericsson describes its radios as having edge computing. None of them gives cores, GPUs, watts or dollars per sensing site, and until one does, that line of the ledger stays blank (Exhibit 6).

EXHIBIT 6

Every cost in the ledger is per base station or per carrier; no cost per customer exists because no sensing price is on the record

RESOURCE	WHAT SENSING USES	FIGURE	EVIDENCE
Sites	Several fused per detection	9 of 10 sources pass with several sites; 3 of 11 with one	Filed
Airtime	Share of the carrier's resources, as reported	1.43% to 28%, median 7.14%	Filed
Licence value of airtime	National 100 MHz C-band carrier	\$290M per 1% ; median \$2.07B	Calculated
Transmit power	While listening	37 or 52 dBm, against radios of 200 to 480 W	Filed; Reported
Isolation	To transmit at full power and listen	83 dB for 320 W; 66 dB of cancellation beyond 80 dB	Calculated
Timing, bistatic	For 1 m and 1 m/s	3.3 ns and 3.3 ppb, against 3 μ s and 0.05 ppm	Calculated from Filed
Transport	Base station to sensing function	0.58 Mb/s at Level C; 129 Gb/s for raw samples	Calculated
Compute	Per sensing site	Not published	n/a

Source: TR 38.765, R1-2601668, TS 38.133 V19.6.0, TS 38.104 V19.6.0, FCC Auction 107 records; arithmetic as set out above (Compiled).

Key terms

- **Sensing resource ratio.** 3GPP's measure of airtime: the resources used for sensing signals plus those lost to communication because of sensing, over all downlink and uplink resources, counted over a period each company chose.
- **Antenna isolation.** How much weaker the transmitter's own signal is at the receiver's input than at its output, from separation and shielding alone, before any cancellation.
- **Self-interference cancellation.** Analogue and digital processing that subtracts the known transmitted signal from what the receiver hears.
- **Sub-band full duplex.** A Release 19 feature in which a base station transmits and receives at once in different parts of one carrier. It is the nearest filed evidence on how hard listening while transmitting is.
- **MHz-POP.** Megahertz times population covered; the unit auction prices are compared in.

Implications

CARRIER STRATEGIST

Price sensing on the sectors and hours it runs. The \$290M of licence value per 1% is a ceiling for a national layer, and protecting a single site uses a sliver of it. Before any trial, ask your vendors for two figures: the isolation in dB at the trial power, and the number of sites they need per detection. Remember that 3GPP's own evaluation passed 9 of 10 sources with several sites and only 3 of 11 with one.

INVESTOR

Do not expect a sensing cost line in any carrier's filing, because the cost sits inside airtime and radios that have already been paid for. The figures to watch are the isolation numbers vendors publish; a radio that can listen at full power, which means about 83 dB at 320 W, would change the economics. Treat any sensing plan that assumes one site per detection as unsupported by 3GPP's own evaluation.

VENDOR

Publish your isolation and cancellation figures. They decide range and power, and 3GPP set its evaluation at 65 and 80 dB only because those were the values it could assume. A radio that holds 83 dB at 320 W changes the whole link budget in [part 4](#). Publish a compute and power figure per sensing site as well, because no vendor yet has.

Method and limits

HOW THIS WAS BUILT

The evaluation results are TR 38.765's own conclusions and the per-company entries in the RAN1#124 results file that its Annex B cites. They are company simulations under stated assumptions, not field measurements. The sensing resource ratio is 3GPP's Option 1: the resources used to send sensing signals, plus the resources lost to communication because of sensing, over all downlink and uplink resources. 3GPP left the time base to each company. Most counted the share within one observation; Qualcomm, vivo, OPPO and Xiaomi counted it over a refresh period, so their figures already include how often sensing runs. We take the median across the 43 high-power baseline results in R1-2601668.

We price airtime at the C-band's \$0.852 per MHz-POP, which is Auction 107's gross proceeds of \$81.169B over 280 MHz and the US Census population of 340,110,988. Auction 110's \$0.662 is given for comparison. A national 100 MHz carrier is valued at 100 MHz times that population times the price, and a sensing share is that share of the value. The annual figure applies an assumed 8% cost of capital over an assumed 15 years. The synchronisation and transport figures are calculated from the specifications cited.

WHAT IT DOES NOT SHOW

Licence value is a sunk cost and an average, and it is not the marginal value of a resource block in a particular sector at a particular hour. Airtime at three in the morning is worth close to nothing; in the busy hour it is worth more than the average. The national figures are ceilings for a sensing layer run everywhere at once, and a service that senses around a handful of named sites uses a small fraction of them. No field-measured sensing overhead has been published, and no compute, power or cost figure per sensing site is on the public record.

Data as of: TR 38.765 V20.0.0 and RAN1#124 evaluation files, FCC auction records, read 7 Oct 2026 · Method version 1.0.

Sources. 3GPP TR 38.765 V20.0.0 (June 2026), clauses 6 and 9 and Annex A, and the RAN1#124 evaluation results and assumptions it cites, R1-2601668 and R1-2601669 (February 2026); TR 38.858 V18.0.0 on sub-band full duplex; TS 38.133 V19.6.0 and TS 38.104 V19.6.0 on synchronisation; RP-253246; FCC Public Reporting System results for Auction 107 and Auction 110; radio output powers as reported by SDxCentral (22 February 2021), Ericsson and Samsung (27 October 2020); the vivo prototype in Communications of Huawei Research, issue 5 (October 2023); trial releases from Samsung (14 September 2026) and Ericsson (10 July 2026), and Light Reading (13 August 2026). Read 7 Oct 2026.

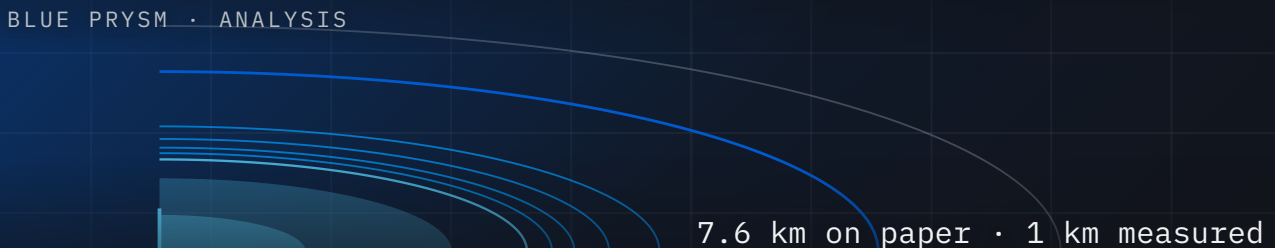
What survives the link budget

How far can a base station see a drone, a person or a car, and which uses survive?

A phone's signal weakens with the square of distance; a radar echo weakens with the fourth power. That difference, more than any other, decides which sensing businesses a mobile network can run. On thermal noise alone, a C-band macro site could see a small drone several kilometres away, yet every measured result on the record stops at a kilometre or less. The gap has five specific causes, and each has a number on the record.

