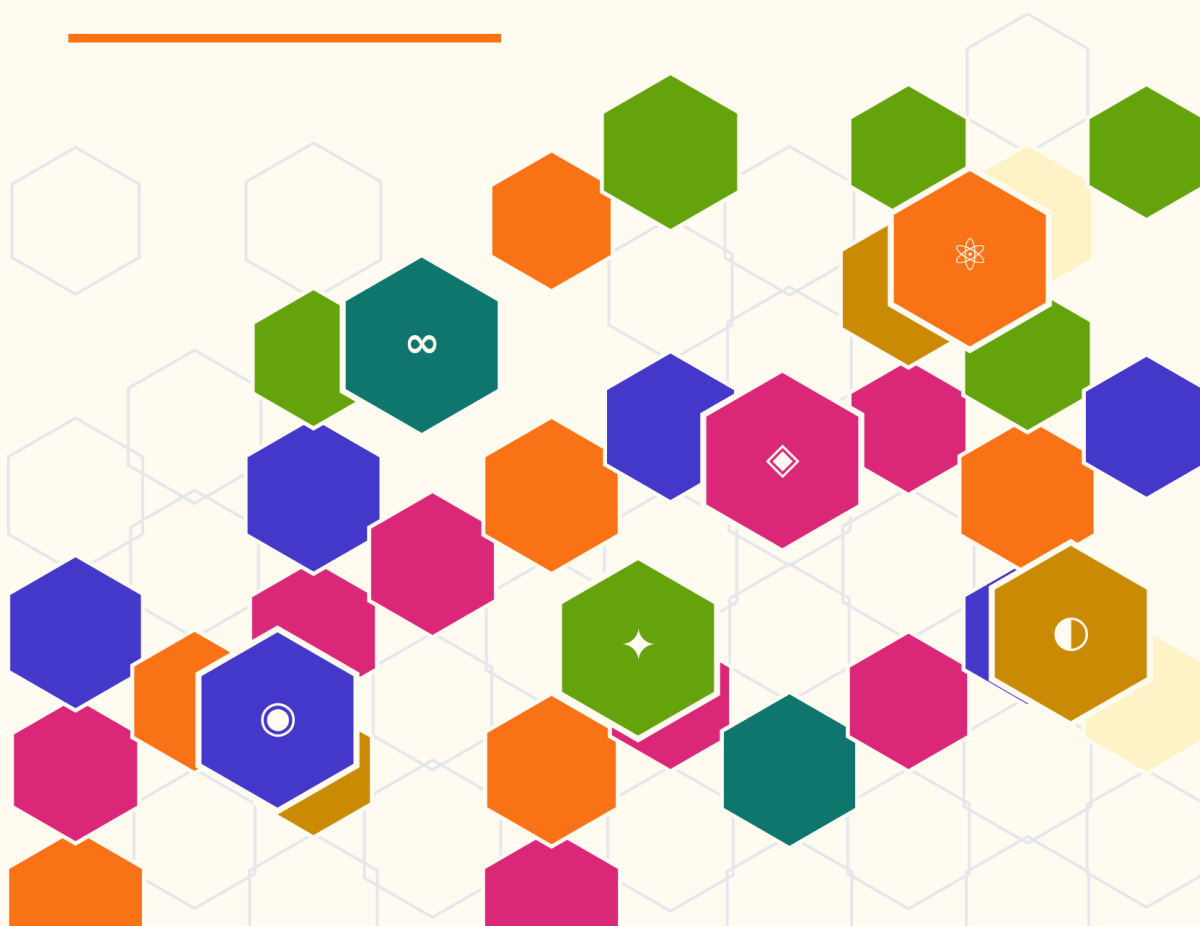


ASI@CONNECT

COMPENDIUM

OF NATIONAL RESEARCH AND
EDUCATION NETWORKS
IN ASIA-PACIFIC

2025



01 August 2026 - Fourth Edition

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Introduction

The Asi@Connect Compendium of National Research and Education Networks 2025 provides a structured reference on the organisation, funding, infrastructure and services of NRENs across the Asia-Pacific TEIN community. It is organised by theme: organisation, funding and governance; connected users; network; services; advanced and AI-enabled services; research engagement; network traffic; and a look at where the community is heading.

The data is drawn from the Asi@Connect NREN survey covering three waves — 2018, 2020 and 2025. This edition focuses on the NRENs that responded in 2025: each chapter analyses the 2025 respondents for that topic, with earlier waves used to draw trend lines where the same NRENs reported in all three years. Where an NREN did not report a metric, this is shown as a dash (–) rather than zero.

This report is built around NREN spotlights: each chapter invites named NRENs that the data identifies as distinctive to contribute a short first-person account of their experience. Those invitation boxes appear inline. Per-NREN profile cards appear in the Appendix as a one-glance reference.

Scope: This edition draws on 16 survey areas across 17 to 21 NRENs depending on the topic. The Services and Advanced Services chapters are based on dual-wave (2020 + 2025) inventories that compare the same survey instrument across both years, allowing growth and decline to be read directly.

Executive Summary

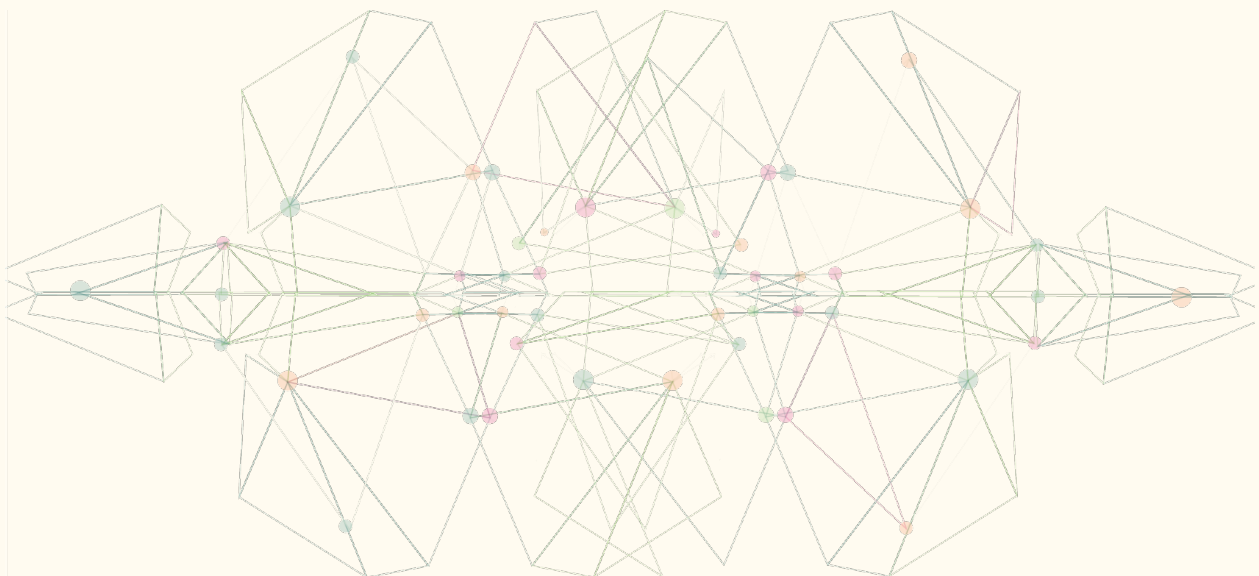
32%

Growth in advanced service implementations from 2020 to 2025

The Asi@Connect NREN community in 2025 is a maturing collective shaped by widening service portfolios, growing technical depth, and uneven but visible progress on governance and sustainability. The headline findings of this edition:

- Staffing among 2025 respondents shows wide variation — from small teams of fewer than ten to networks employing well over two hundred. Across the 15 NRENs with comparable 2018 baselines, total community staffing grew +146% over the seven-year period, with DrukREN's 44× expansion (3 → 131 staff) the most striking transformation in the cohort.
- Government funding remains the backbone of NREN revenue, but client-institution revenue has emerged as a substantial second pillar in 2025, signalling a shift toward more sustainable hybrid and self-financed models.
- Connected institutions continue to broaden: across the consistent 15-NREN panel, non-school connections grew roughly 21% (3,252 → 3,920) between 2018 and 2025, led by a nearly five-fold rise in research-institute links (23 → 110) and steady growth in government-organisation connections (183 → 272). ThaiREN's school-system connections (~10,000) dominate the schools segment.

