

Personal Submission

Telecommunications Universal Service Obligation (Standard Telephone Service – Requirements and Circumstances) Amendment Determination 2026

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Executive Summary

The Amendment Determination proposes five changes to the 2023 Determination governing when Telstra may refuse to supply a Standard Telephone Service (STS). The Government's explanatory statement characterises these as minor. They are not, when read in the context of three concurrent technology transitions already transferring Australians from self-powered telecommunications infrastructure to equipment entirely dependent on consumer premises mains electricity.

The three transitions are:

- a. NGWL to 4G Fixed Wireless — completed October 2024, migrating approximately 5,000 services from a network-assisted-power service to a consumer-mains-dependent Smart Modem.
- b. CAN Radio / HCRC exit — announced by 16 November 2027, affecting approximately 9,000 customers across 17,000 services in remote Queensland, Western Australia, the Northern Territory and South Australia.
- c. Copper PSTN substitution — protected by the Copper Continuity Obligation (CCO) until 30 June 2032, but already occurring by agreement, with Telstra deploying either 4G Fixed Wireless or Starlink Voice as the location-dependent replacement.

The replacement technologies require the consumer to supply residential mains electricity. The amended paragraph 7(4)(a) creates the explicit legal basis for Telstra to refuse a USO service where the consumer cannot provide that electricity. The cost is placed entirely on the consumer.

The replacement Starlink voice service is completely unqualified. This submission argues that Starlink Voice does not meet the criteria for USO designation, and presents evidence and international comparison in support of that position.

Primary Concerns

1. The USO amendment will deliver replacement technology (currently being deployed) which requires consumer premises mains power. Paragraph 7(4)(a), as amended, gives Telstra lawful grounds to refuse USO service to any consumer who cannot supply that power. The population most likely to be refused, remote, off-grid, First Nations and elderly, is the population for whom the USO matters most.
2. Starlink voice as a USO service, is an Australian novelty. No other administration worldwide has authorised Starlink voice for USO purpose. It is not fit for purpose as a USO service.
3. For consumers who already have a Starlink internet service, a Starlink USO voice service eliminates rather than provides redundancy. Copper is exchange-powered and weather-resistant — it keeps working in rain and when mains power fails. Starlink fails in heavy rain and when mains power fails. These are complementary failure modes that together provide genuine resilience: when Starlink is down, copper still works, and vice versa. Replace copper with Starlink Voice, and both services now share the same failure modes — rain, mains power failure, and SpaceX outage take both down simultaneously. The USO transition does not replace a service; it removes an existing safety net. This is developed in Section 5.2.

This submission analyses the Amendment Determination item by item, examines each technology transition, and makes seventeen recommendations. The primary ask is that the Determination not be

registered in its current form. At minimum, paragraph 7(4)(a) must be amended to require Telstra to fund or facilitate a compliant power solution before a USO refusal on power grounds can arise.

The Determination must also be accompanied by a legislative instrument establishing the five preconditions for USO qualification of Starlink Voice set out in Recommendation 17. If registered without these changes, the Senate should consider a disallowance motion and the Parliamentary Joint Committee on Human Rights should examine the Statement of Compatibility in Attachment B of the Explanatory Statement.

1. The Technology Stack and the Power Dependency Chain

The central technical fact that makes amended paragraph 7(4)(a) a structural consumer protection issue — rather than a minor administrative update — is the consistent directional shift in power responsibility across every technology transition underway: in each case, power moves from Telstra’s own network infrastructure to the consumer’s domestic electricity supply.

Technology	Status	~Premises	Power source for voice	Behaviour during outage
POTS Copper	Active; CCO until 2032	Majority non fixed line NBN areas	Exchange-powered; no consumer power needed	Continues for hours until exchange batteries exhaust
CAN Radio / HCRC	Exit 16 Nov 2027	~9,000 customers / 17,000 services	Tower solar and battery; no consumer power needed	Tower battery continues service for hours to days
NGWL → 4GFW	NGWL closed Oct 2024; 4GFW live	~5,000+ migrated	Consumer mains power required for Smart Modem; tower also needs grid power	Fails immediately; UPS gives ~4 hrs only; tower outage also terminates service
Copper → 4GFW	Ongoing	Premises with adequate Telstra 4G coverage outside NBN footprint	Consumer mains power for Smart Modem; tower needs grid power	Fails immediately; double power-dependency
Copper → Starlink Voice (\$50/mo)	Rolling out now	All premises outside Telstra’s 4G coverage footprint — including RA2 and RA3 properties surrounding rural towns, and RA4/RA5 outback locations	Consumer mains required; antenna and router 65–90W active (~1.6–2.2 kWh/day). (Source: Telstra, 15 April 2026.)	Fails immediately; no exchange or tower backup; global control plane failure risk

1.1 The Copper Continuity Obligation: What It Protects and What It Does Not

The CCO legally binds Telstra to maintain copper connections in place as at 1 July 2012, for premises outside the NBN fixed-line footprint, until 30 June 2032. It does not apply to HCRC and CAN Radio networks, which are not copper-based.

Three implications follow. First, the Amendment Determination is establishing the framework that will govern the known, scheduled CCO expiry on 30 June 2032. Second, some copper services are already outside CCO protection and can be substituted now. Third, the CCO provides no protection against the quality of service offered after migration, only against its timing. The Amendment Determination should be the instrument guaranteeing service equivalence after migration. It is not.

CCO expiry and the Amendment Determination

Unless successor instruments are significantly strengthened before 2032, all remaining CCO-protected copper customers will transition under a framework that permits power-based refusal, imposes no service quality or availability standard, and offers no price equivalence protection. 2032 is not far away. Building an adequate successor framework must begin now.

2. Item-by-Item Analysis

2.1 Item 1 (first): Rolling CSG Standard Definition

Replacing the 2011 CSG Standard reference with the 2023 Standard is consequential but appropriate. The addition of rolling 'as in force from time to time' language is more significant: any future amendment to the CSG Standard, including reductions in repair timeframes for remote services, will automatically flow through to the USO Determination without further parliamentary scrutiny.

2.2 Item 1 (second): The Deemed Request

The deemed request mechanism correctly recognises that a technology withdrawal is not a consumer's commercial decision. This is a genuine and important improvement on the status quo. The submission supports it.

However, the mechanism is double-edged. It simultaneously activates every refusal ground, including the power-supply ground in paragraph 7(4)(a), against the consumer being transitioned. The combination creates a lawful pathway for Telstra to withdraw a technology and then refuse the replacement service on grounds that only arise because of Telstra's own technology choice.

Combined risk — Items 1(b) and 3

Technology withdrawal → deemed request triggered → power-supply refusal activated → consumer left with no USO voice service, lawfully. Applied to the November 2027 CAN Radio exit alone, this pathway could affect up to 9,000 customers across remote and regional Australia.

The provision also does not require Telstra to give prior notice of the withdrawal or assess power requirements before the deemed request arises. A minimum six months' written notice — against Telstra's current 100–130 day practice — is necessary to allow remote consumers to assess power upgrade requirements, obtain electrician quotes, and arrange procurement and installation before service withdrawal.

2.3 Item 2: CSG Cross-Reference Update

A genuine numbering correction. No substantive concern, subject to confirmation that the provisions referenced carry equivalent substantive obligations to the 2011 Standard.

2.4 Item 3: Amended Paragraph 7(4)(a) — The Power Supply Refusal Ground

New paragraph 7(4)(a)

The person making the request does not make available, at the expense of the person making the request, an electricity supply sufficient for the technology used (or proposed to be used) to provide the standard telephone service at the premises, and the primary universal service provider has, before refusing to supply the service, given the person written notice that clearly sets out: (i) the steps to obtain such an electricity supply; (ii) the technical or other requirements including any requirements for a licensed electrician; and (iii) an indicative reasonable timeframe within which the person could obtain such an electricity supply.

The Explanatory Statement frames Item 3 as adding an 'advice obligation.' The distinction between an obligation to advise on power requirements and any obligation to fund or facilitate them is the central consumer protection question the Amendment Determination fails to resolve. Telstra must tell the consumer what they need; it remains entirely the consumer's cost and problem to provide it.

Issue	Analysis
Full cost on consumer	For properties with no power system, a full SAPS typically costs \$35,000+ (Commodore Australia, April 2026). For existing small solar systems requiring augmentation to support Starlink's ~1.6–2.2 kWh/day load, costs range from \$5,000–\$15,000 before federal battery subsidies — subsidies unavailable to off-grid properties. Telstra's own internal customer scenario planning estimates \$5,000–\$10,000+ for a permanent solution, or \$1,000–\$2,000 for a portable setup that Telstra acknowledges may only work under normal conditions — not during adverse weather when emergency calls matter most.
New ongoing electricity cost	The additional monthly cost of the Starlink service, if power is commercially available and provided @ \$0.30/kWh is ~\$18.00/month.
Licensed electrician	In remote Queensland, NT and WA, a licensed electrician typically charges \$800–\$1,500 per day plus travel costs, with availability requiring weeks or months.
No maximum refusal timeframe	An 'indicative reasonable timeframe' provides no maximum period after which Telstra must supply the service regardless. A consumer who cannot afford a compliant power supply has no remedy and no USO voice service.
No Telstra obligation to assist	The notice obligation is purely informational. Under POTS and HCRC, Telstra's USO service included a working voice service regardless of the consumer's domestic power situation.
No adequacy standard	The provision does not define 'sufficient' electricity, nor specify an independent assessment mechanism or appeal pathway. Telstra assesses its own refusal ground.
First Nations communities	Remote communities relying on community-managed power systems may have systems that do not meet technical specifications for continuous Starlink operation. Telstra could refuse USO service to entire communities — those for whom the USO has its greatest safety significance.

Theoretical worked scenario

Maria lives alone in Far North Queensland (RA5). Her HCRC service is her only access to Triple Zero. Her small solar system cannot support the 65–90W Starlink load. She cannot afford the \$5,000–\$15,000 augmentation. When the CAN Radio exit triggers a deemed request, Telstra assesses her system as insufficient, issues written notice, and refuses the STS. Maria has no USO voice service. This is lawful under the Determination as drafted. It is not hypothetical: Telstra's own CAN Radio Proof of Concept pilot, across 45 sites in mid-2025, identified a material proportion of services with power concerns that prevented migration orders, with some subsequently disconnected without a USO replacement being established.