BLUE PRYSM · ANALYSIS

7.6 km on paper · 1 km measured



IN BRIEF

- A radar loses 12 dB every time the distance doubles, where a communications link loses 6 dB. At 1 km a 320 W C-band radio gives a phone a signal about **58 dB** stronger than the echo it gets back from a small drone.
- On thermal noise alone, the radar equation run on 3GPP's own inputs gives **7.6 km** for a small drone at 52 dBm in a narrow beam, and 1.1 km at 37 dBm in a wide one. The two measured single-site ranges on the record are 500 m or more (Nokia Bell Labs, at 27.6 GHz) and up to 1,000 m (a Huawei site at 4.9 GHz).
- Five constraints that the noise budget leaves out, applied one after another as an illustration, take 7.6 km down to about **1.4 km** before elevation coverage is counted. The levers that move range are isolation, clutter suppression and vertical coverage rather than transmit power.
- Drone tracking in dense urban grids with several sites fused survives, and so does protecting named sites. A national rural drone layer built on existing macros does not: one site is too far from the next to see a small drone reliably, and too loosely synchronised with it to combine. Carriers should ask vendors for isolation, vertical coverage and false-alarm rate before any trial.

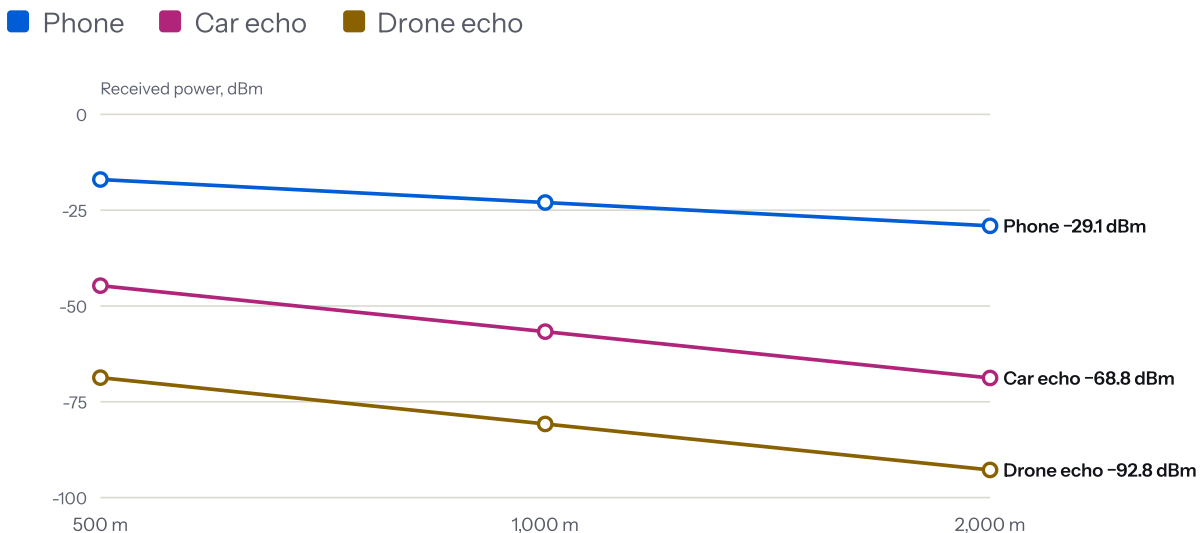
A radar loses signal with the fourth power of distance

A phone receives a base station's signal after one trip, so the power falls with the square of the distance. A radar receives its own signal back after two trips and a reflection in between, so the power falls with the fourth power. Everything that follows comes from that.

Doubling the distance costs a communications link 6 dB and a radar 12 dB, so doubling a radar's range takes sixteen times the energy on the target. One radio put through both equations shows the gap (Exhibit 1). A 320 W radio behind a 26.1 dBi panel at 3.85 GHz delivers a phone 1 km away a signal of -23.0 dBm in free space. The echo it gets back from a small drone at the same distance is -80.8 dBm, about 58 dB weaker. A car, being a much larger reflector, sends back -56.7 dBm.

EXHIBIT 1

At 1 km the same radio gives a phone a signal about 58 dB stronger than the echo it gets back from a small drone



Source: free-space loss and the radar equation at 3.85 GHz, 320 W into 26.1 dBi, 81.1 dBm EIRP, under the FCC limit of 1,640 W/MHz (82.1 dBm in 100 MHz); radar cross-sections from TR 38.901 Table 7.9.2.1, small drone -12.8 dBsm and car +11.3 dBsm (Calculated). Note: phone antenna 0 dBi. The receiver's noise in 100 MHz with a 5 dB noise figure is -89 dBm before integration gain.

Integration closes most of that gap, at least against noise. A 1 ms look across 100 MHz adds about 50 dB of processing gain, which is why the noise-only ranges below run to kilometres. What it cannot do is close the gap against anything that integrates along with the echo: the transmitter's own leakage, reflections from buildings and the ground, and whatever else in the beam happens to be moving.

Every input to the calculation is on a public record

Most of the inputs are 3GPP's own evaluation assumptions; the rest are the FCC's power limits and two preprints (Exhibit 2).

EXHIBIT 2

The FCC allows 82.1 dBm in 100 MHz, but 3GPP capped a listening base station at 37 or 52 dBm

INPUT	VALUE	SOURCE
Power limit, C-band and 3.45 GHz, non-rural	1,640 W/MHz EIRP per sector; 82.1 dBm in 100 MHz	47 CFR 27.50(j)(2) and (k); upper C-band the same (FCC 26-46)
Power limit, millimetre wave	75 dBm per 100 MHz; 81.0 dBm in 400 MHz	47 CFR 30.202(a)
Radios in service	200 W (Samsung, 2020); 320 W (Ericsson AIR 6419); 480 W (AIR 6494)	Company releases and pages, reported
Power while listening	37 dBm or 52 dBm	TR 38.765 Annex A
Array gain	8 dBi element; 26.1 dBi at n77, 32.1 dBi at 28 GHz	TR 38.901 Table 7.3-1; TR 38.765 arrays
Noise figure	5 dB (FR1), 7 dB (FR2)	TR 38.765 Annex A
Cross-section, small drone	-12.81 dBsm mean, spread 3.74 dB	TR 38.901 Table 7.9.2.1-1
Cross-section, person; large drone; car	-1.37 dBsm; -5.85 dBsm; +11.25 dBsm	TR 38.901 Tables 7.9.2.1-1, -2 and -4
Drone cross-sections outside 3GPP	DJI Phantom 4 Pro measured at -15.03 dBsm at 15 GHz and -12.40 at 25 GHz; DJI Air 3 assessed at about -17 dBsm	Ezuma and others, 2019; Nokia Bell Labs, 2026
Detection threshold	17 dB; 13.1 dB for a steady target and 21.1 dB for a fluctuating one, at 90% detection and one false alarm in a million	Nokia Bell Labs; Albersheim and Swerling, calculated

The upper C-band order, FCC 26-46, extended the 3.7 GHz Service to 4.14 GHz from 29 September 2026 with the same base-station limits. The drone figures outside 3GPP are for 15 GHz and above, so the n77 rows use 3GPP's model.

Source: eCFR Title 47 as of 1 October 2026; TR 38.765 and TR 38.901; arXiv:1911.05926 and arXiv:2605.23561; releases as cited (Compiled).

Neither the regulator nor the noise floor is the limit. The FCC allows 82.1 dBm in 100 MHz and a 320 W radio reaches 81.1 dBm, so the licence leaves headroom. The cap that binds is 3GPP's: 37 or 52 dBm while listening, set by receiver saturation and isolation, which [part 3](#) works through.