- Highest delivered bandwidth has crossed the 100 Gbps threshold at REANNZ, SingAREN and ThaiREN; CERNET and MAFFIN reach 40 Gbps; and several others now operate at 10 Gbps — placing the community at a credible regional frontier.
- Core services (IPv4, network monitoring, troubleshooting, IPv6, eduroam) remain near-universal in 2025, while identity federation and security services show clear growth from 2020. eduGAIN connectivity rose from 5 to 7 NRENs, each of which also operates a National Federation (a prerequisite for eduGAIN), so operational National Federations grew in step from 5 to 7. The community's Identity Provider population nearly doubled (620 → 1,219) and Service Providers grew similarly (138 → 273).
- Advanced services tell the most dynamic story: implementation rose by 32% from 2020 (82 → 108), with a substantial planned pipeline of 46 additional implementations. REANNZ, reporting for the first time in 2025, already lists eleven implemented advanced services — among the highest in the community.
- AI is now visible in the community: 16 of 19 reporting NRENs use AI in some capacity, with MAFFIN, NREN (Nepal), PREGINET and SingAREN reporting the most intensive adoption (50–100% of activities).
- Research engagement spans the region: 20 economies took part across the eight APAN meetings tracked, with participation peaking at 357 delegates (APAN55). Japan leads cumulative attendance (341, lifted by hosting APAN 59), followed by Thailand (256, lifted by hosting APAN 57) and South Korea (210).
- Network traffic has scaled sharply: total community traffic reached 30,658 TB (~31 PB) in 2025 — nearly triple the 2018 level of 10,386 TB — with JAPAN and CERNET the largest carriers, at roughly 16,400 and 4,800 TB.



ASI@CONNECT COMPENDIUM OF NRENs • 2025

CHAPTER 1

Organisation, Funding and Governance

How NRENs are staffed, funded and governed — and what the data reveals about the maturation of the community.

IN THIS CHAPTER

- 1.1** Staffing
- 1.2** Workforce Gender Composition
- 1.3** Funding Models & Revenue
- 1.4** Standards and Policies

859

community staff
reported in 2025

+146%

staff growth
since 2018

1. Organisation, Funding and Governance

The Organisation chapter examines how NRENs are staffed, how they are funded, and how their governance frameworks are documented. The community remains highly diverse — large national networks alongside young, lean organisations — and 2025 marks visible movement toward more sustainable financing models alongside continued government dependence.

1.1 Staffing

Seventeen NRENs reported 2025 staffing, totalling 859 staff across the community. The reporting cohort spans an order of magnitude in scale — from compact teams of 5–10 people up to AARnet's 267 — and three survey waves of data make the trajectory of each NREN visible. Across the 15 NRENs with comparable 2018 baseline data, total community staffing has grown by 146% over the seven years, with DrukREN's 44× expansion (3 → 131 staff) the headline transformation of the cohort. CERNET and NKN, which operate at a different scale from the rest, do not report into the staff series. The chart below traces each NREN's three-wave journey on a logarithmic axis: a slate arrow for the 2018 → 2020 segment, a sage arrow for 2020 → 2025.



The Asi@Connect community in 2025: seventeen NRENs, scaling at different speeds

Reported staffing across three survey waves (2018 → 2020 → 2025). Each row shows one NREN's growth journey. Slate arrows trace the 2018→2020 period; sage arrows the 2020→2025 period.

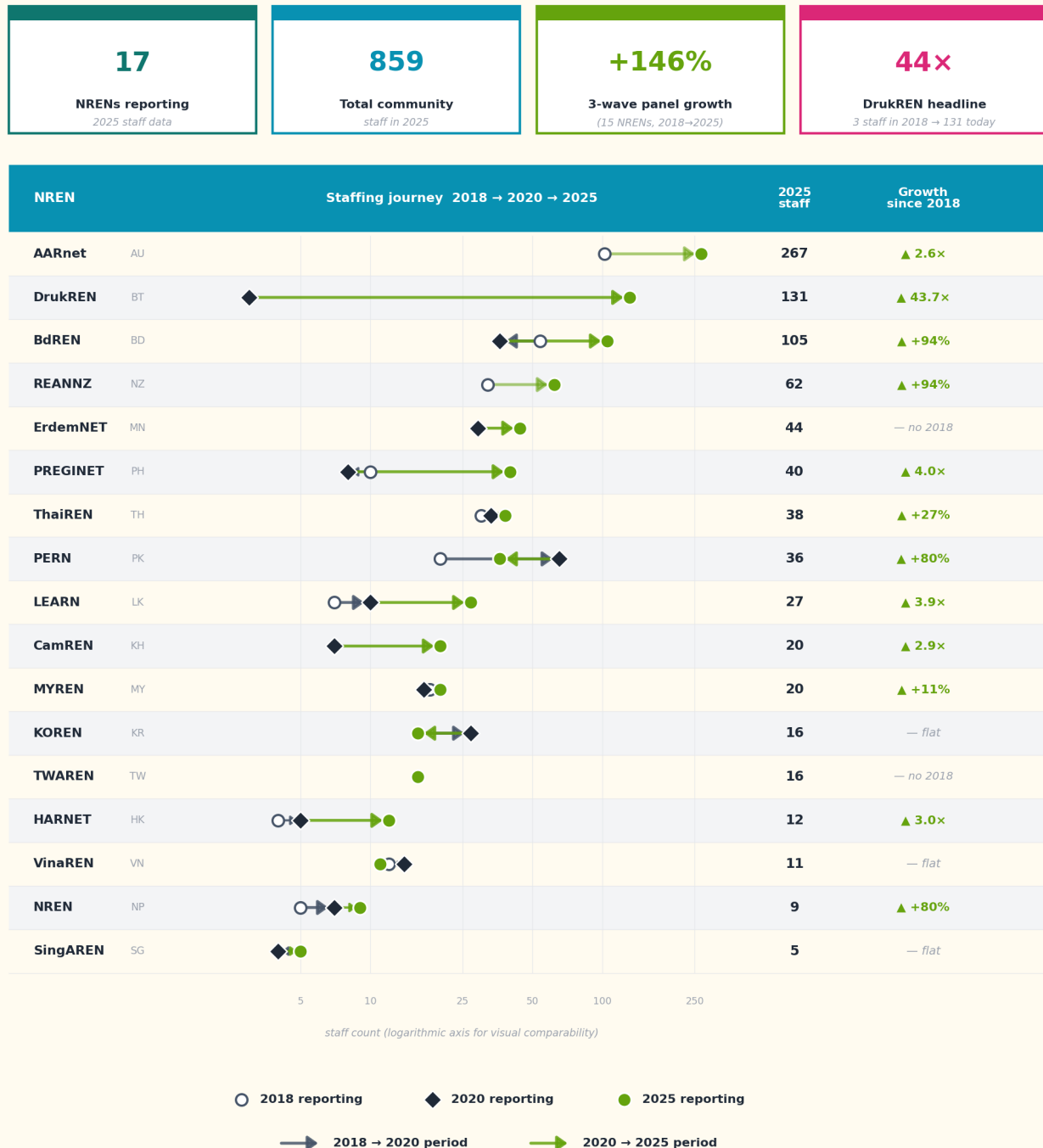


Figure 1.1. NREN staffing journey 2018 → 2020 → 2025, sorted by 2025 size. Two-segment arrows show period-by-period evolution; the right column gives growth multipliers since 2018.

Two non-monotonic stories are worth highlighting. PERN reports 20 → 65 → 36, a sharp rise then a partial pullback that may reflect both organisational restructuring and post-pandemic re-counting. KOREN shows 16 → 27 → 16, a similar pattern at smaller scale. BdREN traces the opposite shape — 54 → 36 → 105 — a dip in 2020, then a near-tripling off that low to 105 by

2025. These oscillations matter: they remind the reader that even single-number 2025 snapshots conceal substantial multi-year volatility for some NRENs.