2.5 Items 4–8: CSG Cross-Reference Updates

Numbering corrections only. Confirmation that substantive obligations — particularly fault repair timeframes for remote customers — are equivalent between the 2011 and 2023 Standards should be published as a side-by-side comparison table.

2.6 Item 9: Removal of Sunset Date

The 2023 Determination's hard sunset date of 1 July 2026 guaranteed a parliamentary review point. The Amendment Determination replaces it with a floating repeal trigger tied to the CSG Standard's life, creating a self-perpetuating instrument that updates automatically without further parliamentary scrutiny. The floating repeal mechanism is in practice worse than the fixed date it replaces: a fixed date guaranteed scrutiny; a date tied to another instrument's repeal does not.

Item 9 also raises a broader procedural concern that warrants direct attention: the adequacy of the consultation record and human rights assessment accompanying this Determination. The Explanatory Statement's consultation section remained incomplete at the time of publication — marked 'To be completed' in the draft circulated for comment. A legislative instrument affecting the rights of tens of thousands of consumers in remote, First Nations, and elderly communities, governing when a carrier may

lawfully withdraw their only means of calling Triple Zero, was put to consultation without a complete account of who was consulted and what they said.

The Statement of Compatibility with Human Rights in Attachment B of the Explanatory Statement concludes that the Amendment Determination raises no human rights concerns. This conclusion is not credible. A provision that creates lawful grounds for Telstra to refuse a USO voice service — including emergency call access — to consumers who cannot fund power infrastructure that was previously unnecessary plainly engages at minimum: the right to life under Article 6 of the International Covenant on Civil and Political Rights, given that denial of access to Triple Zero during a medical emergency or natural disaster is potentially fatal; and the right to equality and non-discrimination under Article 2 of the ICCPR, given that the population most likely to be refused — remote, off-grid, First Nations, elderly — shares protected characteristics and is disproportionately affected by the power-cost burden the provision imposes.

The Parliamentary Joint Committee on Human Rights has standing to examine this Statement. This submission calls on the Committee to do so before the Determination is registered, and specifically to require the Department to explain how a provision that may lawfully deprive vulnerable remote Australians of emergency communications access is compatible with Australia's obligations under the ICCPR.

3. The NGWL to 4GFW Transition: Lessons Already Available

The completed NGWL-to-4GFW migration is the first large-scale USO technology transition from network-assisted power to consumer-mains-dependent voice services. Three power-related failures are identified:

- a. The Telstra UPS, provides approximately four hours of backup for the Gen3 router; wholly inadequate for cyclone-related outages of 24–72 hours, during which emergency calls are most critical. The UPS is not provided by Telstra. It must be purchased by the consumer at approximately \$120, and its serviceability lifetime in the demanding conditions of remote Australia is not specified
- b. 4GFW introduces double power dependency: both the consumer's Smart Modem and the 4G tower require grid power. HCRC ran on dedicated solar-and-battery systems engineered for off-grid resilience.
- c. Telstra withdrew the dedicated NGWL support line post-migration, directing consumers to standard channels significantly less suitable for remote customers with connectivity difficulties.

A formal post-implementation review of the NGWL→ 4GFW migration must be published before the CAN Radio exit commences. Telstra has conducted progressive post-implementation review activities during the CAN Radio Proof of Concept that confirm this data is held and should be released.

4. The CAN Radio / HCRC Exit: The Highest-Risk Transition

The announced exit of Telstra's CAN Radio infrastructure by 16 November 2027 is the highest-risk current transition. Approximately 9,000 customers across 17,000 services move from solar-and-battery-powered, exchange-independent voice to consumer-mains-dependent equipment in areas where reliable mains power is far from guaranteed.

The population served includes remote pastoralists, isolated First Nations communities, School of the Air and Royal Flying Doctor Service families, and remote emergency management infrastructure. For many, the HCRC voice service is their sole means of contacting emergency services.

4.1 The Stand-Alone Power System Problem

A substantial proportion of HCRC customers rely on SAPS rather than grid power. The Starlink load of ~1.6–2.2 kWh/day represents a permanent new electrical load that was never previously required. Telstra's own internal customer scenario planning, drawn from PoC and NGWL migration experience, estimates that approximately 5–10% of current active CAN Radio services (~450–900) have no power at the premises at all, and a further ~5% (~450) have limited off-grid power insufficient for continuous Starlink operation. On Telstra's own projections, between 900 and 1,350 CAN Radio services face power-related barriers to migration — a cohort that, under the Determination as drafted, faces lawful USO refusal with no funded remedy.

4.2 First Nations Community Power Systems

Many remote communities served by HCRC rely on community-managed power systems with known reliability challenges. Telstra's own operational disconnection framework for the CAN Radio migration explicitly identifies 'Migration Refusal or Unable to supply power' as a named disconnection trigger — Scenario 3 in Telstra's internal framework.

Under that framework, non-Priority Assistance and non-identified First Nations customers facing power barriers are routed directly to legacy service disconnection with no escalation requirement. Priority Assistance and identified First Nations customers are routed to an 'Escalate for Decision' pathway — not a guarantee of service continuation. The framework provides no protection for a remote pensioner whose service was never formally identified as Priority Assistance or associated with a First Nations community. The Amendment Determination should close this gap. It does not.

4.3 The Failed 2009 Exit: History Must Not Repeat

Telstra previously attempted to exit HCRC in 2009. Councils and communities pushed back, citing a six-day outage in one community with no alternative service available. Telstra reversed the decision in 2012. The 2027 exit announcement has not been preceded by any independent assessment confirming that every current HCRC customer can be served by an adequate alternative without requiring consumer-funded power infrastructure.

Telstra's own Proof of Concept migration programme deliberately excluded Northern Territory and Queensland sites from its third cohort, citing wet season appointment risks. These are precisely the two jurisdictions most heavily affected by the CAN Radio exit and with the greatest Starlink rain fade risk.

5. Copper Substitution: A Tiered Technology Framework

Copper substitution follows a location-dependent technology hierarchy: 4GFW where adequate Telstra 4G coverage exists; Starlink Voice where it does not. Both pathways require consumer mains power. Paragraph 7(4)(a) can therefore operate as a refusal ground across the entire copper replacement programme, not just for Starlink. The power problem is systemic. It is important to note that the Starlink Voice deployment criterion is not remoteness classification but the absence of Telstra 4G coverage. This means Starlink Voice will be deployed not only at outback RA4/RA5 properties but at any premises outside the 4G footprint — including RA2 and RA3 properties surrounding smaller rural towns across regional Australia. A property 15 kilometres from a rural town like Gloucester, NSW is RA3 and may have mains power, but will receive Starlink Voice as its copper USO replacement because 4G does not reach it. The rain fade risk documented in Section 6 and Appendix A is not a tropical phenomenon alone: the Gloucester Valley itself records 50–90 mm/hr rainfall events in summer storm season that cause Starlink outages, at a location that most Australians would not describe as 'remote.' The submission's concerns about Starlink Voice as a USO replacement therefore extend to the full population of copper customers outside the 4G footprint, irrespective of their remoteness classification.

5.1 What the Satellite Voice CIS Reveals

Priority Assistance: Technology-by-Technology Assessment

Priority Assistance provides priority connection and fault rectification for customers with life-threatening medical conditions. The table below maps PA availability across the substitution stack:

Technology	PA available?	Backup required?	Key limitations
POTS Copper	Yes — full	No	Full PA timeframes. Exchange battery automatic. Soft dial tone on suspension.
4GFW	Conflicted	Consumer-funded ~4 hrs	Satellite Voice CIS states PA 'not available' on 4GFW — directly conflicting with the PA Policy, which includes fixed wireless in fulfilment of the USO. Requires urgent Telstra clarification.
Starlink Voice (\$50/mo)	Yes, with caveats	Yes — Telstra-installed (duration unspecified)	Service fails in mains power outage including emergency calls (per CIS). Battery backup duration not specified. A minimum 24-hour backup (requiring ~1.6–2.2 kWh storage) should be mandated for all Starlink Voice PA customers, with 72 hours for RA4/RA5 — noting that Starlink Voice is

Technology	PA available?	Backup required?	Key limitations
			deployed at premises outside the 4G footprint across all remoteness categories, not only RA4/RA5.

Section 5.3.2 of the PA Policy states that where NBN Co controls the local access network, Telstra ‘may not be able to meet’ its PA repair timeframes and is not obliged to do so.

The Power Failure Clause and Medical Devices

The Satellite Voice CIS states explicitly: ‘You will not be able to use your service in a power failure (including emergency calls).’ Customers are advised to check device compatibility with their manufacturer — transferring a complex technical problem to the consumer without any Telstra obligation to assess or resolve it as part of migration.

Telstra’s Unilateral Right to Change Technology

The CIS allows Telstra to change the underlying technology with 30 days’ notice, with the consumer required to ‘provide all reasonable assistance.’ Any such change would trigger the deemed request mechanism again, potentially re-activating the paragraph 7(4)(a) refusal ground a second time.

The Starlink Acceptable Use Policy Incorporation

The CIS requires consumers to comply with Starlink’s Acceptable Use Policy ‘as amended from time to time.’ A USO-designated voice service incorporating, by reference, the unilaterally amendable commercial terms of a private US company outside Australian regulatory jurisdiction is inconsistent with the USO’s character as a statutory consumer protection. This concern extends beyond the AUP text itself. The Starlink broadband service and the Starlink Direct-to-Cell D2D service share common SpaceX ground infrastructure, orbital control systems, and corporate governance. A single SpaceX regulatory, technical, or commercial failure affects both services simultaneously — meaning the USO voice service and the only available satellite messaging backup for affected consumers are not independent of each other and cannot provide mutual redundancy.