On noise alone a C-band macro would see a small drone kilometres away

Run on those inputs, the radar equation is generous. It gives ranges of kilometres for every target at n77 and of a kilometre or more at 28 GHz (Exhibit 3).

EXHIBIT 3

On thermal noise alone an n77 macro sees a small drone at 1.1 to 18 km, depending on power, beam and dwell

CASE	EIRP	DWELL	SMALL DRONE	PERSON	CAR
n77, 37 dBm, wide search beam	45.0 dBm	1 ms	1.13 km	2.2 km	4.5 km
n77, 52 dBm, wide search beam	60.0 dBm	1 ms	2.7 km	5.2 km	10.7 km
n77, 52 dBm, narrow beam	78.1 dBm	1 ms	7.6 km	14.6 km	30.2 km
n77, 320 W, narrow beam	81.1 dBm	16 ms	18.0 km	34.9 km	72.1 km
28 GHz, Nokia Bell Labs radio	51.5 dBm	1 ms	465 m	899 m	1.86 km
28 GHz, 3GPP assumption, 30 dBm	62.1 dBm	1 ms	1.41 km	2.73 km	5.63 km

Monostatic; n77 at 3.85 GHz and 100 MHz, 28 GHz at 400 MHz; threshold 17 dB; 3 dB implementation loss. A wide search beam transmits at element gain, 8 dBi, and receives on the full array. Range scales as the fourth root of the budget: 3 dB is a factor of 1.19, 12 dB a factor of 2.

Source: radar equation, energy form, on TR 38.765 and TR 38.901 inputs as tabled in Exhibit 2; Blue Prism calculation (Calculated).

Two measurements provide a check on the method. In May 2026 [Nokia Bell Labs](#) reported detecting a DJI Air 3 with unmodified commercial 5G radio units at 27.6 GHz, “in over 500 meters distance in a challenging radio environment rich of strong clutter”, with a median range error of 23 cm against satellite positioning. Researchers at the University of Science and Technology of China report “a sensing range of up to 1,000 m” and a mean localisation error of 4.9 m in their [BSense](#) preprint. Their site is a 4.9 GHz Huawei 5G-Advanced base station with 128 channels and a combined OFDM and chirp waveform. Those are the only two measured single-site ranges on the record, and both fall well inside the noise-only figures.

THE NOKIA BELL LABS MEASUREMENT AT 27.6 GHZ

On Nokia's published inputs, our method gives 797 m on noise alone.

A single building 30 m away drives third-order intermodulation in the radio's own transmitter and raises the interference floor by 2.9 dB. That alone takes 797 m down to 675 m.

The share of the echo that falls outside the receive window at 120 kHz spacing takes 675 m to 540 m, which is Nokia's own modelled range.

The drone was detected out to at least 500 m, the end of the flight route, with a median range error of 23 cm. Every noise-only range in Exhibit 3 is therefore an upper bound.

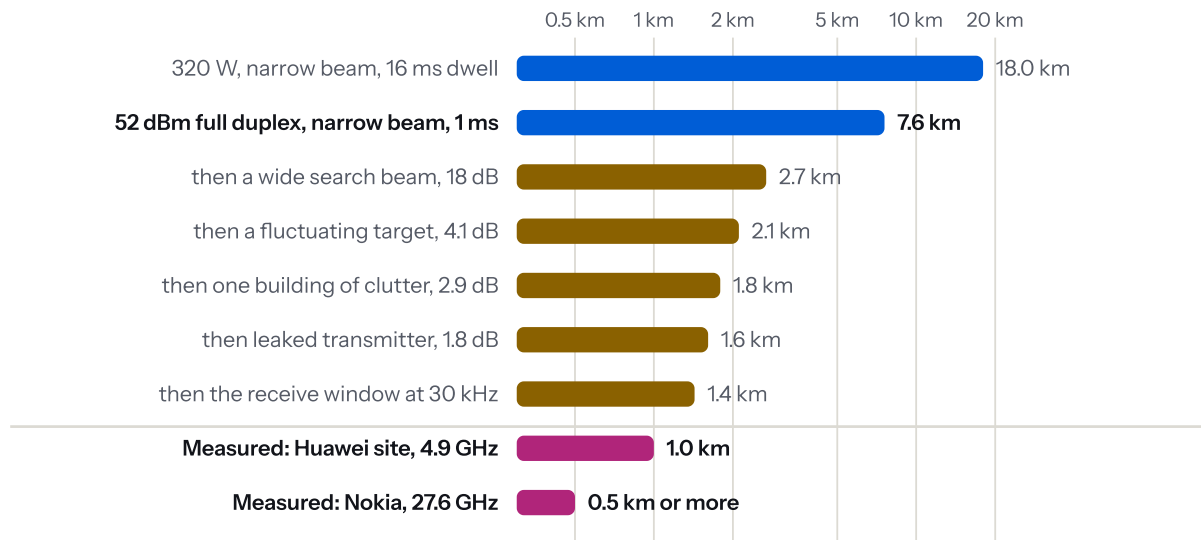
Five constraints take 7.6 km on paper to about 1.4 km

Between 7.6 km on paper and a kilometre in the field lie five constraints that the noise budget leaves out, and each has a number on the record. Applied one after another, as an illustration, they bring the n77 range down to about 1.4 km before elevation is counted (Exhibit 4).

EXHIBIT 4

A wide search beam, a fluctuating target, one building's clutter, transmitter leakage and the receive window take 7.6 km to 1.4 km, near the two measurements

■ Calculated, noise only ■ Calculated, with each penalty in turn ■ Measured, one site



Detection range, logarithmic. Small drone, -12.8 dBsm (3GPP model); Air 3 about -17 dBsm. n77 at 3.85 GHz, 100 MHz, 17 dB threshold. Each step applies to the row above it.

Source: radar equation on TR 38.765 and TR 38.901 inputs, as an illustration (Calculated). Steps: transmit gain 8 dBi instead of 26.1 dBi; Swerling 1 threshold 21.1 dB instead of 17 dB; clutter as the 2.9 dB rise in the interference floor that one building causes, through transmitter intermodulation, in Nokia Bell Labs' model of their 27.6 GHz radio; residual self-interference 5 dB above thermal, a further 1.8 dB; Nokia's receive-window formula at 30 kHz, window unshifted. Measured: BSense on a Huawei 5G-A base station, arXiv:2603.29187, and Nokia Bell Labs, arXiv:2605.23561, both preprints (Reported).

- 1. The transmitter.** 3GPP capped monostatic power at 37 or 52 dBm because a receiver saturates at -28 dBm and isolation was assumed at 65 or 80 dB. Whatever leaks past the cancellation raises the noise floor. The companies in 3GPP's evaluation modelled that leakage at 0, 5 or 10 dB above thermal noise; at 5 dB the floor rises by 3 dB and range falls by 16%. The alternative, transmitting at full power and listening afterwards, leaves the site deaf while it transmits. One 30 kHz OFDM symbol lasts about 35.7 μ s, which blinds the site to everything within about 5.35 km. The rural results that met 3GPP's objectives, all from one source, did both: 37 dBm while listening, plus 56 dBm transmissions while the receiver was off.
- 2. Clutter.** In Nokia's model the echo of one building 30 m away raises the interference floor by 2.9 dB through transmitter intermodulation, and that alone takes 797 m to 675 m. The BSense team describe what clutter looks like at the receiver: in one frame "only a single point corresponds to the UAV, while 174 points are noise". They averaged 168 false detections in every 640 ms frame and got that down to

0.04 only by filtering at the point, object and trajectory levels. In 3GPP's evaluation, one single-site result with moving clutter reported false alarms of 91%.