NREN SPOTLIGHT > Scaling a national NREN team > DrukREN (Bhutan)

Since its establishment in 2018, DrukREN has undergone an extraordinary transformation, growing from a small team of dedicated professionals to an organisation of more than 100 staff by 2025. DrukREN is operated and managed by the Government Networks Division, Department of Digital Infrastructure, Government Technology Agency. This growth represents one of the most significant organisational expansions within the Asi@Connect community and reflects Bhutan's commitment to building a robust digital ecosystem for research and education. Today, DrukREN is operated and managed by the Government Networks Division under the Department of Digital Infrastructure, Government Technology (GovTech) Agency. Besides DrukREN, the Government Networks Division also operates and manages the Government Network (GovNet) infrastructure connecting around 1500+ government agencies. The main factor in DrukREN's ability to scale its workforce so dramatically was the strategic capitalization of manpower across government mandates. The 100+ staff members do not work in isolation; instead, they are cross-functional. They manage and support both government agencies connected to the broader GovNet infrastructure and individual DrukREN members. This rapid growth directly reflects Bhutan's commitment to building a robust digital ecosystem for research, education, and public administration. DrukREN's journey has been guided by a clear vision to provide secure, reliable, and high-speed connectivity and digital services to Bhutan's research and education institutions. Over the years, the organisation has expanded its national network and strengthened its operational and technical capabilities to provide high-speed connectivity to support collaboration, teaching, learning, and research. The Royal Government of Bhutan has been instrumental in this journey. Through sustained policy support, strategic guidance, and investment, the Government recognised the importance of a National Research and Education Network (NREN) as a critical enabler of quality education, innovation, and research. This commitment has enabled DrukREN to broaden its mandate, strengthen organisational capacity, and extend services to universities, colleges, schools, and research institutions across the country. International partnerships have also played a pivotal role in DrukREN's success. Through the Asi@Connect programme and collaboration with NSRC, TEIN*CC, and National Knowledge Network (NKN), other regional and global NREN partners, DrukREN has benefited from technical assistance, capacity-building programmes, knowledge exchange, and collaborative projects. These partnerships have strengthened staff expertise, improved organisational governance, introduced international best practices, and enabled the deployment of modern network technologies that meet global standards. A key lesson from DrukREN's experience is that sustainable growth requires more than expanding infrastructure. Equal attention must be given to developing human capacity, strengthening governance, fostering strategic partnerships, and ensuring financial and operational sustainability. Emerging NRENs can benefit from adopting a phased approach to growth, aligning organisational development with national priorities while remaining responsive to the evolving needs of the research and education community.

1.2 Workforce Gender Composition

29%

Female across reporting NRENs in 2025

Where NRENs reported a male/female breakdown for 2025, women comprise approximately 29% of the combined workforce — and the distribution varies notably across the community. ErdemNET (Mongolia) sits at exactly 50% gender parity, with DrukREN, ThaiREN, LEARN and KOREN in the 44–47% range. At the other end, BdREN and CamREN report under 10%. The pattern broadly mirrors global research-networking benchmarks and reinforces the relevance of the region's capacity-building initiatives aimed at women network engineers.

Workforce Gender Composition per NREN, 2025

NRENs reporting male/female breakdown (n=17); community average shown top right.

29%

Female across reporting NRENs

NREN	Country	Total staff	% Female	Gender mix (Female / Male)
AARnet	Australia	267	24%	
DrukREN	Bhutan	131	47%	
BdREN	Bangladesh	105	4%	
REANNZ	New Zealand	62	29%	
ErdemNET	Mongolia	44	50%	
PREGINET	Philippines	40	22%	
ThaiREN	Thailand	38	45%	
PERN	Pakistan	36	14%	
LEARN	Sri Lanka	27	44%	
CamREN	Cambodia	20	5%	
MYREN	Malaysia	20	35%	
KOREN	South Korea	16	44%	
TWAREN	Chinese Taipei	16	31%	
HARNET	Hong Kong	12	33%	
VinaREN	Vietnam	11	18%	
NREN	Nepal	9	22%	
SingAREN	Singapore	5	80%	

Female
 Male
 | White tick = 50% parity

Note: CERNET (China) and NKN (India) excluded as scale outliers. NRENs reporting only total staff (without M/F split) not shown.

Figure 1.2. Workforce gender composition per NREN, 2025. CERNET and NKN excluded as scale outliers; NRENs not reporting an M/F split not shown.

NREN SPOTLIGHT > Women in the NREN workforce > DrukREN (Bhutan)

DrukREN is committed to fostering an inclusive workplace where women have equal opportunities to contribute and grow in both technical and non-technical roles. Recruitment is based on merit, with an emphasis on creating a supportive and inclusive work environment that encourages women to pursue careers in ICT and research networking. To support retention and professional growth, DrukREN invests in continuous learning through training, mentorship, and participation in regional programmes offered by Asi@Connect, NSRC, TEIN*CC and other partners. These initiatives have enabled women staff to strengthen their technical skills, build professional networks, and take on leadership roles. An important lesson for other NRENs is that gender inclusion should be embedded in organisational culture rather than treated as a standalone initiative. Providing equal access to training, leadership opportunities, and regional collaboration can help attract, develop, and retain talented women across all roles.

NREN SPOTLIGHT > Women in the NREN workforce > ErdemNET (Mongolia)

At ErdemNET, women make up 50% of our total workforce — the highest level of gender parity among the reporting NRENs in the region, against a community average of roughly 29%. We are proud that this balance holds across both technical functions (network engineering, NOC/operations, systems administration) and non-technical functions (management, finance, project coordination, and user support).

For us, this balance is not the product of a recent initiative but a reflection of long-standing cultural norms. In Mongolia's traditional nomadic society, women have historically shared responsibility for managing the household economy and community affairs, and have held positions of genuine authority and administration throughout the country's history. Gender equality is therefore deeply rooted in Mongolian culture, and it is natural that this heritage is reflected in our workforce today.

What has worked for us:

- Skills- and merit-based recruitment. We hire and promote strictly on capability, and we make a deliberate effort to keep shortlists balanced so qualified women are considered for every technical opening.
- Investing in technical training. Women engineers are given equal access to certifications, hands-on labs, and regional capacity-building opportunities so they can grow into senior technical roles.
- A supportive, flexible workplace. Family-friendly and flexible working arrangements help us retain experienced staff through different life stages, which has been key to retention.
- Visible role models and mentoring. Women in senior and technical positions mentor newer staff, which strengthens both recruitment appeal and retention.

What others could adapt: Our experience suggests parity is achievable for a small NREN without a large formal programme — by treating balance as a hiring and promotion discipline, guaranteeing women equal access to technical development, and offering a flexible workplace. We would welcome a regional peer-exchange or mentoring network for women network engineers and are happy to share our practices with the community.

NREN SPOTLIGHT > Women in the NREN workforce > LEARN (Sri Lanka)

Contributed by: *Wathsala Dayananda, Operations Manager, LEARN*

LEARN's commitment to gender equality is deeply integral to our daily operations, as reflected in the 2025 Compendium, where women comprise 44% of our 27-member workforce. This benchmark places LEARN in the top-tier bracket for regional gender parity, standing significantly ahead of the 29% community-wide average.

We achieve this by operating under a strict non-discriminatory policy, ensuring that no technical or administrative role is defined by gender. This inclusivity begins at the recruitment phase, where our advertisements consciously feature diverse imagery to challenge legacy stereotypes. Once on board, LEARN actively promotes a flexible, hybrid work environment that champions healthy work-life balance, enabling our female professionals to thrive within an equitable workplace culture.

Crucially, we recognise that targeted capacity-building initiatives serve as a vital catalyst for cultivating women network engineers and technical leaders. Dedicated frameworks like the BeLISAC project under Asi@Connect have provided essential pathways for technical growth. Going beyond our immediate staff, we actively embed these principles into our regional leadership. In initiatives such as AP-GAINED (Asia Pacific - Generative AI for NREN Empowerment and Development), equal technical opportunities and visibility are intentionally provided to female participants employed across the broader APAC community. By aligning progressive workplace infrastructure with proactive regional capacity building, LEARN mirrors proudly and advances global research-networking benchmarks for gender diversity

1.3 Funding Models and Revenue Composition

Looking across the three survey waves at the consistent panel of 13 NRENs that reported a revenue breakdown in 2018, 2020 and 2025, two trends stand out. Government funding has stayed close to 60% of community revenue throughout — 61% in 2018 and 2020, easing to 57% in 2025. The most striking change is the growth of Client Institution funding — from 23% in 2018 to 33% in 2020 and 35% in 2025 — pointing to a maturing community moving steadily beyond pure grant dependence. Donation revenue, first tracked in 2020, has also emerged as a small but growing stream (3% in 2020 to 7% by 2025), while the residual 'Others' category has fallen sharply — from 16% in 2018 to 3% in 2020 and under 1% in 2025 — as previously-bundled sources have been reclassified into the named categories. This community-wide Others → Client shift is driven by four NRENs in particular: NREN (Nepal), BdREN, HARNET and LEARN — each of which reclassified revenue previously bundled under Others into the properly-tracked Client Institutions category as their financial reporting matured.