5.2 The Redundancy Problem: Replacing a Safety Net with a Single Point of Failure

A significant and underappreciated consequence of the copper-to-Starlink Voice transition is its effect on consumers who already subscribe to Starlink broadband. This cohort is substantial: Starlink has been actively marketed to rural and regional Australians precisely because they are outside the NBN fixed-line footprint — the same population that will receive Starlink Voice as their copper USO replacement. Many of these consumers adopted Starlink broadband specifically to augment, or provide a backup to, their existing copper or CAN/HCRC telephone service. The USO transition removes that redundancy entirely.

The current arrangement — copper telephone service plus Starlink broadband — provides genuine, complementary resilience. Copper PSTN is exchange-powered, weather-resistant, and immune to consumer premises power failures. Starlink broadband fails in heavy rain and requires consumer mains power. These are complementary failure modes: when one service fails, the other typically continues. A consumer whose Starlink goes down in a thunderstorm can still call Triple Zero on copper. A consumer whose mains power fails can still use copper, which requires no premises power at all.

After the USO transition, the same consumer has two Starlink services: Starlink Voice and Starlink broadband. These share identical failure modes. Rain takes out both simultaneously — the Ku/Ka-band attenuation documented in Section 6.5 is indifferent to whether the data path is carrying voice or broadband. A mains power failure takes out both simultaneously — both the Starlink Voice router and the Starlink broadband router require consumer premises power. A SpaceX infrastructure failure or outage takes out both simultaneously — both services depend on the same SpaceX ground stations, orbital control systems, and constellation as documented in Section 5.1. The redundancy is not diminished; it is eliminated and replaced by correlated failure risk.

The irony is pointed. The consumer most likely to have adopted Starlink broadband is the consumer most likely to be in an area with no 4G coverage, no NBN fixed line, and no alternative connectivity — which is precisely the consumer who will receive Starlink Voice as their USO replacement. This consumer has been prudent enough to invest in a backup communications capability. The USO transition rewards that prudence by removing the service the backup was designed to supplement.

No other USO technology transition in Australia's history has had this property. The transition from NGWL to 4GFW does not replicate the failure modes of a consumer's Starlink broadband service. The transition from HCRC to 4GFW does not replicate the failure modes of a consumer's mobile phone. But the transition from HCRC, NGWL or copper to Starlink Voice, for a consumer who already has Starlink broadband, takes a two-technology resilience arrangement and collapses it into a single-vendor, single-constellation, single-power-dependency system. The Amendment Determination contains no recognition of this problem and no remedy for it. The submission proposes no specific recommendation against Starlink Voice deployment at premises where Starlink broadband already exists — mandating technology diversity would be impractical — but the Department and the ACMA should be required to report annually on the proportion of Starlink Voice USO services at premises that also subscribe to Starlink broadband, and to assess whether the resulting correlated failure risk is consistent with the USO's obligation to provide a reliable voice service.

6. The Evidentiary Basis for LEOSat as a USO Technology

6.1 The MOS Measurement Gap

The Scyne Advisory Trials used an E-Model eMOS metric calculated from network performance parameters when voice traffic is flowing. The ITU-T G.107 standard that underpins the E-Model explicitly notes it is not recommended for actual customer opinion prediction.

More significantly: a MOS score can only be calculated when voice traffic is flowing. When the service is completely unavailable, no traffic flows and no measurement is generated. Periods of complete service outage are empirically outside the eMOS measurement window.

The measurement gap

If a severe rain event causes a complete Starlink outage at a trial site, that period generates no MOS data. It does not appear as a low score — **it does not appear at all**. The MOS scores reported represent quality during periods when the service was functioning. They do not represent the experience of a consumer who, during a storm, picks up the phone to call Triple Zero and finds no service. Service unavailability during adverse conditions is precisely the dimension that matters most for USO assessment.

6.2 The Wet Season Anomaly

The trials ran November 2024 to July 2025, deliberately spanning the northern wet season. Independent peer-reviewed research documents significant Starlink throughput degradation at rainfall intensities below those routinely experienced during the Northern Territory monsoon. Darwin averages more than 1,700 mm of rainfall per year, almost entirely in the wet season, regularly producing rainfall events exceeding 50 mm per hour.

The publicly available trial data does not show statistically significant degradation at northern Australian sites during the wet season. Given the structural measurement gap described above, the absence of observed degradation is exactly what the physics and the methodology, in combination, would predict — regardless of whether degradation actually occurred. The per-site analysis in **Appendix B** specifically examines northern tropical Zone 1 sites — Humpty Doo, Katherine, Alligator, Croydon-Etheridge and Ashburton — and documents the test-count asymmetry between Starlink and co-located services at moderate to high rainfall rates at each location.

6.3 Service Availability: The Missing Metric

The trials do not report annual availability in terms directly comparable to the PSTN five-nines standard (99.999%, approximately five minutes and fifteen seconds of unplanned downtime per year). New Zealand's independent measurement programme found Starlink disconnects approximately every four hours — implying annual availability of approximately 99.58%, or roughly two nines. Without a comparable Australian figure, the trial data cannot establish that LEOSat meets the availability standard the USO implies.

6.4 The Absence of a Fixed-Line Baseline

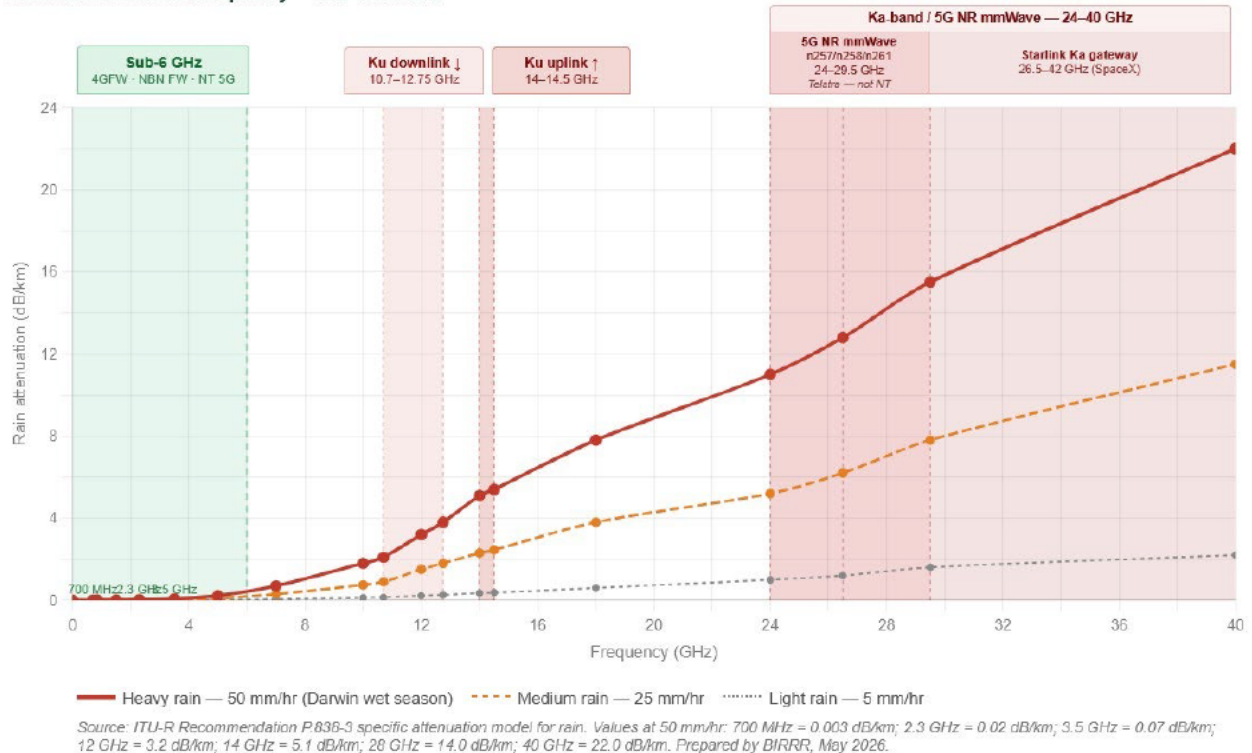
The trials compared LEOSat against NBN fixed wireless and NBN satellite services — both with known quality limitations. The question the trial must answer is whether LEOSat is adequate to replace POTS as

the USO technology. A POTS circuit under ideal conditions yields an eMOS of approximately 4.4 at 99.999% availability. The Scyne trials provide no data point for this comparison.

6.5 Rain Fade and Frequency: The Physics the Trial Could Not Measure

ITU-R Recommendation P.838 defines specific attenuation as a function of frequency and rainfall rate. The relationship is non-linear: at 14 GHz (Starlink's Ku-band uplink), rain attenuation at 50 mm/hr — routinely exceeded in Darwin wet season storms — produces approximately 5.1 dB/km. Over a 7 km slant path to a low-orbit satellite, that is approximately 36 dB of total attenuation, exceeding the link margin of any standard consumer terminal.

Rain Attenuation vs Frequency — ITU-R P.838-3



Key frequency comparison:

Frequency	Technology	25mm/hr	50mm/hr	100mm/hr	Assessment
700–900 MHz	Telstra 4GFW	~0.001	~0.003	~0.007	Negligible. Omitted from link budgets.
2.3 GHz	NBN Fixed Wireless	~0.01	~0.02	~0.05	Effectively negligible.
12 GHz (Ku-band DL)	Starlink Voice downlink	~1.5	~3.2	~6.0	Significant. ~22 dB at 50mm/hr over 7km slant path. Exceeds typical link margin.
14 GHz (Ku-band UL)	Starlink Voice uplink	~2.3	~5.1	~9.5	Severe. ~36 dB at 50mm/hr. Service terminates below peak monsoon intensity.
26–28 GHz (Ka-band)	Starlink gateway links	~7.5	~14	~26	Extreme. Complete link failure at moderate tropical intensities.

Source: ITU-R P.838-3. Slant path: 7 km at 50° elevation, representative of LEO satellite geometry from tropical northern Australia.