3. **The search.** A narrow beam has to be pointed somewhere, and a drone could be anywhere. A wide transmit beam covers the sky but gives up about 18 dB of gain, which divides range by 2.8. The millimetre-wave array 3GPP evaluated is analogue and has to sweep. The one result of seven that met every objective used 220 transmit beams with observations of up to 10 ms each, which is about 2.2 s to come back round to every beam.
4. **The receive window.** OFDM's cyclic prefix is about one fourteenth of a symbol. At 30 kHz spacing an echo from beyond about 357 m arrives outside it, and the unshifted receive window ends near 5.35 km. At 120 kHz the figures are 89 m and 1,338 m, which match Nokia's own. In Nokia's model the window takes 675 m to 540 m at 27.6 GHz; at 30 kHz it takes our n77 step-down from 1.6 km to 1.4 km.
5. **Elevation.** A macro panel is built to cover the ground, and drones are not on the ground. Seen from a 25 m mast, a drone at 120 m is 43.5° up at 100 m, 17.6° at 300 m and 2.7° at 2 km. 3GPP's evaluation offered panels with no tilt or with 12° of downtilt, whereas China Mobile advertises its sensing sites with an opening angle of at least 60°, which is a vertical pattern built for the purpose. A hovering drone is a separate problem. Nokia's missed detections came at radial speeds under 5 m/s, where the processing that removes static clutter removes the drone along with the buildings.

Thermal noise is not what limits a sensing network. Five constraints, applied in turn as an illustration, take a 7.6 km noise-only range to about 1.4 km before elevation is counted. They are a wide search beam, a fluctuating target, one building's clutter as Nokia Bell Labs modelled it, transmitter leakage 5 dB above thermal noise, and the receive window. That lands much closer to the two published measurements, 500 m and 1,000 m, than to the noise budget. The levers that move range are isolation, clutter suppression and vertical coverage; transmit power is not among them.

The claims above 2 km publish no conditions

Five range figures are on the record, and they are not all of the same kind: two measurements that publish their conditions, two claims that do not, and one multi-site demonstration (Exhibit 5).

EXHIBIT 5

The two measured single-site ranges are 500 m and 1,000 m; the two claims above 2 km publish no band, power, dwell or false-alarm rate

WHO AND WHEN	BAND AND SITE	RANGE REPORTED	CONDITIONS PUBLISHED
Nokia Bell Labs, May 2026 (preprint)	27.6 GHz; unmodified commercial radio units; one site	500 m or more ; median range error 23 cm	Yes : inputs, clutter model and missed detections
University of Science and Technology of China, BSense, March 2026 (preprint)	4.9 GHz; Huawei 5G-Advanced base station, 128 channels; one site	Up to 1,000 m ; mean localisation error 4.9 m	Yes : waveform, false-detection counts and filtering
China Mobile and Huawei, Shenzhen, May 2023	5G-A sensing base station; band not stated	Above 2 km from one site; targets as small as 0.01 m ² (−20 dBsm)	No : no band, power, dwell, altitude or false-alarm rate
China Mobile Shandong and ZTE, January 2024	128-transceiver site; band not stated	Above 2 km from one site; 0.01 m ²	No
AT&T and Ericsson, AT&T Stadium, July 2026	Massive MIMO radios on several existing sites	Drones tracked at 300 to 400 feet; “at least three” radios for reasonable tracking	Partly: altitude and site count; no range or power

Source: arXiv:2605.23561 and arXiv:2603.29187 (preprints); National Business Daily, 27 May 2023; ZTE, 30 January 2024; Ericsson release via Placera, 10 July 2026; RCR Wireless, 4 August 2026 (Reported).

In May 2023 China Mobile and Huawei claimed that a Shenzhen 5G-A base station could sense targets of 0.01 m², or −20 dBsm, at “单站探测距离超2KM”, a single-site range of more than 2 km. China Mobile Shandong and ZTE repeated both claims in January 2024. On the noise budget with a wide search beam, a −20 dBsm target is seen at 3.5 km with 52 dBm and a 16 ms dwell, and at 0.75 km with 37 dBm and 1 ms. The claims fall inside the first case and outside the second, and since none publishes its conditions there is no way to tell which applies. The AT&T and Ericsson multistatic demonstration points the other way. Ericsson Federal’s chief executive told RCR Wireless that “It takes at least three for ‘reasonable tracking’”, which is the conclusion 3GPP’s evaluation reached with monostatic sites: one site on its own is rarely enough.

Which uses survive

Set against the ranges, the evaluation and the measurements, the candidate uses sort themselves by how far they need to see and by what limits them first (Exhibit 6).

EXHIBIT 6

Drone tracking in dense grids and protection of named sites survive; a rural drone layer from existing macros is marginal, and single-site detection beyond 2 km is unproven

USE	RANGE IT NEEDS	WHAT LIMITS IT	VERDICT
Drone tracking in a dense urban grid, several sites fused	Up to about 300 to 450 m from the nearest site	Clutter, false alarms, elevation	Survives ; 9 of 10 and 7 of 9 sources with fusion
Point protection: stadiums, prisons, airports	A few hundred metres round a perimeter	Clutter; who may act on a detection	Survives technically ; the buyer is public, see part 5
People: crowd density, presence	Tens to hundreds of metres	Permission and privacy rather than physics	Survives at venue scale; the Verizon trial used phone signals, not body echoes
Vehicles and traffic	Hundreds of metres	Cameras and car radar in place	Survives technically; weak case
Millimetre-wave small-cell sensing	Up to 200 m between sites	Beam revisit; 89 m prefix window	Short-range niche with 0.375 m resolution
Wide-area rural drone surveillance from existing macros	1 to 2 km	Full-duplex power cap; synchronisation for bistatic	Marginal ; 37 dBm full duplex failed in 3GPP's rural case
Single-site small-drone detection beyond 2 km	Above 2 km	Isolation, false alarms, elevation	Unproven ; claims without published conditions
Rainfall from microwave links	n/a: attenuation, not echoes	Access to link data	Proven science on existing links; needs no sensing air interface

Rainfall from link attenuation was shown by Messer, Zinevich and Alpert in Science (2006) and mapped across the Netherlands from about 2,400 links by Overeem, Leijnse and Uijlenhoet in PNAS (2013). 5GAA's view is in [part 8 of the 6G series](#).

Source: our reading of the ranges above, TR 38.765's results and the measurements cited (Judgement).

Sensing survives where the network is dense and the customer is fixed in place. A city grid with sites 500 m apart puts every drone within a few hundred metres of three sites, which is the geometry 3GPP's evaluation passed in. A stadium or a prison is a fixed perimeter that a carrier, or a private network, can surround with sites chosen for the purpose. The use the roadmaps most often draw, a national drone-surveillance layer from existing rural macro sites, does not survive on today's evidence. Its sites are too far apart for one to see a small drone reliably, and too loosely synchronised for several to combine, as [part 3](#) showed. That use waits for the bistatic, multistatic 6G design.