Revenue Composition Trend, 2018 → 2020 → 2025

Concentric rings: 2018 inner, 2020 middle, 2025 outer. 13 NRENs reporting in all three waves.

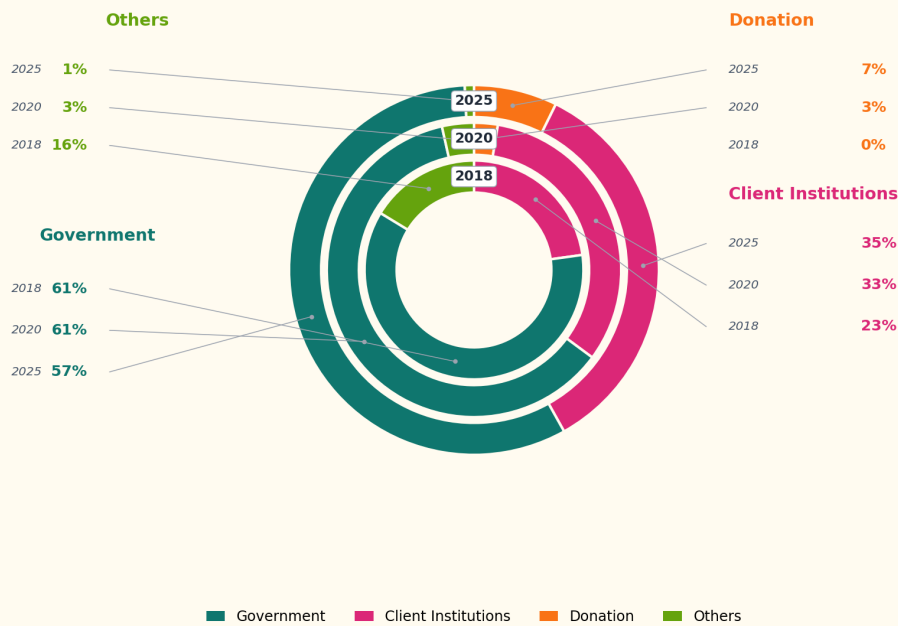


Figure 1.3. Revenue composition trend, 2018 → 2020 → 2025. Concentric rings show the same 13-NREN consistent panel across three waves; 2018 inner ring, 2025 outer ring. Donation was not a tracked category in 2018 and is shown as 0%.

The per-NREN view for 2025, shown separately for capital and operating expenditure, reveals considerable variation across the community. Most NRENs report the same funding mix for both CAPEX and OPEX — but four (NREN/Nepal, REANNZ, IDREN, PERN) report different splits, indicating that different funding sources cover capital projects versus day-to-day operations. Four NRENs are fully Client-funded on both sides: BdREN, CERNET, HARNET and LEARN — the strict self-sufficient cluster. REANNZ is fully Client-funded on the CAPEX side but Government and Others on the OPEX side, an interesting hybrid model worth examining. At the other end, nine NRENs report 100% Government funding for both CAPEX and OPEX. The presence of a self-sufficient cluster points to a maturing community moving steadily beyond grant dependence.

Revenue Composition by NREN, 2025 — CAPEX vs OPEX (n=18)

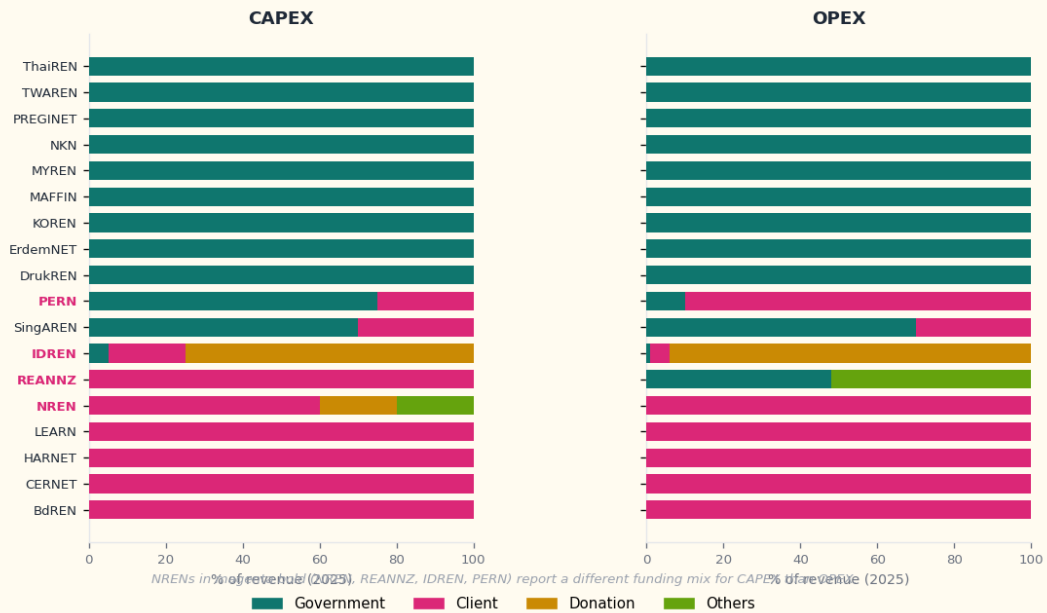


Figure 1.4. Per-NREN 2025 revenue composition, shown separately for CAPEX and OPEX. NRENs in magenta bold (NREN/Nepal, REANNZ, IDREN, PERN) report a different funding mix for the two sides. Sorted by CAPEX government share.

NREN SPOTLIGHT > Fully Client-funded NRENs > BdREN (Bangladesh)

Contributed by: Dr. Mohammad Farooq Ali Tarafder (FCMA, ACS), Chief Finance Officer, BdREN

BdREN's Self-Financed Model: Sustaining Both CAPEX and OPEX

Few research and education networks worldwide can claim what BdREN has achieved: complete self-financing of both capital and operating expenditures. The journey from FY 2019-20 to FY 2024-25 tells a remarkable turnaround story — total revenue grew from BDT 20.00 crore to BDT 44.86 crore, transforming a net loss of BDT 10.50 crore into a net income of BDT 2.69 crore.

BdREN's Financial Growth

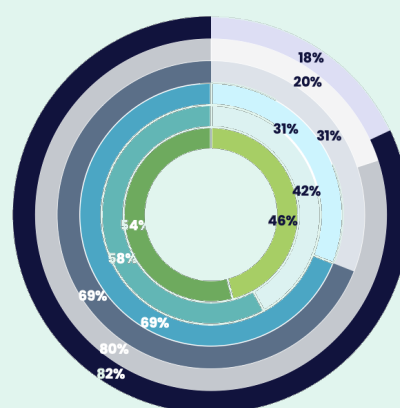
From FY 2019-20 to FY 2024-25



More telling is the quality of this growth. Operating income — earned from services rather than external support — rose from 46% to 82% of total income, evidence that BdREN's sustainability is built on value delivered, not subsidies received.

Percentage Share of Operating and non-Operating Income
Over the years from FY 2019-20 to FY 2024-25

Several strategic initiatives drove this transformation. Usage-based packages for public universities encouraged maximum utilization rather than rationing, multiplying total traffic. Service availability of 99.95% — ensured through secondary and tertiary backups — persuaded universities to consolidate their entire connectivity with BdREN, terminating links with other ISPs.



Legends:

Financial Year



Operating



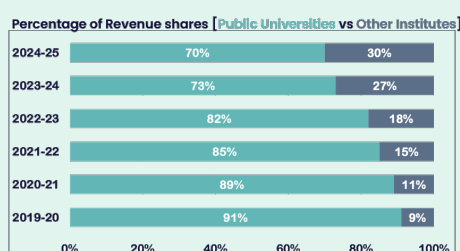
Non-Operating

Horizontal expansion brought private universities into the fold, while the service portfolio grew to include in-house applications, licensed tools such as Zoom and Grammarly, AI-enabled services, e-books, e-journals, virtualization, and storage — supporting the complete digital transformation of universities.