All Australian network operators' frequency selection decisions demonstrate that this physics is understood and applied: sub-6 GHz for tropical and remote coverage; NR mmWave only for dense urban capacity in temperate cities. Telstra 4GFW uses rain-transparent 700–900 MHz. NBN Fixed Wireless uses rain-transparent 2.3 GHz. Telstra's 5G in Darwin uses 2.3 GHz and 3.5 GHz exclusively. Darwin has no mmWave consumer deployment by any carrier.

Starlink Voice is the only USO-designated voice technology operating above the rain fade threshold, deployed as the primary USO service in precisely the region where that threshold is most consequential. The theoretical attenuation values in the table above are corroborated by field measurements from the author’s own property in the Gloucester Valley, New South Wales, documented in **Appendix A**. Those measurements record two separate rain events at peak rainfall rates of 87 mm/hr and 75.6 mm/hr respectively, each producing Starlink service outages exceeding 30 minutes, while simultaneously confirming that a co-located copper telephone service and a 700 MHz 4G relay remained uninterrupted throughout both events. The aggregate and per-site Scyne data analysis in **Appendix B** provides the systematic 50-site evidentiary counterpart to these field observations: it demonstrates that at the rainfall intensities predicted by ITU-R P.838 to cause link failure, Starlink test data disappears from the trial record entirely — consistent with the physics, consistent with the field measurements, and **inconsistent with the trial’s reported aggregate availability figure of approximately 98%**.

7. The Evidentiary Timeline and International Comparison

7.1 Technology Deployed Before Suitability Established

A defining characteristic of Australia’s USO modernisation is that technology deployment preceded the evidentiary basis for making it:

Date	Event	Evidence at that time
2023	Telstra begins migrating NGWL customers to 4GFW as sole USO voice.	No USO suitability trial conducted.
March 2024	Telstra launches Starlink Voice as commercial USO product (\$50/month).	No prior government-commissioned trial.
28 Oct 2024	3G closes; NGWL→4GFW migration complete. ~5,000 USO services on 4GFW as their only service.	No USO suitability trial ever conducted for 4GFW in this primary role.
Nov 2024	Scyne trial commences — 8 months after Starlink Voice deployed, after 4GFW migration complete.	E-Model eMOS only. No POTS baseline. No 4GFW assessment.
July 2025	Scyne trial concludes.	The trial did not inform the technology decisions. Those decisions were fully executed before the trial began.

7.2 VoLTE vs Best-Effort SIP VoIP: A Material Distinction

VoLTE runs on a Guaranteed Bit Rate bearer with dedicated QoS priority and reserved radio resources. Voice quality research using POLQA consistently shows VoLTE delivering quality equal to or better than POTS under adequate coverage. SIP VoIP over a best-effort data bearer has no guaranteed resource allocation, competes with all other traffic, and degrades unpredictably as link quality decreases.

Starlink Voice delivers SIP VoIP over the Starlink broadband data connection — best-effort, unmanaged for QoS. No VoLTE pathway exists on a satellite data connection. The distinction is material for USO assessment and is unaddressed in any government policy document or the Scyne trial methodology.

7.3 Australia as an International Outlier

No jurisdiction — including New Zealand, the United Kingdom, the United States, or the European Union — has formally designated Ku/Ka-band LEOSat residential voice as a primary USO technology.

- a. The UK uses FTTP VoIP with carrier-mandated backup power as a separate legislative requirement.
- b. The FCC specifically declined to approve Starlink’s Rural Digital Opportunity Fund application, citing ‘still developing technology.’ The July 2025 Starlink outage is now referenced in Congressional Research Service material.
- c. New Zealand uses FTTP and Fixed Wireless VoIP. Its independent measurement programme found Starlink disconnects approximately every four hours under normal conditions.

- d. Canada and the EU treat LEOSat as supplemental to terrestrial networks, not as a primary fixed voice USO technology.
- e. Australia's own LEOSat Working Group recommended extensive testing before USO inclusion. The CAN Radio exit is already deploying Starlink Voice as a primary USO replacement before that precondition is met.

Australia has made a unique policy decision on the basis of evidence no other regulator has found sufficient for this purpose. It has done so using a measurement approach that is, as Section 6 documents, structurally blind to service unavailability during adverse conditions.

7.4 The Power Requirements Dimension

The technology selection carries a power consumption consequence with no parallel in any other jurisdiction's USO framework:

- a. POTS copper and CAN Radio/HCRC: zero consumer premises power required.
- b. FTTP VoIP (New Zealand and UK): 340–430 Wh/day. Carriers mandated to provide backup power at no consumer cost.
- c. Telstra 4GFW (Smart Modem): ~225–307 Wh/day (Telstra, 15 April 2026). No backup standard mandated in Australia.
- d. Telstra Starlink Voice: 1,600–2,200 Wh/day (Telstra, 15 April 2026). No backup standard. Consumer bears full cost.

Starlink Voice consumes four to six times the daily energy of FTTP and fixed wireless technologies used for USO replacement in New Zealand and the UK. Australia mandates nothing and imposes the full power cost on consumers.

7.5 Australia as the World's Only LEOSat USO Voice Jurisdiction

Australia is the first and only country to have designated a consumer LEOSat product as a primary USO replacement technology for residential fixed voice services. Telstra's own announcement described it as a 'world first.' **Being first is not inherently a virtue.**

7.5.1 The Specific Risks of Global Novelty

- a. No international operational evidence base exists. No other regulator has conducted longitudinal, all-weather monitoring of Starlink Voice as a primary USO service. Australia is conducting that experiment on its most vulnerable remote consumers without a rollback mechanism.
- b. Single-vendor dependency. Starlink Voice creates a USO dependency on SpaceX — a private US company outside Australian regulatory jurisdiction. The Starlink AUP can be amended by SpaceX at any time, potentially in ways incompatible with USO obligations. This dependency is more structurally embedded than it may appear. The Starlink broadband service (which carries Starlink Voice as SIP VoIP) and the Starlink Direct-to-Cell D2D service (used for satellite SMS) are not independent systems. While the D2D sub-fleet of approximately 650 satellites carries a separate IMT-band radio payload to the Ku/Ka-band broadband payload, both services share the same SpaceX ground station network, the same orbital control systems, the same inter-satellite laser link infrastructure, and the same corporate entity. A systemic SpaceX failure — whether technical, regulatory, or commercial — affects both services simultaneously. A consumer who loses Starlink Voice due to a SpaceX infrastructure failure cannot fall back to D2D messaging, because that service is also offline. The two services therefore provide no redundancy against each other despite being superficially different technologies. No other USO jurisdiction has accepted a framework in which both the primary USO voice service and its only available backup messaging capability depend on a single private foreign company's uninterrupted operation.
- c. Atmospheric degradation in the highest-risk deployment zone. Tropical northern Queensland and the Northern Territory have the highest rainfall intensities in Australia and therefore the highest Ku/Ka-band rain fade risk. No other jurisdiction has designated Ku/Ka-band LEOSat as primary USO voice in a tropical monsoon climate.
- d. No performance floor. New Zealand's independent measurement data shows Starlink disconnects approximately every four hours, implying ~99.58% annual availability — three orders of magnitude below the five-nines PSTN standard. Australia has designated a technology whose independently measured availability falls materially below the standard it is asked to replace.

7.5.2 Why 4GFW and Starlink Voice Are Not Equivalent

4GFW delivers voice via VoLTE on a QoS-managed IMS bearer. The call path is powered at the tower. The technology is weather-resistant at 700 MHz. It is, in the assessment of comparable international regulators, the appropriate class of technology for USO voice replacement where terrestrial wireless coverage exists.

Starlink Voice delivers best-effort SIP VoIP over a consumer broadband data bearer. Voice quality depends on the broadband data path, which depends on consumer premises mains power, Ku/Ka-band atmospheric conditions, and SpaceX's commercial infrastructure outside Australian regulatory jurisdiction. No comparable regulator has found this adequate for primary USO voice designation. **Australia has.**

Where 4GFW coverage exists at a premises, it should be the mandated USO replacement technology. Starlink Voice should only be designated where 4GFW is genuinely unavailable — and only then subject to the consumer protections and performance conditions its novel nature demands. The Amendment Determination makes no such distinction.

7.5.3 What a Responsible Framework Would Require

Starlink Voice is not currently USO-qualified. It may become USO-qualified when five specified, objectively measurable preconditions are met. Until they are, it should not be used to discharge a USO obligation, and no legacy service should be withdrawn where the only available replacement is Starlink Voice.

This position is not obstructionist. It is the position every comparable international regulator has implicitly adopted by declining to make this designation. The five preconditions are:

- a. A minimum availability standard, expressed in five-nines-comparable terms, verified by independent continuous measurement including during adverse weather events. The standard must be met before the designation is confirmed, not monitored after it is made.
- b. A mandatory technology preference hierarchy establishing that 4GFW VoLTE is the primary USO replacement wherever it can be delivered, with Starlink Voice reserved for premises where 4GFW is genuinely unavailable.
- c. Carrier-funded power supply and backup power obligations, recognising that the technology's consumer premises power dependency is a consequence of the technology selection decision, not a pre-existing consumer responsibility.
- d. A domestic regulatory anchor requiring ACMA approval before any amendment to the Starlink AUP or service terms takes effect in respect of USO-designated services.
- e. A rollback mechanism allowing the Minister to revoke or suspend the USO designation if measured performance falls below the minimum standard, if SpaceX amends its AUP incompatibly with USO obligations, or if independent assessment finds the technology is not delivering equivalent consumer outcomes to the service it replaced.

Until all five preconditions are independently verified as met, Telstra must maintain legacy services at its own cost where the only available replacement is Starlink Voice. These preconditions are set out as Recommendation 17.