Key terms

- **Radar cross-section (dBsm).** How large an object looks to a radar, in decibels relative to one square metre. A small drone is about -13 dBsm, a twentieth of a square metre; a car is about +11 dBsm.

- **EIRP.** Effective isotropic radiated power: transmit power plus antenna gain, the figure the FCC limits.
- **Dwell.** The transmit time integrated on one target; range grows with its fourth root.
- **Swerling 1.** A standard model of a target whose echo fluctuates from look to look. It needs about 8 dB more signal than a steady one for the same detection probability.
- **Cyclic prefix.** The guard copied onto each OFDM symbol. An echo delayed beyond it spills into the next symbol unless the receiver shifts its window.

Implications

CARRIER STRATEGIST

Sell what survives: drone detection in dense grids with several sites fused, and protection of named sites with sites placed for the purpose. Before a trial, ask the vendor for three numbers: the isolation in dB at the trial power, the panel's vertical coverage, and the false-alarm rate per hour. Those decide range far more than transmit power does, because the step from 7.6 km to 1.4 km comes from beam, clutter, leakage and window rather than from watts.

INVESTOR

Discount any range claim that leaves out band, power, dwell, altitude and false-alarm rate. The published measurements are 500 m at 27.6 GHz and 1,000 m at 4.9 GHz from one site; the claims above 2 km publish no conditions. A plan priced on national rural coverage rests on the use the evidence supports least, since 37 dBm full duplex failed 3GPP's rural case.

VENDOR

Build the roadmap on the gap between 7.6 km on paper and a kilometre in the field. It has three parts: isolation that allows full power while listening, clutter suppression that keeps hold of a hovering drone, and panels that see upwards. Then publish measured range with the conditions attached. No vendor has yet done so outside a preprint.

Method and limits

HOW THIS WAS BUILT

Detection range is the monostatic radar equation in its energy form. Range to the fourth power equals transmit power times dwell time times both antenna gains times wavelength squared times radar cross-section, over $(4\pi)^3$ times thermal noise density times noise figure times losses times the required signal-to-noise ratio. Bandwidth cancels out. The inputs are 3GPP's: panels of 8 dBi elements, 64 per polarisation at n77 (3.85 GHz) and 256 at 28 GHz, giving 26.1 dBi and 32.1 dBi; noise figures of 5 and 7 dB; transmit powers of 37 and 52 dBm; and the cross-sections in TR 38.901. We assume a 3 dB implementation loss and a 17 dB threshold, which is the figure Nokia Bell Labs used. Dwell is 1 ms (a 10 ms frame with 10% given to sensing) or 16 ms (a 160 ms observation at 10%).

We checked the method against the one published measurement with a matching link budget, Nokia Bell Labs'. With their inputs it gives 797 m on noise alone. Adding the two effects their own model adds, clutter-driven intermodulation and the receive window, reproduces their 540 m, and they measured 500 m or more. Every noise-only range is therefore an upper bound. The step-down from 7.6 km is an illustration rather than a prediction; the source line of Exhibit 4 lists its five steps and the decibels each one takes. The Swerling 1 threshold is 21.1 dB at 90% detection and one false alarm in a million.

WHAT IT DOES NOT SHOW

Nothing here models clutter in a specific city, multipath, the elevation pattern of a real panel or any particular vendor's processing. The step-down borrows its clutter penalty from one urban site at 27.6 GHz and should be read as an illustration of scale rather than a prediction. The 3GPP cross-sections are frequency-independent models, and the measured drone cross-sections cited are for 15 GHz and above. The two measurements are preprints. The Chinese range claims publish no conditions at all.

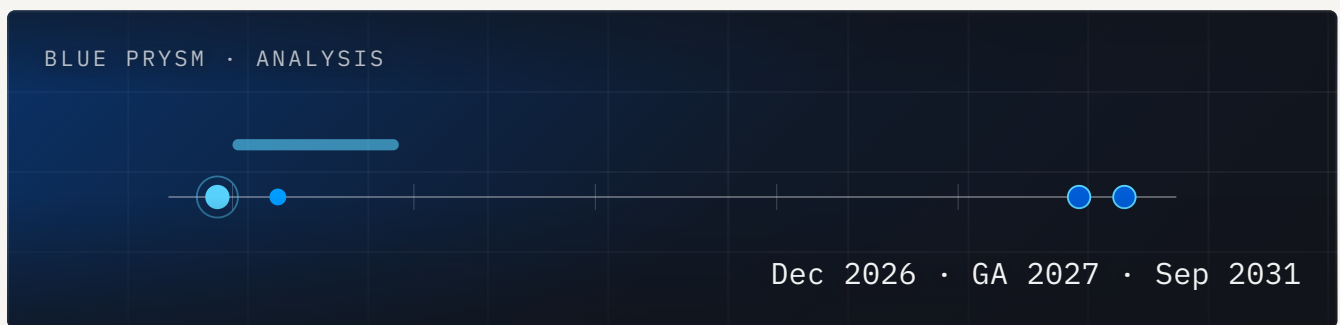
Data as of: 3GPP reports, eCFR as of 1 Oct 2026, preprints and releases as read 7 Oct 2026 · Method version 1.0.

Sources. 3GPP TR 38.765 V20.0.0, Annex A, clauses 6.3 and 9, and TR 38.901 V19.5.0, Tables 7.3-1 and 7.9.2.1-1 to 7.9.2.1-4; 47 CFR 27.50 and 30.202 as in force on 1 October 2026, and the upper C-band order as published at 91 FR 48700; Saur and others (Nokia Bell Labs), "Reliable UAV Detection with ISAC", 22 May 2026, and Meng and others, BSense, 31 March 2026, both preprints; drone cross-sections from Ezuma, Funderburk and Guvenc (2019) and Semkin and others, IEEE Access (2020); radio powers as reported by SDxCentral and Sivers Semiconductors; China Mobile trial claims as reported by National Business Daily (27 May 2023), ZTE (30 January 2024) and Beijing Daily (21 May 2024); the AT&T and Ericsson release via Placera (10 July 2026) and RCR Wireless (4 August 2026). Read 7 Oct 2026.

Who pays for sensing

Who is paying for network sensing, and who is allowed to sell it?

No mobile operator has disclosed any revenue from sensing. The first paid sensing offer in the United States belongs to a defence contractor and runs as a subscription over a carrier's network rather than as a carrier product. Every buyer on the record is a state or a security agency. Beneath all of this sits a question that no FCC proceeding has yet asked: whether a mobile licence permits a carrier to sell radar at all.



IN BRIEF

- None of the six latest filings from AT&T, Verizon and T-Mobile mentions sensing, drones or radar, and China Mobile's reports describe only trial networks. **No priced sensing contract** is on the record anywhere.
- The first paid US offer is Lockheed Martin's NetSense, running on Verizon's network: a subscription for security operations, with pilots from late 2026 and general availability planned for **2027**. Ericsson expects a commercial product "some time next year", and says it will start as a private network for defence and public safety.
- A Part 27 or Part 30 licence covers fixed and mobile services, and radiolocation in 3.45 to 3.7 GHz belongs to the Federal Government. The only interagency statement on the point, from August 2020, says radar detection of drones "requires a Radiolocation Service license". The FCC has opened **no proceeding** on network sensing.
- In December 2025 Congress widened the authority to act on a detection to trained state and local agencies, until 2031. Germany's data-protection authorities said in June 2026 that consent is unsuitable for area-wide sensing. Carriers need the permission answer before the product, and investors can expect the first prices in 2027.