Free Zoom licenses during the pandemic built enduring community confidence, while software development for local and overseas education markets and support for campus network, video conferencing, surveillance, and digital-service projects opened further income streams.

Crucially, growth has come with diversification. Revenue dependence on public universities declined from 91% to 70%, with other institutes now contributing 30% — insulating BdREN from single-segment risk and strengthening long-term resilience.

Distribution of Revenue earning from Public Universities and other Institutes



Public Universities
This Revenue includes the income generated from all the public universities in Bangladesh

Other Institutes
This Revenue includes income generated from any institutes other than the public universities

The above Data vindicates the diminishing dependence on the revenues from Public Universities which is a good sign of attaining resilience.

Self-financed, service-driven, and increasingly diversified, BdREN's financial model stands as a blueprint for sustainable research and education networks across the developing world.

NREN SPOTLIGHT > Fully Client-funded NRENs > CERNET (China)

The funding model of CERNET is primarily sustained by membership fees from its member universities to cover the construction and operation of its backbone network, alongside additional research project grants from national and local governments. Focused on higher education communities, CERNET offers comprehensive services including high-performance

networking, cybersecurity, cloud platforms, etc. And the resulting service revenue further empowers CERNET to continuously advance technological and service innovation.

NREN SPOTLIGHT > Fully Client-funded NRENs > HARNET (Hong Kong)

Contributed by: *Mr. David Choi, Technical Consultant (JUCC), HARNET*

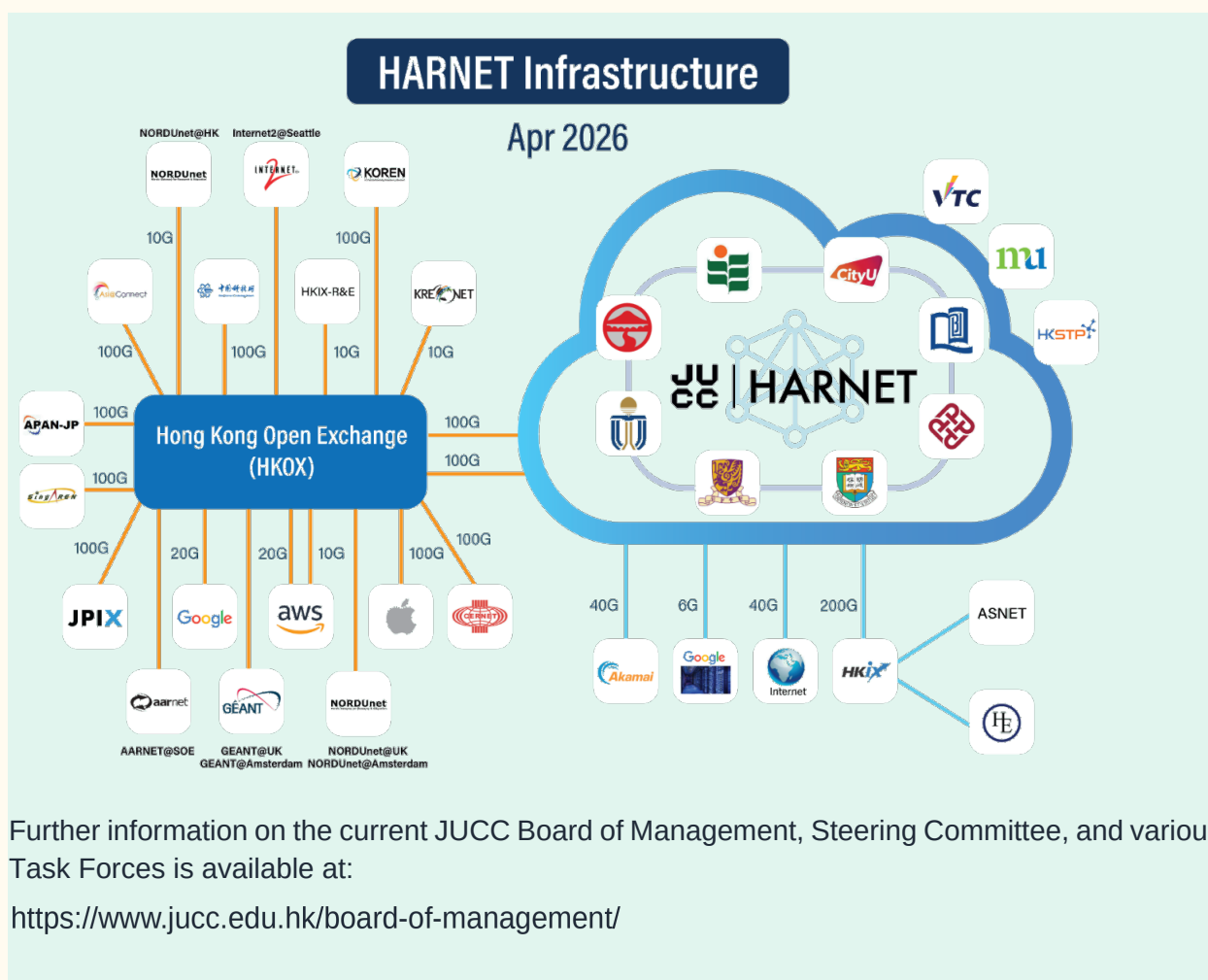
Like many National Research and Education Networks (NRENs) around the world, the Hong Kong Academic and Research Network (HARNET) was originally funded by the Hong Kong Government through the University Grants Committee (UGC) in the 1970s. HARNET is operated by the Joint University Computer Centre Limited (JUCC), an organization established by the eight UGC-funded universities in Hong Kong to foster collaboration in information and communications technology (ICT).

Under the direction of its Board of Management (BM) and with the support of its Steering Committee (SC), JUCC promotes inter-institutional cooperation in the development and application of ICT to support teaching, research, and administrative services across Hong Kong's higher education sector. Since its establishment, HARNET has provided UGC-funded universities with connectivity to leading academic and research networks, including BITNET, the Internet, Internet2, CERNET, TEIN2, and numerous NRENs worldwide.

In August 2006, the UGC decided to cease providing additional funding for HARNET. Subsequently, in September 2006, the Heads of Universities Committee in Hong Kong (HUCOM) agreed that HARNET would be funded collectively by JUCC member institutions, with each institution's contribution determined in proportion to its allocation of the UGC block grant. The UGC block grant is the principal source of recurrent public funding for UGC-funded universities in Hong Kong.

This funding model has proven to be both effective and sustainable. The JUCC Board of Management, comprising Chief Financial Officers (CFOs) or senior finance executives together with Chief Information Officers (CIOs) or IT Directors from member institutions, works closely with the Steering Committee, which consists of CIOs or IT Directors from the same institutions, to oversee HARNET's capital and operating budgets, funding arrangements, and expenditures.

This collaborative governance and funding framework has remained successfully in place since 2006. Over the years, HARNET has expanded its scope beyond serving UGC-funded universities to support other educational and research-related organizations, including the Hong Kong Science and Technology Parks Corporation (HKSTP), the Vocational Training Council (VTC), and Hong Kong Metropolitan University (HKMU). In addition, JUCC operates and funds the Hong Kong Open Exchange Point (HKOX), which enhances connectivity between Hong Kong's academic community, international NRENs, and major cloud service providers. A summary of the current connectivity framework is illustrated below.



NREN SPOTLIGHT > Fully Client-funded NRENs > LEARN (Sri Lanka)

Contributed by: Gayani Herath, Financial Controller, LEARN

LEARN's financial sustainability is built on a balanced funding model that combines stable recurring revenue. The core operational (OPEX) and capital (CAPEX) requirements of LEARN are primarily financed through contributions from member institutions, providing a predictable and sustainable financial foundation for the continuous operation, maintenance, and enhancement of the National Research and Education Network.

The revenue composition of LEARN reflects a diversified approach designed to ensure both financial stability and long-term growth. Institutional contributions represent the primary recurring revenue stream, enabling LEARN to maintain essential services, manage operational requirements, invest in infrastructure development, and deliver reliable digital connectivity solutions to its member community. This model ensures that the organisation remains financially independent while maintaining transparency, affordability, and equitable access for member institutions.