A forward-looking note

The conditional suspension in Recommendation 17 is not permanent opposition to satellite voice as a USO technology. The next generation of direct-to-device satellite infrastructure — deploying dedicated 2 GHz MSS spectrum (well within the ITU rain rate goldilocks zone) with higher spacecraft EIRP and larger phased array antennas — has the potential to dramatically change the picture. If that infrastructure operates at or near the -115 dBm RSRP threshold that defines the terrestrial USO coverage standard, as spacecraft antenna gain and downlink power density trajectories suggest may be achievable, it could deliver VoLTE on a QoS-managed IMS bearer at link budgets where performance is well understood and genuinely equivalent to terrestrial 4GFW VoLTE. The position is not that satellite voice cannot qualify. It is that the qualification framework must exist before the designation is made — and that the next generation of satellite technology, when it arrives, should be assessed against that framework rather than inheriting a precedent set by an inferior technology deployed without one.

8. Consolidated Recommendations

Seventeen recommendations span three categories. **Recommendations 2, 3, 8 and 16 address direct amendments to the Determination.** Recommendations 1, 4, 5, 6, 7 and 15 address the USO Performance Agreement and consumer protection standards across all three transitions. Recommendations 9–14 address the evidentiary and technical basis for USO technology decisions. Recommendation 17 addresses USO qualification itself.

Recommendations 3, 4, 5, 6, 16 and 17 carry the greatest urgency.

#	Recommendation	Applies to	Mechanism
1	Where Telstra's replacement USO technology requires consumer mains power and the current technology does not, Telstra must fund or facilitate an adequate power supply at no capital cost to the consumer.	All three transitions	New subsection in s.7; Telstra USO Performance Agreement
2	Para 7(4)(a) power refusal must not apply to deemed requests unless Telstra has first made a genuine offer to resolve the power supply issue at its own cost.	All transitions; HCRC most urgent	Carve-out in Item 1(b); new proviso in para 7(4)(a)
3	Explicit exemption from power-based refusal for: (a) any premises outside the Telstra 4G coverage footprint, (b) First Nations Community Purpose premises, and (c) Priority Assistance customers.	All transitions; critical for HCRC exit	New subsection 7(4A)
4	Minimum backup power standard: 24 hours minimum for all Starlink Voice USO deployments; 72 hours for RA4/RA5. Funded by Telstra as migration cost.	4GFW (4 hrs only at consumer cost); HCRC; copper	USO Performance Agreement; technical specification
5	4G tower power resilience: minimum 24-hour backup at towers serving 4GFW USO customers; mandatory severe weather hardening in Cyclone Risk Zones.	NGWL→4GFW (existing); HCRC→4GFW (upcoming)	USO Performance Agreement; ACMA technical standard
6	HCRC exit subject to premises-by-premises power assessment. No service withdrawn before power-independent or adequately power-supported replacement confirmed at that premises.	CAN Radio/HCRC exit (Nov 2027)	Ministerial direction; condition of exit programme approval
7	Dedicated remote-specific support channels maintained throughout all technology migrations and for 24 months post-completion.	All transitions; absent from 4GFW migration	USO Performance Agreement condition
8	Reinstate a 3-year mandatory review date in the Determination. Require a fitness-for-purpose review within 18 months of each major technology transition event.	Removal of July 2026 sunset date	Amend Item 9
9	Publish a post-implementation review of the NGWL→4GFW migration before the HCRC exit commences, including power-related failures and complaint data.	NGWL→4GFW (retrospective)	Departmental requirement; ACMA reporting
10	Publish a clear methodological statement on how periods of complete service unavailability were treated in the Scyne trial availability calculations.	Scyne trial evidence base	Departmental publication
11	Commission a supplementary analysis correlating Bureau of Meteorology rainfall intensity records against Scyne trial measurement timestamps at northern Australian sites.	Scyne wet season findings	Independent technical analysis; BoM data matching
12	Before any policy instrument designates LEOSat as USO-equivalent for residential fixed voice, conduct a supplementary trial using: (1) ICMP probing at 1-second intervals; (2) synthetic SIP call attempts at 5-minute intervals; and (3) PESQ/POLQA measurement on completed calls. Correlate against BoM rainfall records. Include a POTS reference site. No comparable regulator has accepted E-Model eMOS evidence alone as the basis for a LEOSat USO voice designation.	LEOSat USO designation	New trial contract; pre-condition of any USO designation instrument
13	Telstra must confirm, in each USO voice CIS, whether voice is delivered via (a) VoLTE on a QoS-managed IMS bearer or (b) SIP VoIP over a best-effort data bearer. USO Performance Agreement to establish a mandatory technology preference	4GFW and Starlink Voice USO products	USO Performance Agreement; ACCC CIS compliance review

#	Recommendation	Applies to	Mechanism
	hierarchy: 4GFW VoLTE where available; Starlink Voice only where 4GFW is genuinely unavailable.		
14	A retrospective 4GFW USO suitability review must be commissioned covering voice quality (PESQ/POLQA against a POTS reference), annual availability in five-nines-comparable terms, power resilience, and voice bearer type. To be completed before the CAN Radio exit commences.	NGWL→4GFW migration (retrospective)	Departmental requirement; independent assessment
15	No USO voice replacement technology should cost the consumer more than the regulated copper STS price without an ACCC-approved price equivalence assessment. Starlink Voice at \$50/month, and any future price increases under the 30-day notice clause, must be subject to this assessment.	Starlink Voice (\$50/month)	ACCC price equivalence determination; USO Performance Agreement
16	Amendment Determination to include explicit number portability provisions: (a) interim number period not to exceed 48 hours; (b) Caller Line Identification and Directory Listing activated automatically; (c) consumer to receive written porting completion date before original service is decommissioned; (d) PA status transferred simultaneously with number port.	All USO technology transitions	Amendment to Determination; USO Performance Agreement; ACMA oversight
17	The Minister should suspend the use of Starlink Voice to discharge USO obligations pending independent verification that the five preconditions in Section 7.5.3 are met. Until all five are independently verified, no legacy CAN Radio, HCRC, NGWL or copper service should be withdrawn at a premises where the only available replacement is Starlink Voice. Telstra must maintain such legacy services at its own cost in the interim.	All transitions deploying Starlink Voice; HCRC exit (Nov 2027); copper substitution (post-2032)	Ministerial direction under s.9(3) TCPSS Act; new preconditions instrument under s.9(2D); ACMA technical standard for LEOSat USO qualification

9. Consultation Process and Next Steps

The Amendment Determination is subject to disallowance by either House of Parliament within 15 sitting days of tabling. Recommended parallel actions:

- Submit this document to the Department as a formal consultation response.
- Engage the Parliamentary Joint Committee on Human Rights to examine Attachment B of the Explanatory Statement, which concludes no human rights issues arise. A legislative instrument creating lawful grounds for Telstra to refuse USO voice service — including Triple Zero access — to off-grid pensioners and remote First Nations communities, on grounds that they cannot fund consumer-side power infrastructure that was previously unnecessary, plainly engages the right to life (Article 6, ICCPR) and the right to non-discrimination (Article 2, ICCPR).
- Engage the Minister for Communications directly on specific wording amendments to paragraph 7(4)(a), the Item 1(b) deemed request provision, and Item 9 sunset provisions.
- Request the TIO to publish complaint volume data relating to the NGWL→4GFW migration, including power-related service failures. Request the Department to require Telstra to publish the Post-Implementation Review of the CAN Radio PoC1 migration programme — including power-related service outcome data — before the full exit programme commences.
- Monitor the Telstra USO Performance Agreement renewal as a parallel vehicle for mandating power supply obligations, backup power standards, and migration support requirements.
- If the Determination is registered without adequate amendment to paragraph 7(4)(a) and the deemed request provision, consider requesting a Senator to give notice of a disallowance motion and provide a technical briefing to cross-bench and regional Senators.
- Engage state and territory governments regarding their responsibility to ensure that power infrastructure in remote communities meets the baseline requirements of any technology the Commonwealth designates as USO-compliant.

Appendix A: Field Measurements — Starlink Rain Fade Events, Gloucester NSW

The following field measurements were recorded at the author's property, Gloucester NSW, 2422. The property has simultaneous access to Sky Muster Plus satellite broadband, Starlink broadband, a copper telephone service (connected to Bindera exchange), and a self-funded 700 MHz 4G relay service using a solar-powered repeater on a ridge 600 metres from the homestead, connecting to a Telstra base station 39 kilometres distant. This combination of services provides a direct empirical comparison across all three USO-relevant technology classes i.e. copper PSTN, Ku-band LEOSat, and 700 MHz terrestrial wireless, under identical weather conditions at the same premises simultaneously.

Event 1: 25 March 2023 — Peak Rainfall 87 mm/hr, Total 51–55 mm

A typical east coast storm season event, commencing at 4.10 am and concluding at approximately 6.30 am. The Newcastle Bureau of Meteorology radar confirmed rainfall in excess of 50 mm at the property location. The automated rain gauge recorded a peak rate of 87 mm/hr and a total event rainfall of 51.0 mm; the manual gauge recorded 55 mm.