No carrier reports sensing revenue

The simplest test of whether a business exists is whether anyone reports it. On that test, sensing does not yet exist anywhere (Exhibit 1).

EXHIBIT 1		
The three US national carriers never mention sensing, drones or radar in their latest filings, and China Mobile’s reports stop at trial networks		
OPERATOR	DOCUMENTS READ	WHAT THEY SAY ABOUT SENSING
Verizon, AT&T, T-Mobile US	10-K FY2025 and 10-Q Q2 2026 of each	Nothing: no “sensing”, “drone”, “unmanned aircraft” or “radar”
China Mobile	Annual Report 2024	Piloted “sensing and communication integration”; “proposed the industry’s first 5G-A integrated sensing and communications technology system”, supporting “ten typical low-altitude application scenarios”
China Mobile	Annual Report 2025	“built low-altitude technology trial networks in areas including Xiong’an, Hangzhou, Guangzhou, Shenzhen and Suzhou”; no “sensing” or “drone”
China Mobile	Interim Report 2026	“Sensing” only in the name of a chip interconnect; no “low-altitude” or “drone”
The US 10-Ks were filed on 9, 11 and 17 February 2026 and the 10-Qs on 22, 23 and 31 July 2026 (AT&T, T-Mobile, Verizon); each discusses the carrier’s C-band or 3.45 GHz spectrum. China Mobile’s 2025 report counts more than 2.77 million 5G base stations.		
Source: SEC EDGAR filings and China Mobile annual and interim reports as listed, searched 7 October 2026 (Filed).		

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Mentions of “sensing”, “drone”, “unmanned aircraft” or “radar” in the FY2025 10-Ks and second-quarter 2026 10-Qs of AT&T, Verizon and T-Mobile.

The one figure that gives a sense of scale in China comes from the press rather than from a filing. In April 2025 China Mobile said, as [Xinhua reported](#), that it had “部署超过500个通感一体基站”, more than 500 integrated sensing base stations, covering 42 low-altitude routes and serving 130,000 industrial drones. Set against the more than 2.4 million 5G base stations its 2024 annual report counts at the end of that year, the sensing sites come to about two in every ten thousand. China Mobile’s own filings describe a technology system and trial networks, with no sensing revenue, contract or site count.

No carrier has disclosed sensing revenue, and no priced sensing contract is on the record anywhere. Any sensing revenue in a model today is an assumption, and it should be labelled as one.

The buyers on the record are public bodies

Every sensing offer or trial on the record is a demonstration, a laboratory exercise or a subscription with no published price, and every named buyer is a state or a security agency (Exhibit 2).

EXHIBIT 2			
Every sensing offer on the record is a demonstration or an unpriced subscription, and every named buyer is public			
OFFER OR TRIAL	WHEN AND WHERE	FORM AND BUYER	PRICE
Lockheed Martin NetSense on Verizon	Miami, July 2026 demonstration; pilots late 2026; general availability 2027	Subscription “that works with customers’ security operations”, “without having to change the 5G network”; payer not stated	None published
AT&T and Ericsson	AT&T Stadium, July 2026 demonstration	Roadmap to “Support a wide-area drone awareness system for public-sector stakeholders”	None
Ericsson product	“Probably, some time next year” (August 2026)	“mostly a software upgrade”; “will start as a private network”; defence and public safety first	None
Ericsson and Erillisverkot	Finland, September 2026 demonstration	Drone detection on 5G for the state security network operator; wider commercialisation “in the 6G timeframe”	None
Vodafone and Tiami Networks	Malaga laboratory, February 2026; testing through 2026	Detection of unconnected objects across a 5G network; no buyer named	None
China Mobile	More than 500 sensing base stations, 42 low-altitude routes, 130,000 industrial drones (April 2025)	Operator capital spending against the state’s airspace programme	No tariff; no revenue in filings
Statements are company releases and named executives in the trade press, reported and not verified.			
Source: Light Reading (13 August 2026); Ericsson release via Placera (10 July 2026); RCR Wireless (4 August 2026); Ericsson (18 September 2026); ISPreview (26 February 2026); Xinhua (23 April 2025) (Reported).			

In China the buyer is, in effect, the state’s airspace programme. The money flows through operator capital spending against a national priority rather than through a sensing tariff. Four facts give a sense of the scale.

- **Policy.** The low-altitude economy has been in the national Government Work Report in each of 2024, 2025 and 2026, as [Chongqing Daily](#) recorded in March 2026.
- **Guidelines.** [Caixin](#) reported on 12 February 2026 that the Ministry of Industry and Information Technology and four other departments had issued guidelines requiring the operators to strengthen communication, positioning and surveillance below 300 m.
- **Projection.** The China Academy of Information and Communications Technology projects 360,000 new low-altitude base stations and RMB 111 billion of investment by 2035. It is a projection rather than a contract.
- **Cost.** Chongqing Mobile says sensing cut its low-altitude network construction cost by 25%.

In the United States the first paid offer is a contractor's, and no release names a price or says who pays whom. [Light Reading](#)'s report on NetSense is silent on both. AT&T's [demonstration with Ericsson](#) in July set out a roadmap aimed at "public-sector stakeholders". Ericsson Federal's chief executive, Christopher Ling, told [RCR Wireless](#) in August that "ISAC will start as a private network [solution] just so we can make sure it works locally". Ericsson's [release](#) on its Finnish demonstration says early deployments "will likely focus on defense and public safety users". The vendors agree on who the first customer is.

Those buyers already buy drone detection from radar makers. Echodyne's radar sits inside Trust Automation's \$490M indefinite-delivery contract for US Air Force counter-drone systems, announced in August 2025, as [Business Wire](#) reported in April 2026. A network-sensing offer will meet that competitor in a security tender. Europe's only entry so far is a laboratory one: Vodafone and Tiami Networks detected unconnected objects across a 5G network at Vodafone's Malaga lab, as [ISPReview reported](#) in February 2026.

THE CIVIL BUYER WAITS ON AN FAA RULE

The FAA's Part 108 proposal for flights beyond visual line of sight was published on [7 August 2025](#) and reopened in January 2026. The Fall 2025 Unified Agenda put the final rule at July 2026; none had been published by 7 October 2026. An FAA official told [The Flight Brief](#) in September that the agency hopes to publish by the end of 2026.

The companion Part 146 would certify providers of "DAA services, which provide surveillance information or avoidance maneuvering instructions to operators". It names "mobile network operators" with a drone command-and-control offering among the companies it may apply to.

Cooperative drones already broadcast Remote ID, which has been required since 16 September 2023. What a network radar adds is the target that does not announce itself: the rogue drone, for a security buyer, and the uncooperative aircraft that a beyond-line-of-sight drone has to avoid. Neither market exists until the rule is final.

A US mobile licence covers fixed and mobile services only

A flexible-use licence is wide, but it is not unlimited, and the limit is written in two sentences of the Commission’s rules (Exhibit 3).