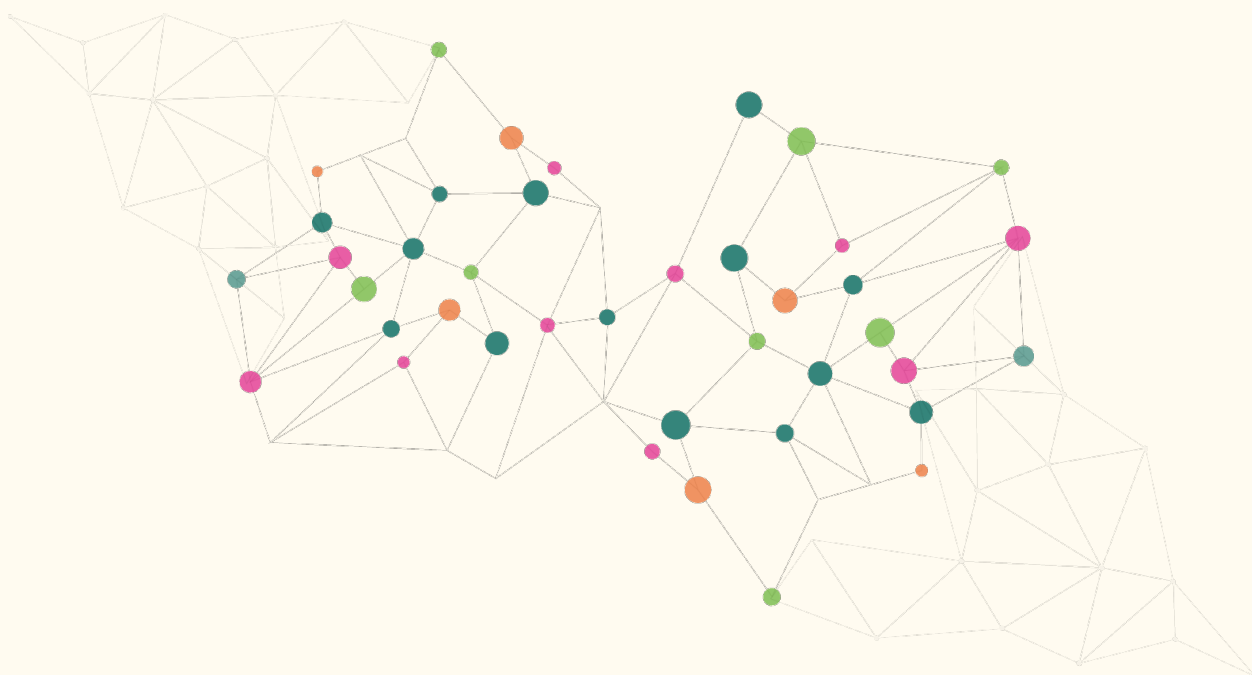
Beyond its core institutional funding, LEARN strengthens its financial capacity through externally funded programmes, regional initiatives, and strategic collaborations. Projects & Grants supported through the Asi@Connect, provide opportunities to implement major infrastructure enhancements, introduce innovative technologies, Capacity building programmes, strengthen technical capabilities, and expand some services without increasing the financial burden on

member institutions. These external funds are utilised as strategic investments that complement LEARN's core funding model rather than serving as operational dependencies.

LEARN also benefits from sponsorships and partnerships with local and international technology providers and development partners. These collaborations contribute to innovation, knowledge sharing, capacity building, and access to emerging technologies while supporting the continuous improvement of services offered to the research and education community.

This blended funding approach enables LEARN to maintain a clear separation between operational sustainability and strategic investments. Recurring institutional contributions provide financial stability for ongoing service delivery, while grants, sponsorships, and project funding support transformation, innovation, and future-oriented initiatives. This approach reduces financial risks, improves long-term predictability, and strengthens organisational resilience.

Through prudent financial management, transparent resource allocation, continuous review of service costs, and strong stakeholder engagement, LEARN ensures that its funding model remains responsive to the evolving needs of Sri Lanka's research and higher education sector. The combination of sustainable institutional funding, diversified revenue streams, and strategic partnerships, collaborations has enabled LEARN to operate as a financially resilient and strategically independent National Research and Education Network.



1.4 Standards and Policies

Formal policies define how an NREN operates, what it promises its users, and how it manages risk. The 2025 survey covered eight policy areas. Of the 19 NRENs reporting, the breadth of documented policy frameworks varies considerably — from organisations with most areas documented to those still formalising the basics.

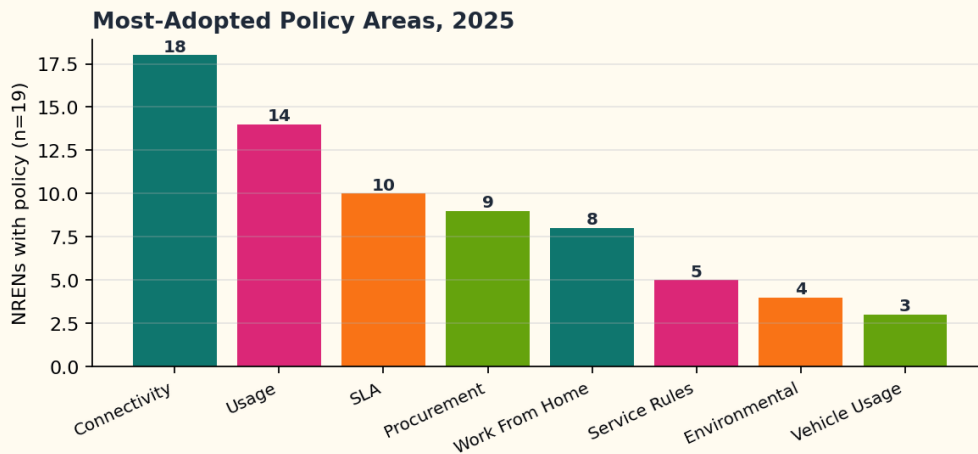


Figure 1.5. *Most widely adopted policy areas in 2025.*

Connectivity and Usage policies are the most universally documented, reflecting the operational core of every NREN. Service-level-agreement, procurement and work-from-home policies form a middle tier, each documented by between four and six NRENs in ten, while vehicle-usage and environmental policies remain the rarest — pointing to an obvious development area for the community.



Policies in Place by NREN, 2025 (n=19)

NREN	Connectivity	Usage	SLA	Procurement	Work From Home	Service Rules	Environmental	Vehicle Usage
BdREN	★	★	★	★	★	★		★
DrukREN	★	★	★	★	★	★		★
LEARN	★	★	★	★	★	★		★
CERNET	★	★		★	★		★	
IDREN	★		★		★	★	★	
MAFFIN	★	★	★	★			★	
REANNZ	★	★	★	★	★			
NREN	★		★	★		★		
PERN	★	★		★	★			
CamREN	★	★			★			
HARNET	★	★		★				
KOREN	★	★					★	
PREGINET	★	★	★					
ErdemNET	★	★						
MYREN	★		★					
NKN	★	★						
ThaiREN	★	★						
ASGC			★					
SingAREN	★							

Figure 1.6. Policy adoption matrix: which NRENs have documented which policies in 2025.

NREN SPOTLIGHT > Building a comprehensive governance framework > **BdREN (Bangladesh)**Contributed by: *Mohammad Imam Hosen Sayem, Deputy Manager (HR), BdREN*

BdREN's Success in Framing Structured Policies

Why policies

As BdREN expanded its nationwide infrastructure and diversified its services, it recognized that sustainable growth demanded more than technical excellence: a comprehensive governance framework ensuring operational consistency, service quality, transparency, accountability, and risk management. The framework has evolved from operational need rather than regulatory compliance, and is reviewed regularly to keep pace with technology, growth, and stakeholder expectations.

Keeping the right track

The Connectivity Policy — the Standard Operating Procedure (SoP) for Network Connectivity — defines the maximum last-mile fiber length (overhead and underground), backup connectivity, minimum bandwidth, mode of connectivity (direct or through other operators), PoP extension to member sites, and maintenance staffing — ensuring reliable, consistent network services.

Building customer confidence

Comprehensive Usage Policies and Service Level Agreements (SLAs) with member institutions define service commitments, responsibilities, performance expectations, support mechanisms, and escalation procedures. The SLA incorporates financial compensation, based on connectivity type, for any breach — underlining BdREN's commitment to customer satisfaction.