[Bureau Home](#) > [Radar Images](#) > [128 km Newcastle Since 9 am Rainfalls](#)

128 km Newcastle Since 9 am Rainfalls

[View the current warnings for New South Wales](#)

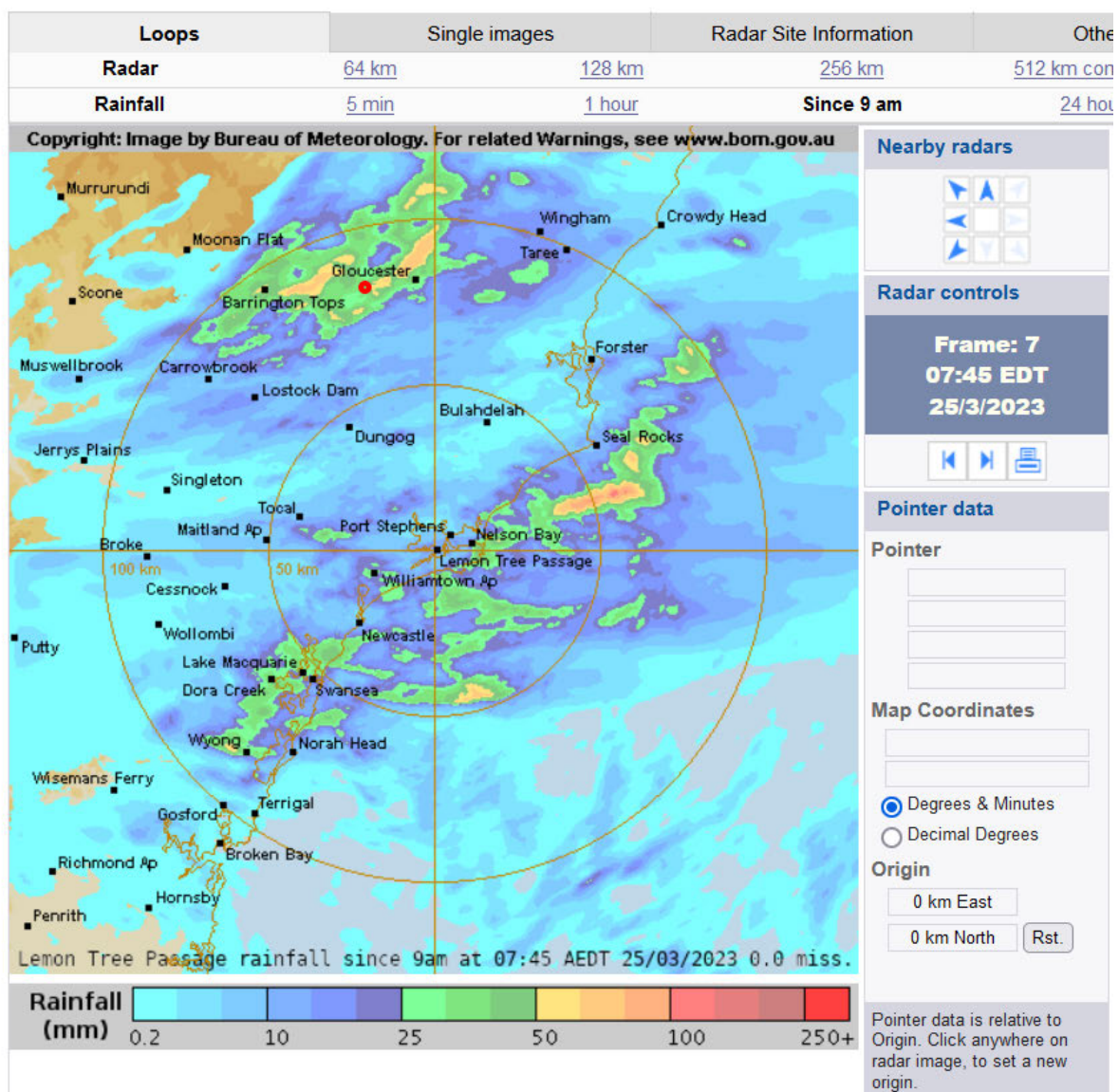


Figure A1: Bureau of Meteorology Newcastle radar, 25 March 2023, 07:45 AEDT. Red dot marks Wahoonga Farm. Yellow/orange zones indicate rainfall exceeding 50 mm. Source: BoM radar archive.

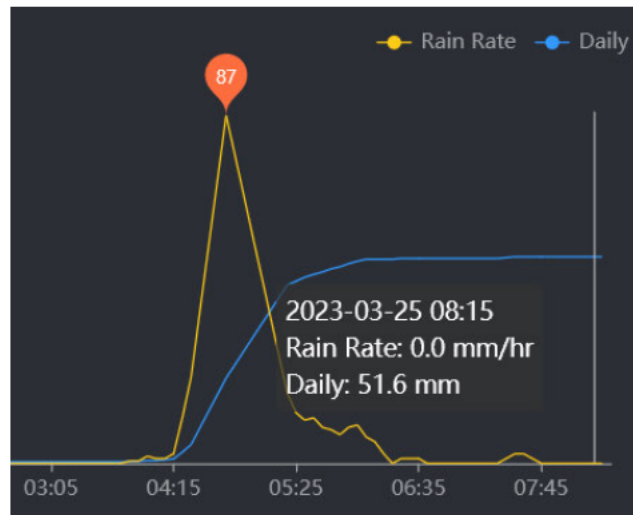


Figure A2: Automatic rain gauge record, 25 March 2023. Peak rain rate 87 mm/hr at 04:15; total event rainfall 51.6 mm. Source: on-site Davis weather station.

Technology	Outage duration	Notes
Sky Muster Plus (Ka-band LEOSat)	~55 minutes	Recorded by Pingplotter and independently confirmed by Sam Knows monitoring.
Starlink (Ku-band LEOSat)	~30+ minutes	Recorded by Pingplotter.
Copper telephone (PSTN)	No outage	Uninterrupted throughout the event. Exchange-powered; no dependency on consumer premises power or atmospheric conditions.
700 MHz 4G relay (solar-powered, 39 km to Telstra tower)	No outage	Uninterrupted throughout. 700 MHz is effectively transparent to rainfall at all intensities experienced in Australia.



Figure A3: Pingplotter — Sky Muster Plus, 25 March 2023. Solid red = 100% packet loss. Outage ~55 minutes from 04:46.



Figure A4: Pingplotter — Starlink, 25 March 2023. Two outage blocks totaling 30+ minutes. Both satellite services failed simultaneously during the peak rain period.

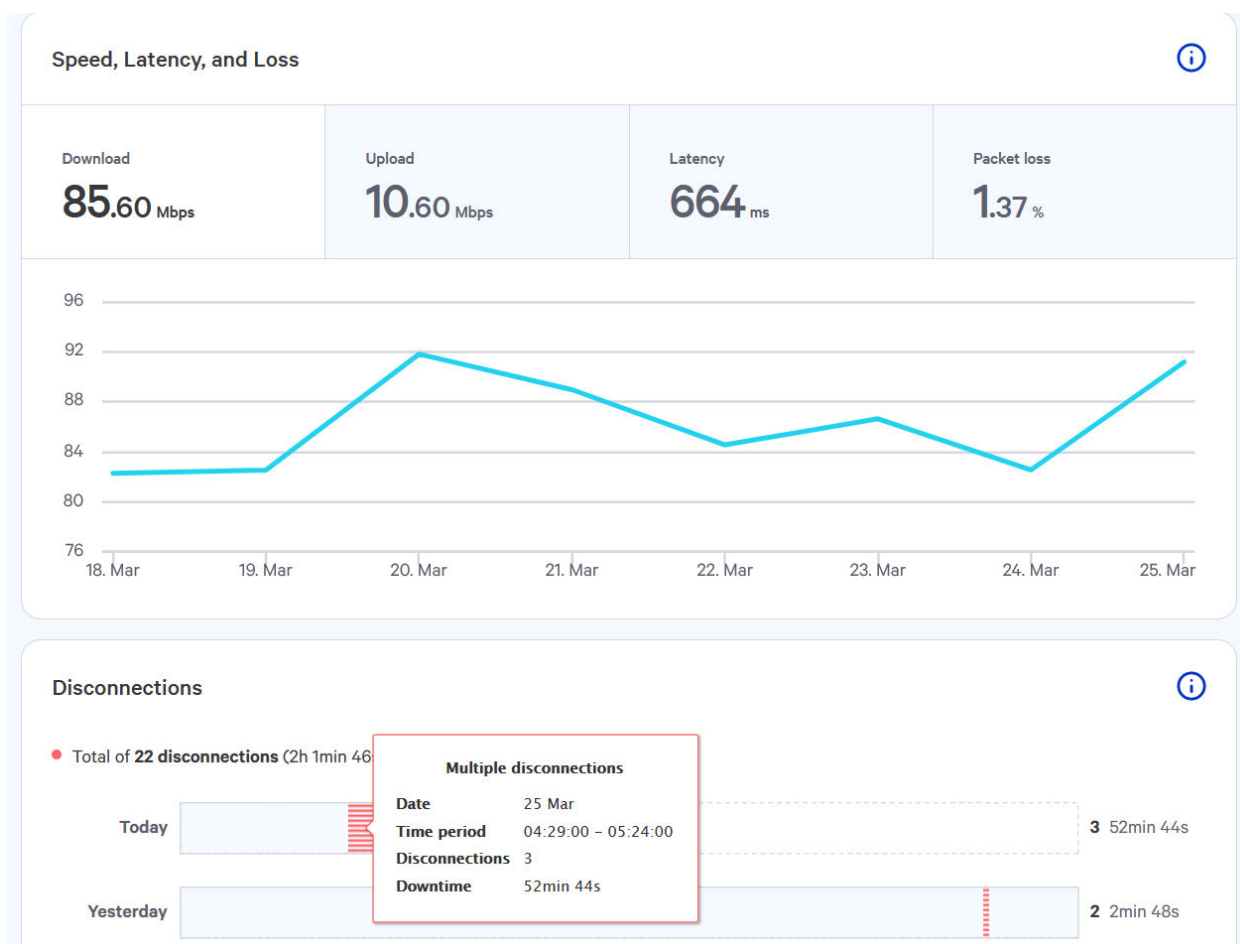


Figure A5: Sam Knows — Sky Muster Plus, 25 March 2023. 3 disconnections totaling 52 min 44 sec (04:29–05:24). NBN Co commissioned independent monitoring service.



Figure A6: Solar-powered 700 MHz 4G relay, Wahroonga Farm ridge (600 m from homestead; 39 km to Telstra tower). Uninterrupted through both rain events. 700 MHz is rain-transparent at all Australian rainfall intensities.

Event 2: 1 February 2026 — Peak Rainfall 75.6 mm/hr, Total ~90mm

A thunderstorm typical of summer conditions at Gloucester, with a high rainfall rate that persisted over two distinct peaks. The author's weather station recorded a peak rainfall rate of 75.6 mm/hr. The Bureau of Meteorology rainfall map for the event showed the property within the yellow-to-orange intensity zone; it is likely that all properties within that zone experienced comparable satellite service disruption simultaneously.