Under section 27.2(a), a Part 27 licensee “may provide any services for which its frequency bands are allocated, as set forth in the non-Federal Government column of the Table of Allocations”. Section 30.6(a) says the same for the millimetre-wave bands. Section 2.1 defines the services. Radiodetermination is “The determination of the position, velocity and/or other characteristics of an object, or the obtaining of information relating to these parameters, by means of the propagation properties of radio waves”. Radiolocation is “Radiodetermination used for purposes other than those of radionavigation”. The mobile service is “A radiocommunication service between mobile and land stations, or between mobile stations.” On those definitions, detecting a drone by its echo is radiodetermination.

EXHIBIT 3		
In every band a US carrier would sense in, the non-Federal allocation is fixed or mobile, and radiolocation is Federal or absent		
BAND	NON-FEDERAL ALLOCATIONS	RADIOLOCATION FOR THE LICENSEE
3.45 to 3.55 GHz (Auction 110)	Fixed; mobile except aeronautical mobile	No; radiolocation is Federal (US431B)
3.55 to 3.7 GHz (CBRS)	Fixed; mobile except aeronautical mobile; fixed-satellite in 3.6 to 3.7 GHz	No; radiolocation is Federal
3.7 to 4.0 GHz (C-band)	Fixed; mobile except aeronautical mobile	No
4.0 to 4.16 GHz (most of the upper C-band, and the guard band)	Mobile except aeronautical mobile, added by FCC 26-46; fixed-satellite removed in the contiguous US	No
24.25 to 24.45 and 24.75 to 25.25 GHz; 27.5 to 28.35 GHz	Fixed; mobile; fixed-satellite in parts	No
The international Region 2 table carries a secondary radiolocation allocation in 3.4 to 3.7 GHz, which the US non-Federal column does not.		
Source: 47 CFR 27.2(a), 30.6(a), 2.1 and 2.106; the FCC Online Table of Frequency Allocations (revised 1 July 2022) and, for 3.7 to 4.16 GHz, the upper C-band order FCC 26-46 as published at 91 FR 48700 on 31 July 2026 (Filed). Note: the Code of Federal Regulations is the legal text.		

The federal government’s only statement on the point was written before the technology existed. On 17 August 2020 the FAA, the Justice Department, the FCC and Homeland Security issued a joint advisory which says: “For example, use of radar to detect UAS requires a Radiolocation Service license from the FCC.” An executive order of 6 June 2025 directed the agencies to revise that advisory within 30 days, but the FAA’s page still lists only the 2020 version and no revision appears there. The FCC’s drone docket, opened with [DA 26-314](#) on 1 April 2026, asks about the 24 GHz band “for radar and detection operations” and about Echodyne’s petition for radiolocation there. It observes that the Communications Act “may

nonetheless pose barriers to Counter-UAS deployment”, but it does not ask about cellular network sensing. Ericsson, CTIA, ATIS and an aviation coalition do mention integrated sensing in their filings in that docket. The NTIA’s National Spectrum Strategy of November 2023 does not use the word sensing at all.

In our view the line runs through the product. Sensing that reuses a base station’s ordinary communication transmissions is arguably part of operating a mobile station. A drone-detection service sold to a third party looks much more like the radiolocation service the 2020 advisory says needs its own licence. So does a dedicated sensing waveform, such as the combined OFDM and chirp signal in the Huawei-based BSense trial that [part 4](#) cites. There are four routes to an answer, and none is pending.

- **Declaratory ruling.** The Commission states whether network sensing is a mobile service.
- **Allocation.** A table change or footnote adds radiolocation for the band’s licensees.
- **Waiver.** A licensee asks for one to run a sensing service.
- **Rulemaking.** A proceeding writes conditions for sensing, as CEPT is doing in Europe.

Permission is the one input a carrier cannot supply for itself. Its licence covers fixed and mobile services, and radiolocation in its bands belongs to the Federal Government. The only interagency statement says radar detection of drones needs a radiolocation licence. The FCC has opened no proceeding on network sensing. Europe has one, the ECC work item at 3.4 to 3.8 GHz that [part 2](#) describes.

Congress widened the authority to act on a detection in December 2025

Detecting a drone and doing something about it are governed by different law, and the second half changed in December 2025.

The SAFER SKIES Act, division H of Public Law 119-60, enacted on 18 December 2025, rewrote [6 U.S.C. 124n](#). Homeland Security and the Justice Department keep the power to “detect, identify, monitor, and track” a drone “without prior consent” and to mitigate it, notwithstanding the aircraft, computer, wiretap and pen-register statutes. What the Act adds is a new class of actor: a State, local, Tribal or territorial law enforcement or correctional agency may, once it has completed the training the statute sets, mitigate a credible threat. The protected objects are people, facilities, “a venue or set of venues used for large-scale public gatherings or events, critical infrastructure, or correctional facilities”. The federal authority ends on 30 September 2031 and the state and local authority on 31 December 2031. The 2020 advisory adds a point that matters for a radar. Detection systems which emit signals and read reflections, “such as radar”, are “less likely to pose concerns under federal criminal surveillance statutes”, whereas detectors that read a drone’s control link may implicate the wiretap and pen-register laws.

For a carrier the division is clear. Selling detection, echoes in and tracks out, rests on firmer criminal-law ground than an RF detector does, subject always to the spectrum question above. Acting on a detection belongs to the agencies the statute names, until 2031. The buyer who can use the whole chain, from detection to response, is therefore a public-safety agency, which is also the first customer Ericsson names.

Network privacy law was written for customers rather than bystanders

Sensing sees people who are not customers, and the privacy rules written for networks protect customers. The first regulator to address that gap has said that consent cannot close it (Exhibit 4).

In the United States, customer proprietary network information is defined in [47 U.S.C. 222\(h\)\(1\)](#) as information about a telecommunications service “made available to the carrier by the customer solely by virtue of the carrier-customer relationship”. An echo off a bystander is not made available by any customer. The Sixth Circuit held on 2 January 2025 that “mobile broadband is a private mobile service”. On our reading, the CPNI rules do not reach network sensing of bystanders. California’s privacy law reaches part of it. Its definition of biometric information includes “gait patterns or rhythms”, while “precise geolocation” is limited to data “derived from a device”, so device-free location may fall outside the law while gait used to identify a person falls inside it. No statement on network sensing from the FCC, the FTC or any state attorney general is on the public record.

In Europe the ePrivacy Directive defines location data as data about “the terminal equipment of a user”, so device-free sensing falls under the GDPR alone. One regulator has said what that means in practice.

THE GERMAN DATA-PROTECTION CONFERENCE RESOLUTION OF 17 JUNE 2026

The conference of federal and state data-protection authorities adopted a position on integrated sensing in Wi-Fi and 6G. In our translation it makes four points. Sensing data as a rule relate to persons, so data-protection law applies. Inferring gait, sex, facial features, gestures, breathing or heartbeat engages the special categories of Article 9.

Consent “erweist sich im Bereich der flächendeckenden Sensorik als ungeeignet”: it is unsuitable for area-wide sensing, so wide use is conceivable mainly on public-interest or legitimate-interest grounds. The intrusion is comparable to imperceptible video surveillance, and the legislature will need to write rules for public and private users alike.

Its chair, Professor Tobias Keber, put it more directly: if potentially every mobile device gains a radar function, there are hardly any spaces left in which we can be unobserved. 3GPP, as [part 2](#) records, agreed that no privacy solution will be specified.