Efficient and candid procurement

All procurement strictly adheres to the Government of Bangladesh's Public Procurement Rules (PPR), ensuring fairness, competitiveness, accountability, and value for public resources. The Board of Trustees, as the highest policy body, approves any deviation required for special cases.

Work flexibility, green environment

The COVID-19 pandemic prompted a Work-from-Home Policy that kept critical network services running through nationwide restrictions. Retained beyond the pandemic, it improves employee well-being, work-life balance, and business continuity — and by saving commuting time and office space, contributes to a greener environment.

Building employee satisfaction

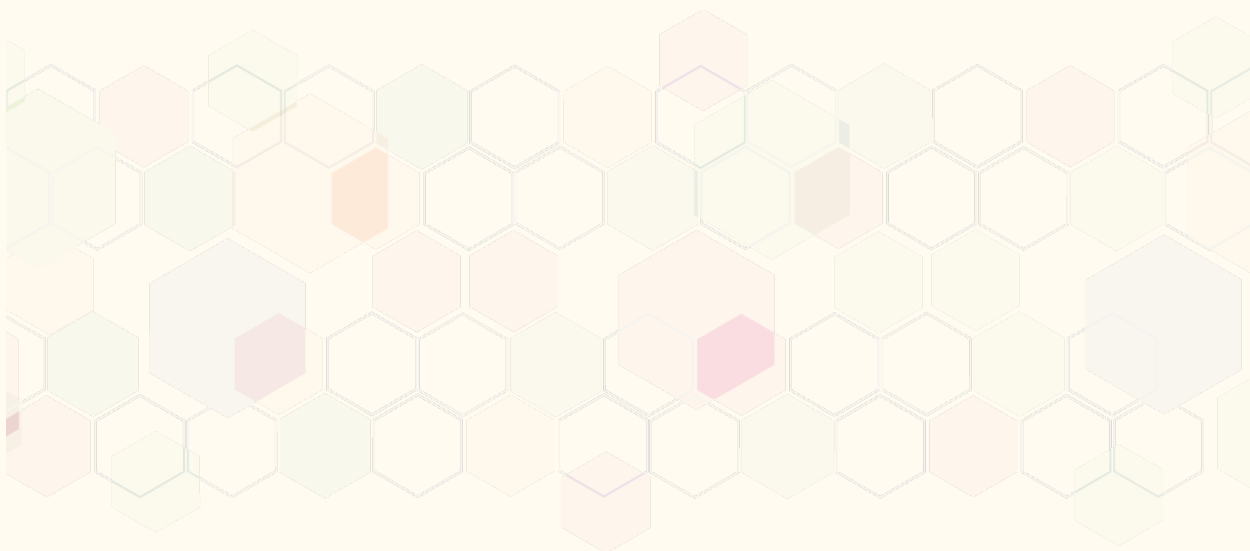
As an autonomous trust, BdREN developed its own exclusive Service Rules — a modern human resource and administrative framework tailored to a technology-driven organization — preserving dynamism, job satisfaction, and employees' rights, resulting in strong retention.

Keeping the users on track

A Vehicle Usage Policy governs the deployment, operation, maintenance, and efficient utilization of vehicles for official commuting and infrastructure maintenance, complemented by an interest-free Vehicle Loan Policy for senior employees — balancing staff welfare with operational efficiency.

Final say

My advice to other NRENs: do not rush the framing of policies by following the footprints of others. Respond as the situation demands — rushed policies might breed unwarranted outcomes.



ASI@CONNECT COMPENDIUM OF NRENs • 2025

CHAPTER 2

Connected Users

Who the NRENs actually serve — universities, research institutes, government, and schools across the community.

IN THIS CHAPTER

Connections by sector

Schools & colleges

Per-NREN institutional base

+21%

**Overall
growth**

3,252 → 3,920

+18%

**University
growth**

2,658 → 3,127

4.8×

**Research-institute
growth**

23 → 110

+49%

**Government-org
growth**

183 → 272

2. Connected Users

The second chapter examines who the NRENs actually serve. Connected institutions span universities, research institutes, government organisations, schools and colleges, and a smaller "others" category. Across the consistent panel of 15 NRENs that reported in all three waves, the community has grown its non-school connections from 3,252 in 2018 to 3,920 in 2025 — a roughly 21% expansion driven primarily by Universities (which dipped slightly in 2020 before recovering strongly), Research Institutes (which grew nearly five-fold from 23 to 110), and Government Orgs (which grew from 183 to 272).

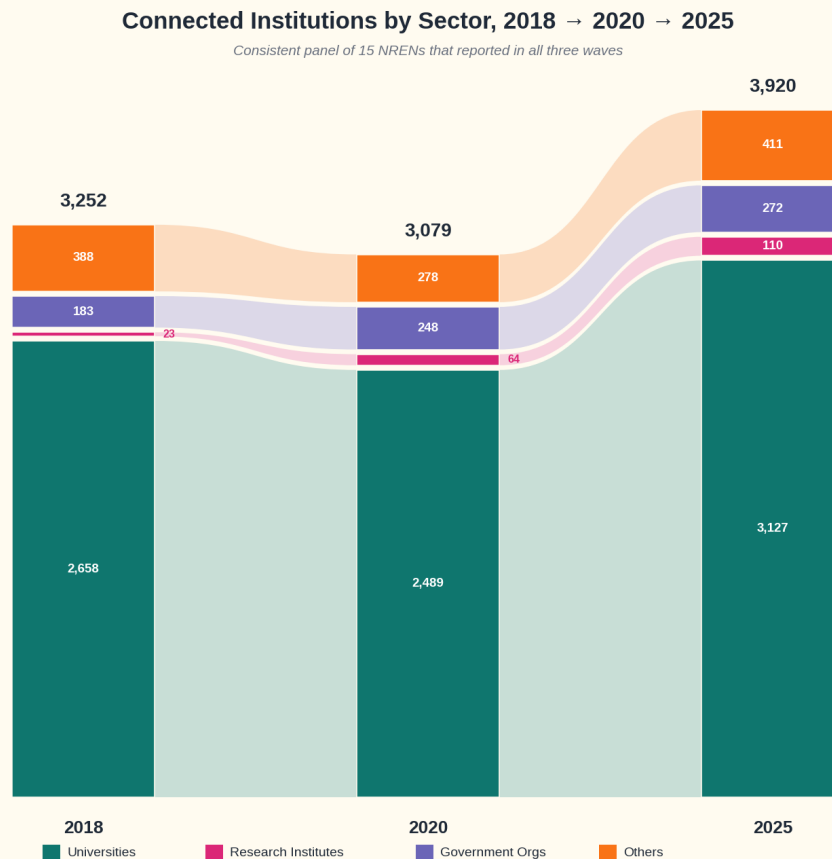


Figure 2.1. Connected Institutions by sector, excluding Schools/Colleges, across the consistent reporting panel of 15 NRENs. Year columns are bordered in solid colour; lighter shaded transitions between years show the flow. REANNZ reported in 2018 and 2025 but not 2020, so it is excluded from this three-wave panel; a two-wave comparison of 2018 versus 2025 that includes it (16 NRENs) appears in the Executive Highlights.

Schools and Colleges connections are shown in a dedicated chart below. ThaiREN's school-system connections (~10,000) so dominate the community total that it warrants its own panel — while a smaller but growing cluster of NRENs (ErdemNET, DrukREN, CERNET, MYREN, BdREN, PERN) have started connecting their own school systems since 2020.

Connected Schools & Colleges by NREN, 2018 → 2020 → 2025 (n=15)



Figure 2.2. Connected Schools & Colleges by NREN. Top panel shows ThaiREN at linear scale (~10,000 schools); bottom panel shows the other 14 NRENs on a log scale with alternating row bands for clarity.

Stripping out schools and colleges exposes each NREN's underlying institutional base. CERNET dominates on sheer scale — 2,444 connections, almost entirely universities — and PERN is similarly university-led, while the composition varies sharply elsewhere: PREGINET's base is overwhelmingly government organisations, DrukREN leans heavily on research institutes, and networks such as KOREN and REANNZ show a more even spread across all four sectors.

Each NREN's connected institutions by sector in 2025, excluding Schools/Colleges (log scale)

Universities, research institutes, government organisations and other connections — the institutional base behind each network.