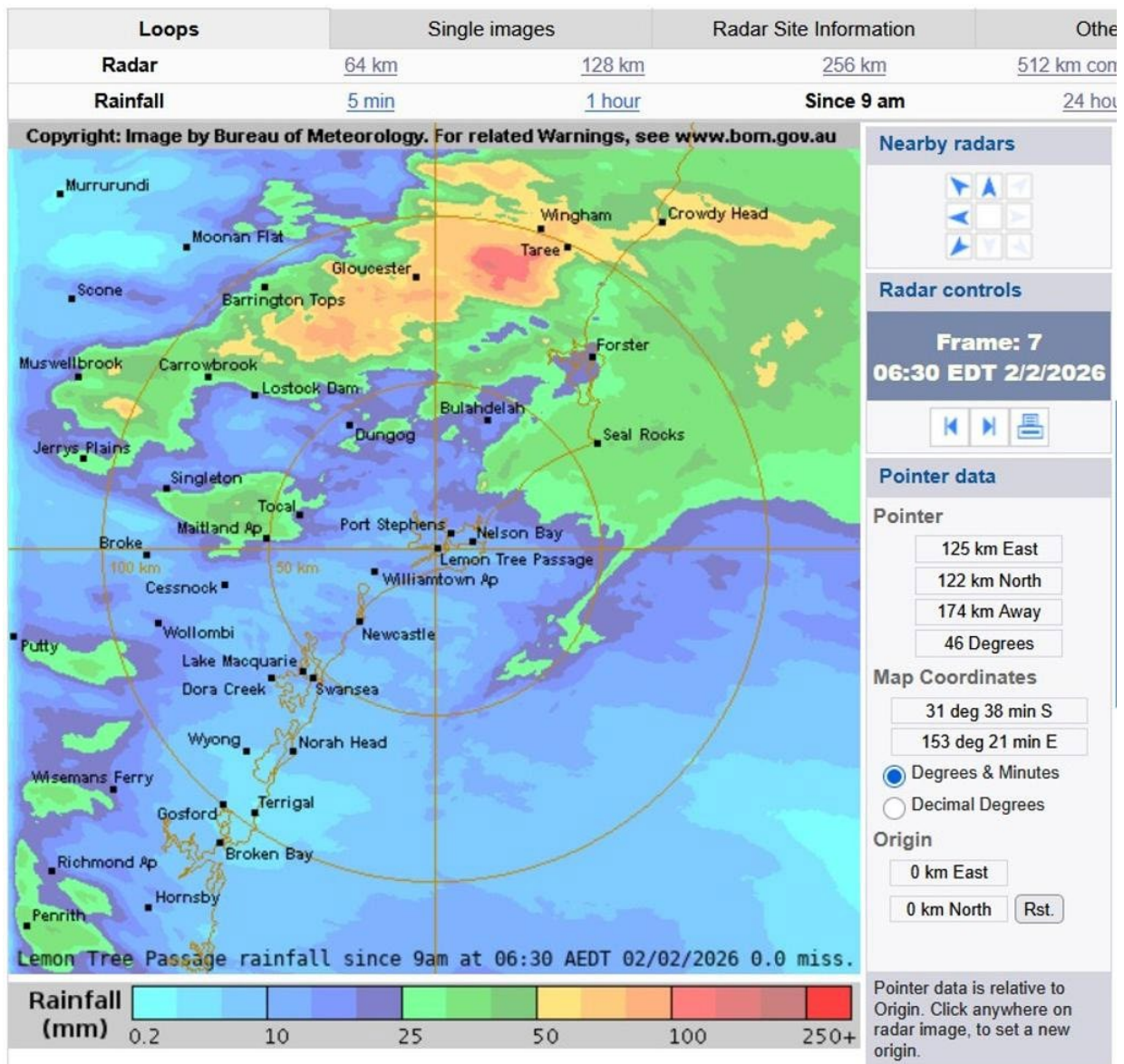


Figure A7: Bureau of Meteorology Newcastle radar, 2 February 2026, 06:30 AEDT. Gloucester is within the yellow/orange zone (50–100+ mm rainfall). Source: BoM radar archive.

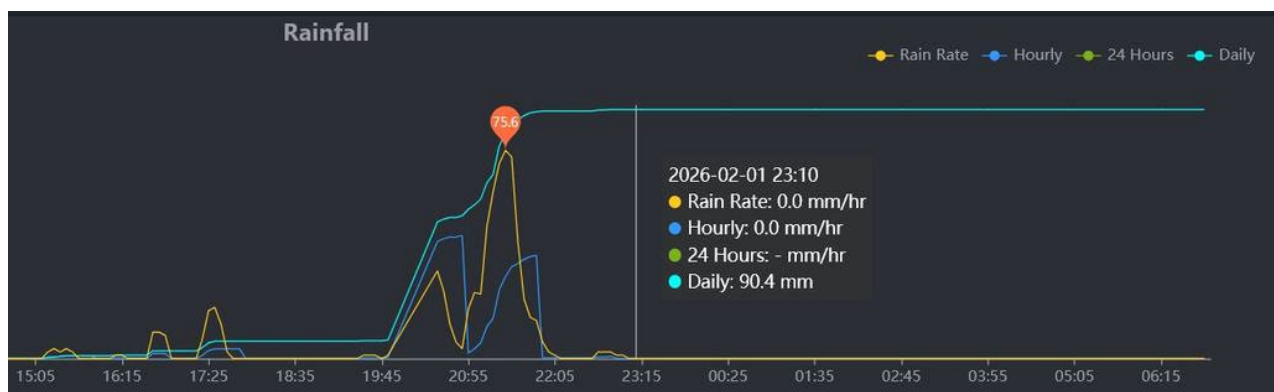


Figure A8: Weather station rainfall record, 1 February 2026. Peak rain rate 75.6 mm/hr; daily total 90.4 mm. Two distinct high-intensity peaks visible. Source: on-site Davis weather station.

Technology	Outage duration	Notes
Starlink (Ku-band LEOSat)	More than 1 hour total	Unusable for more than one hour. Sam Knows recorded 42 minutes of confirmed downtime; the service recovered briefly then failed again. Two distinct high-rainfall peaks produced two service interruption events.
Copper telephone (PSTN)	No outage	Uninterrupted throughout.

Disconnections



- Total of **31 disconnections** (47min 10s) registered in the past week



Figure A9: Sam Knows — Starlink, 1 February 2026. 21 disconnections on the event day totalling 42 min 1 sec. Service recovered briefly then failed again. The Starlink service was unusable for more than one hour total during the event.

Key observations across both events

1. Both Ku-band (Starlink) and Ka-band (Sky Muster) LEOSat services failed during rain events at intensities routinely experienced during the east coast storm season — rainfall rates of 75.6 and 87 mm/hr respectively. These intensities are unremarkable for the NSW mid-coast and are substantially below the peak intensities experienced in Darwin and Cairns during the tropical monsoon season, where Starlink Voice is being deployed as the primary USO replacement for HCRC services.
2. The copper PSTN service was uninterrupted during both events. The copper USO service continued to function throughout the precise meteorological conditions that caused the proposed USO replacement technology to fail. This is the direct empirical consequence of the frequency difference: exchange-powered copper at DC/voice frequencies versus consumer-premises-powered Ku/Ka-band satellite at frequencies where rainfall attenuation is severe.
3. The solar-powered 700 MHz 4G relay was uninterrupted in Event 1. This confirms that the frequency selection, not satellite geometry, is the determining factor: 700 MHz is rain-transparent at all intensities measured. A 4GFW service would have been unaffected. The rain fade problem is specific to the Ku/Ka-band technology selected for satellite voice, not to satellite communications per se.
4. In both events, the outage durations (30 minutes to more than one hour) would prevent a consumer from calling Triple Zero during an emergency. The ITU-R P.838 theoretical values in Section 6.5 predict exactly this outcome. These measurements confirm it occurs in practice, at a temperate NSW location, at rainfall intensities well below peak tropical values.

Measurement equipment: Pingplotter network monitoring software; Sam Knows broadband performance monitor (NBN Co programme); Davis Instruments automatic weather station; manual rain gauge; Bureau of Meteorology Newcastle radar archive. All data held by the author and available on request.

Appendix B: Scyne Voice Trial — Rainfall vs Service Availability Analysis

Independent analysis of survivorship bias in Starlink rain fade measurement | 50-site Scyne / Power BI dashboard extract

B.1 Executive Summary

This appendix presents an independent analysis of voice call service availability data extracted from the Scyne / Power BI trial dashboard, encompassing all 50 trial sites across Australia. The data reveals a systematic and statistically significant measurement bias affecting the reported Starlink service availability figures during rainfall events.

The core finding: Starlink Ka-band satellite terminals suffer rain fade — signal attenuation caused by atmospheric moisture — at moderate to heavy rainfall rates. When rain fade occurs, the terminal loses connectivity entirely. Because the trial's measurement methodology only records test data when a connection exists, failed connection periods are invisible to the measurement system. The reported Starlink availability figures therefore reflect only those periods when Starlink was already working, systematically excluding the worst-performing conditions. The aggregate Starlink availability figure of approximately 98% published by the Department is materially misleading as a representation of service reliability during rainfall — the conditions under which reliable voice communication is most operationally critical for remote and rural users.

B.2 Data Overview

Data was extracted from the Scyne / Power BI dashboard covering all 50 trial sites. The dataset records voice call service availability percentages and test counts, stratified by rainfall intensity in mm/hr increments, for three services: NBN Fixed Wireless (FW, mid-band ~3.5 GHz, negligible rain attenuation); NBN Sky Muster (SM, Ka-band geostationary ~20/30 GHz, susceptible to rain attenuation); and Starlink (SL, Ka/Ku-band LEO ~10.7–40 GHz, susceptible to rain attenuation). The dashboard records tests in 15-minute blocks only when the service connection is active. This design feature is the root cause of the survivorship bias documented below.

B.3 Aggregate Data — All 50 Sites Combined

The table below presents the aggregate dataset across all 50 trial sites. '—' = no data recorded. 'NO DATA' (highlighted) = the service recorded zero tests at a rate where a co-located service did record tests — this distinction is the analytical signature of complete link failure.