EXHIBIT 4

On the permission questions the United States has no answer, Europe has a process, and China's primary documents were not found

QUESTION	UNITED STATES	EUROPE	CHINA
May a licensee sense in its band?	Radiolocation not allocated to Part 27 or 30 licensees; no FCC proceeding	ECC work item on 3.4 to 3.8 GHz since June 2026	Ministry guideline reported; text not found
Who may act on a detection?	DHS, DOJ and trained state and local agencies, to 2031	Member state authorities; no EU-wide counter-drone rules (Commission, October 2023)	Not found
Do privacy rules reach bystanders?	CPNI probably not; California biometric definition includes gait	GDPR applies; consent unsuitable; legislation needed (DSK)	Not found
Does the standard protect them?	TR 33.777: "no solution will be specified"	Same	Same

"Not found" means no primary document was located in this research, not that none exists.

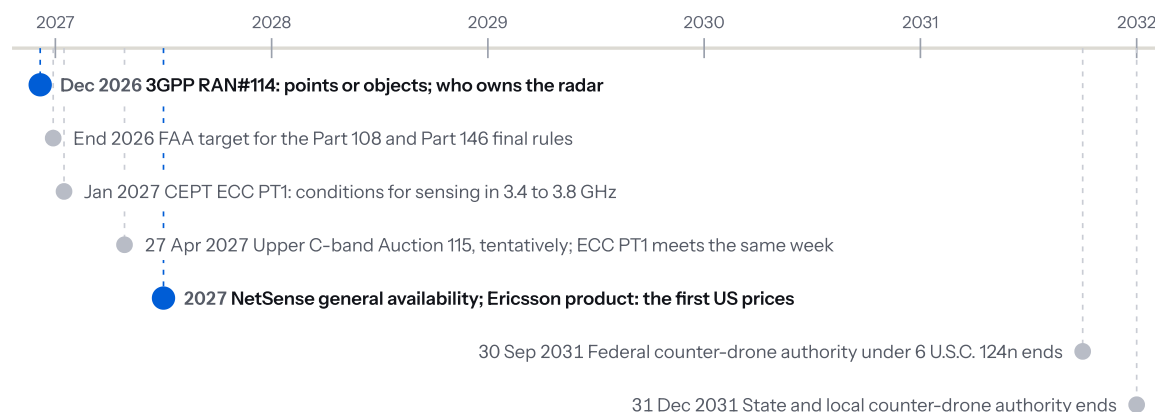
Source: 47 CFR Parts 2, 27 and 30; 6 U.S.C. 124n; 47 U.S.C. 222; CCPA; GDPR and Directive 2002/58/EC; COM(2023) 659; DSK resolution, 17 June 2026; RP-262217; TR 33.777; our reading of each (Judgement).

The dates to watch

Seven dated events between December 2026 and the end of 2031 would change the answers above (Exhibit 5).

EXHIBIT 5

The first US sensing prices arrive in 2027, and the authority to act on a detection runs to 2031



Source: FAA Unified Agenda and Federal Register, with the FAA target as reported by The Flight Brief, 14 September 2026; RP-261901; ECC PT1 liaison (RP-262217); FCC public notice DA 26-769 of 24 July 2026, published 3 August 2026; Light Reading and RCR Wireless; 6 U.S.C. 124n(j) (Filed and Reported).

The one event that would settle the US permission question has no date at all: an FCC ruling, waiver or rulemaking on network sensing. In the meantime the payment record and the permission record point to the same first business: drone detection sold to a public-safety or defence buyer by a vendor or an integrator. It runs as a subscription or a private network around a named site, on a carrier's radios. Whether the carrier can sell it under its own name and its own licence, at national scale, waits on the FCC. The licences going on sale in April 2027 come with the same mobile allocation as the bands in Exhibit 3 (see our [spectrum position decision page](#)).

Implications

CARRIER STRATEGIST

Settle the permission answer before you build the product. A sensing service sold under your own licence is exactly the case the 2020 advisory says needs a radiolocation licence, and no FCC proceeding has addressed it. Until one does, the defensible model is wholesale, with a vendor or integrator holding the customer as Lockheed Martin does on Verizon, or a private network around the site.

INVESTOR

Model no sensing revenue from any operator's accounts, because none reports any. The first prices you will be able to see are NetSense and Ericsson's product in 2027, and the first market-making rule is the FAA's Part 108 and Part 146, targeted for the end of 2026. The first permission signal would be an FCC ruling or proceeding on network sensing, and so far there has been none.

VENDOR

Sell to defence and public safety first, because they are the only buyers on the record. Expect to compete against dedicated radar on multi-year contracts, such as the \$490M Air Force award that includes Echodyne. Hold the customer relationship if you can; in the first US offer the integrator holds it, not the carrier. In Europe, take part in the ECC PT1 work on 3.4 to 3.8 GHz, which next meets on 11 to 15 January 2027, because it is writing the technical conditions for the band.

Method and limits

HOW THIS WAS BUILT

The revenue test is a text search of each carrier's latest annual and quarterly filings for "sensing", "drone", "unmanned aircraft" and "radar", together with a reading of China Mobile's annual and interim reports. Commercial statements are taken from company releases and from named executives in the trade press; they are reported, not verified. The permission record is read from the regulations as in force on 1 October 2026, the allocation table, the statute as amended, the court's opinion and the regulators' own documents. The German passages are our own translations.

WHAT IT DOES NOT SHOW

This is not legal advice. The reading of whether network sensing is a mobile service or a radiolocation service is ours, and the FCC has not said. Filings in the FCC's drone docket that mention integrated sensing could not be retrieved, and they may well contain the industry's position. The Chinese ministry guideline of February 2026 is known only from the press; its title and text were not found. Illinois's biometric privacy statute was not consulted.

Data as of: SEC and China Mobile filings, eCFR as of 1 Oct 2026, Federal Register, court and regulator records, read 7 Oct 2026 · Method version 1.0.

Sources. Filings: the FY2025 10-Ks of Verizon, AT&T and T-Mobile and their second-quarter 2026 10-Qs; China Mobile's 2024 and 2025 annual reports and 2026 interim report. Rules and law: 47 CFR 27.2, 30.6 and 2.1 as in force on 1 October 2026; the FCC's Table of Frequency Allocations and the upper C-band order (91 FR 48700); FCC DA 26-314; the Auction 115 public notice, DA 26-769, as published at 91 FR 48809; the 2020 interagency advisory on drone detection; 6 U.S.C. 124n as amended by Pub. L. 119-60; the FAA's Part 108 proposal, reopening and Unified Agenda entry; 47 U.S.C. 222; Ohio Telecom Ass'n v. FCC (6th Cir., 2 January 2025); the CCPA, the GDPR and the ePrivacy Directive; the European Commission's communication on drone threats, COM(2023) 659; the German data-protection conference's resolution of 17 June 2026; ETSI GR ISC 004. Reported: Light Reading (13 August 2026), RCR Wireless (4 August 2026), Ericsson releases of 10 July and 18 September 2026, ISPreview, Xinhua (23 April 2025), Caixin (12 February 2026), Chongqing Daily (15 March 2026), Business Wire (20 April 2026) and The Flight Brief (14 September 2026), each linked where cited. Read 7 Oct 2026.



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