Rain mm/hr	FW Avail%	FW Tests	Sky Muster%	SM Tests	Starlink%	SL Tests
0	98.08	439,720	98.56	505,845	98.54	945,034
5	98.38	2,225	98.55	2,352	98.52	4,591
10	98.93	747	98.92	740	98.76	1,535
15	97.41	270	95.75	259	98.38	554
20	97.96	147	96.33	109	97.15	281
25	100.00	54	94.44	36	97.22	108
30	100.00	9	86.67	15	100.00	32
35	100.00	13	100.00	11	95.00	20
40	100.00	9	100.00	10	89.47	19
45	100.00	7	—	—	100.00	19
50	50.00	4	100.00	5	100.00	9
55	100.00	4	—	—	100.00	9
60	100.00	3	100.00	5	100.00	4
65	100.00	3	100.00	4	100.00	2
70	100.00	2	—	—	100.00	1
75	100.00	1	100.00	1	100.00	1
80	100.00	3	100.00	1	NO DATA	—

Rain mm/hr	FW Avail%	FW Tests	Sky Muster%	SM Tests	Starlink%	SL Tests
85	75.00	4	100.00	1	100.00	1
90+	—	—	—	—	100.00	various

B.4 Five Patterns Evidencing Survivorship Bias

Pattern 1 — Starlink Data Disappears at High Rainfall

At Fixed Wireless comparison sites (Humpty Doo, Casino, Mareeba, Woodford-D'Aguilar), NBN Fixed Wireless continues to record successful voice calls at rainfall rates of 45, 55, 60, 65, 70, 80, 85, 110, and 140 mm/hr. At these identical rainfall rates, Starlink records zero data points. Ka-band signals experience severe rain attenuation above approximately 25–30 mm/hr in tropical and subtropical Australian conditions. When the signal falls below the minimum threshold, the Starlink terminal loses link entirely. With no active connection, no call attempt is possible, and the measurement system records nothing — not a failed call, but no record at all.

Pattern 2 — Fixed Wireless is an Unaffected Control

The mid-band frequencies used by NBN Fixed Wireless (~3.5 GHz) experience negligible rain attenuation at all recorded rainfall rates, confirming Fixed Wireless as an ideal control. Fixed Wireless maintains availability at or near 100% from 0 to 190 mm/hr. Wherever Fixed Wireless has a data point and Starlink does not, Starlink was offline during those identical weather conditions.

Pattern 3 — Progressive Degradation Before Complete Data Loss

At Casino (NSW), Starlink shows textbook rain fade: availability falls from 95.65% at 10 mm/hr, to 88.24% at 15 mm/hr, to 83.33% at 25 mm/hr — then no data at all above 25 mm/hr while Fixed Wireless records successful calls at 45 and 70 mm/hr. Degraded performance followed by complete link failure is the expected physics-based pattern.

Pattern 4 — Test Count Asymmetry Quantifies the Gap

At baseline (0 mm/hr), all services record comparable test counts, confirming equivalent measurement periods. As rainfall increases, the Starlink test count drops disproportionately relative to co-located services. At Casino: both services record ~22,800 tests at 0 mm/hr; above 25 mm/hr only Fixed Wireless has any data. Both services were co-located and exposed to the same weather events — the gap in test counts is the quantitative measure of Starlink's absence during those periods.

Pattern 5 — Tropical Zone 1 Sites Show the Greatest Impact

Tropical Zone 1 (Hot Humid) sites — Alligator (NT), Humpty Doo (NT), Katherine (NT), Mareeba (QLD), Croydon-Etheridge (QLD), Ashburton (WA) — experience higher rainfall frequency and intensity than southern sites. The combination magnifies rain fade impact. At Ashburton (Onslow, WA), a distinct severe event row shows Sky Muster at 7.04% availability (71 tests) and Starlink at only 1.16% (86 tests) — near-total failure of both Ka-band services during a severe weather event.

B.5 Per-Site Data — Key Northern and Tropical Sites

Rows highlighted in orange indicate Starlink recorded NO DATA at a rainfall rate where the co-located service recorded successful tests.

Humpty Doo (NT) — Zone 1 Hot Humid | Fixed Wireless vs Starlink

Above 50 mm/hr, Fixed Wireless continued recording at 55, 60, 65, 80, 110 and 140 mm/hr. Starlink recorded zero data above 50 mm/hr.

Rain mm/hr	FW Avail%	FW Tests	Starlink%	SL Tests
0	99.63	18,880	99.29	18,640
5	99.15	118	100.00	119
10	100.00	45	100.00	41
15	100.00	14	100.00	18
20	100.00	17	94.44	18

Rain mm/hr	FW Avail%	FW Tests	Starlink%	SL Tests
25	100.00	8	100.00	6
30	100.00	2	100.00	3
35	100.00	5	100.00	2
40	100.00	2	100.00	1
45	100.00	2	100.00	1
50	50.00	2	100.00	1
55	100.00	1	NO DATA	—
60	100.00	2	NO DATA	—
65	100.00	1	NO DATA	—
80	100.00	2	NO DATA	—
110	100.00	1	NO DATA	—
140	100.00	1	NO DATA	—

Casino (NSW) | Fixed Wireless vs Starlink

Starlink availability degrades progressively from 95.65% at 10 mm/hr to 83.33% at 25 mm/hr, then disappears entirely above 25 mm/hr while Fixed Wireless records data at 45 and 70 mm/hr.

Rain mm/hr	FW Avail%	FW Tests	Starlink%	SL Tests
0	97.76	22,790	96.89	22,849
5	98.18	220	98.14	215
10	100.00	64	95.65	69
15	100.00	24	88.24	17
20	100.00	17	92.86	14
25	100.00	4	83.33	6
45	100.00	2	NO DATA	—
70	100.00	1	NO DATA	—

Mareeba (QLD) — Zone 1 Hot Humid | Fixed Wireless vs Starlink

Fixed Wireless records data at 35, 40 and 80 mm/hr while Starlink has no data at those rates.

Rain mm/hr	FW Avail%	FW Tests	Starlink%	SL Tests
0	96.00	17,339	96.37	17,333
5	86.84	76	86.32	95
10	90.00	20	93.33	15
15	87.50	8	90.91	11
20	100.00	9	81.25	16
25	100.00	8	87.50	8
35	100.00	2	NO DATA	—
40	100.00	1	NO DATA	—
80	100.00	1	NO DATA	—

Alligator (NT) — Zone 1 Hot Humid | Sky Muster vs Starlink

Sky Muster records data at 60 mm/hr while Starlink has no data. At 25 mm/hr, Starlink availability drops to 66.67% — the lowest recorded availability at this site.

Rain mm/hr	Sky Muster%	SM Tests	Starlink%	SL Tests
0	99.78	23,217	99.67	22,909
5	98.63	146	99.25	134
10	98.25	57	100.00	54
15	94.74	19	100.00	15
20	100.00	5	100.00	5
25	100.00	1	66.67	3
60	100.00	1	NO DATA	—

Croydon-Etheridge (QLD) — Georgetown, Zone 1 Hot Humid | Sky Muster vs Starlink

Sky Muster records data at 35 and 40 mm/hr while Starlink records zero tests at these rates.

Rain mm/hr	Sky Muster%	SM Tests	Starlink%	SL Tests
0	99.22	20,935	99.17	20,873
5	100.00	78	100.00	83
10	100.00	42	100.00	51
15	100.00	20	100.00	24
20	100.00	9	93.75	16
25	100.00	3	100.00	9
35	100.00	3	NO DATA	—
40	100.00	1	NO DATA	—

Woodford-D'Aguilar (QLD) | Fixed Wireless vs Starlink

Fixed Wireless records data at 35 and 85 mm/hr; Starlink has zero data at both rates.

Rain mm/hr	FW Avail%	FW Tests	Starlink%	SL Tests
0	99.20	8,017	99.48	3,813
5	96.97	66	100.00	51
10	96.67	30	100.00	15
15	92.31	13	100.00	6
20	100.00	10	100.00	7
25	100.00	3	100.00	1
35	100.00	1	NO DATA	—
85	100.00	1	NO DATA	—

Ashburton (WA) — Onslow, Zone 1 Hot Humid | Sky Muster vs Starlink

A severe event row shows Sky Muster at 7.04% (71 tests) and Starlink at 1.16% (86 tests) — near-total failure of both Ka-band services.

Rain mm/hr	Sky Muster%	SM Tests	Starlink%	SL Tests
0	99.46	19,751	99.28	19,418
5	98.08	52	97.92	48
10	100.00	18	95.83	24
Severe event	7.04%	71 tests	1.16%	86 tests

B.6 Conclusions and Implications

Core finding

The Scyne trial's measurement methodology — recording data only when an active connection exists — creates a structural survivorship bias that systematically inflates reported Starlink availability during rainfall. The true availability of Starlink during moderate to heavy rainfall events cannot be determined from this dataset because the worst-performing periods are entirely absent from the data.

Operational implication

The conditions under which the measurement system fails to capture Starlink's performance — moderate to heavy rain — are precisely the conditions under which reliable voice communication is most operationally critical for remote and rural Australian users, particularly for emergency services, agricultural operations, and vulnerable households. A service that is unavailable during heavy rain but measured only during the periods it is available will always report near-100% availability. This is not a feature of the service; it is a feature of the measurement methodology.

Recommendations arising

(1) The Department should commission a revised analysis accounting for connection-down periods as availability failures, not as gaps in the measurement record. (2) Tropical Zone 1 sites should be separately reported, as the rain fade effect is materially more severe in these areas than aggregate figures suggest. (3) The trial should report the number of measurement periods where no test could be conducted due to connectivity failure, alongside current test count figures. (4) Any policy instrument designating LEOSat as USO-equivalent for residential fixed voice should include explicit caveats regarding this bias and require the supplementary measurement methodology described in Recommendation 12 of this submission.

Data source: Scyne / Power BI Dashboard (50-site extract). This analysis is based on data extracted from the publicly accessible trial dashboard and represents a secondary analysis of that data. Patterns identified are consistent and replicated across multiple sites and technology comparisons. A definitive quantification of true Starlink availability during rainfall would require access to the underlying connection logs, including failed connection periods. All analysis available on request.