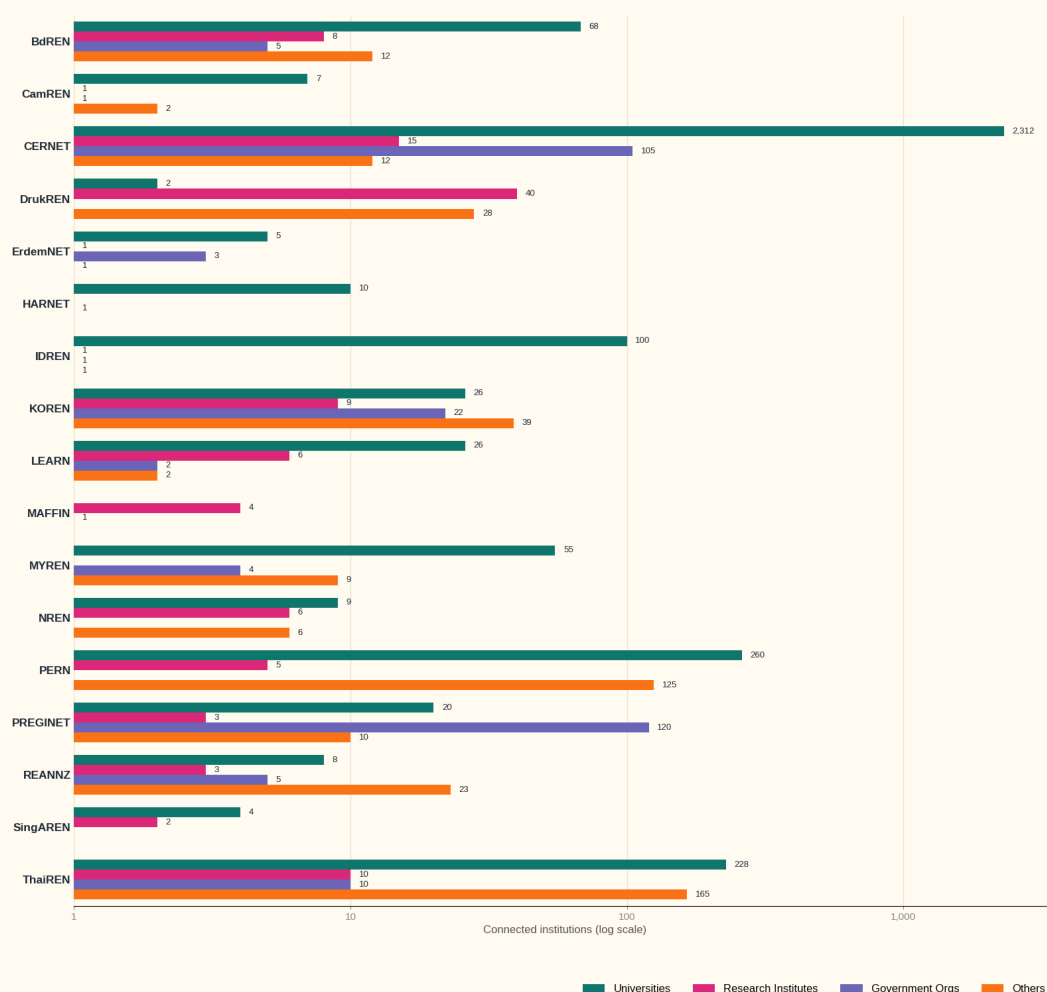


Figure 2.3. Connected institutions by NREN in 2025 by sector, excluding Schools/Colleges — Universities, Research Institutes, Government Organisations and Others (log scale).

NREN SPOTLIGHT > Building national school connectivity > DrukREN (Bhutan)

As of today, DrukREN has connected around 195 schools across Bhutan, including primary, middle, and higher secondary schools, expanding from a very limited baseline since 2020 to near nationwide coverage. This expansion has been driven by the Royal Government of Bhutan's strong commitment to equitable access to digital education and reducing the rural–urban digital divide, in line with national development priorities. The policy direction and funding support were enabled through the government, with DrukREN positioned as the national platform for research and education connectivity. Close coordination with the Ministry of Education and Skills Development and other stakeholders ensured alignment with Bhutan's ICT

and education strategies. Operationally, DrukREN implemented a phased and centrally coordinated rollout approach. Schools were onboarded in batches using standardised network designs, supported by structured site readiness processes, coordinated installation, and collaboration with local education authorities. Capacity building for school ICT focal points and ongoing technical support have been essential to ensure effective adoption and sustained use of services. This experience highlights that Bhutan's school connectivity scale-up has been enabled by strong government leadership, coordinated implementation, and a practical, scalable rollout model adapted to the country's geography and dispersed school system.

NREN SPOTLIGHT > Building national school connectivity > **BdREN (Bangladesh)**

Contributed by: *Imranur Rahman, Assistant Manager – Sales, BdREN*

Beyond the Campus Gate: Connecting Bangladesh's Colleges

Bangladesh Research and Education Network (BdREN) has long been known as the country's National Research and Education Network, linking universities and research institutions to the world. But since 2024, under the College Education Development Project (CEDP), BdREN has taken on a quieter, harder mission: bringing dedicated, high-quality internet connectivity to government colleges in the country's most underserved corners. Today, 60 colleges across Bangladesh — spanning multiple zones and reaching deep into rural areas — are connected with dedicated bandwidth averaging 50 Mbps each. For institutions that had never had reliable connectivity before, this has opened access to digital classrooms, online academic resources, and administrative systems long taken for granted at the university level.

A story built on struggle

Behind every connected college is a story of persistence. Unlike university campuses, which typically sit near existing fiber infrastructure, most of these colleges are located far from any backbone network, in rural regions where laying fiber means confronting difficult terrain, long distances, and limited local technical support. Unreliable power supply compounded the challenge — network equipment that runs dependably on a university campus often struggles in areas with frequent outages.

Even after a college goes live, the work isn't over. Maintenance has proven an even greater challenge than initial deployment: fiber cuts are common and often far from any technical hub, so fault resolution takes longer than it would in a city; local technicians are scarce; and power instability continues to threaten uptime. These realities led BdREN to plan a new layer of resilience — introducing Starlink satellite connectivity as a redundant backup for these colleges, ensuring that a single point of failure, whether a cut fiber line or a prolonged outage, no longer means a college goes dark.

A mission, not a business line

It is worth being candid about why BdREN does this work at all. Unlike its university services, the college connectivity initiative is not commercially driven — it does not turn a profit, nor does it break even. It exists because BdREN sees digital access for rural colleges as a national responsibility, not a revenue opportunity. In many ways, it functions as BdREN's own grassroots

CSR commitment: extending the benefits of research and education networking to communities that would otherwise be left behind by the digital divide.

Staying close to the ground

Connecting a college is only the beginning of the relationship. BdREN's team conducts regular site visits and technical surveys to monitor network health and understand each college's evolving needs. A dedicated point of contact supports colleges when issues arise, and open feedback channels keep improving service on the ground. Small gestures — the occasional token of appreciation — help sustain the goodwill and trust these partnerships depend on.

Capacity building runs alongside connectivity. BdREN has organized several workshops for college faculty and staff, covering both basic digital literacy and practical use of BdREN's academic resources, from e-journals to digital library access — helping ensure that bandwidth translates into real learning outcomes, not just a faster internet connection.

Looking ahead

With 60 colleges connected and lessons learned from every difficult kilometer of fiber and every outage weathered, BdREN's next chapter is about resilience: layering satellite redundancy onto its terrestrial network to make rural connectivity as dependable as the university links it is known for. It is a reminder that an NREN's mission does not end at the campus gate — sometimes the most meaningful work happens well beyond it.

NREN SPOTLIGHT › Building national school connectivity › CERNET (China)

Committed to serving China's higher education and research communities, CERNET operates a nationwide backbone fiber network spanning 30,000 kilometres, supporting three generations of IP backbone infrastructure. At present, CERNET connects over 3,000 universities and research institutions, serving over 50 million students, faculty and scientists nationwide.

NREN SPOTLIGHT › Building national school connectivity › ErdemNET (Mongolia)

Contributed by: *Nanjidjamts Jigjidsuren, Chief/Core Engineer (Networking Department), ErdemNET*

ErdemNET connects approximately 679 government (state) schools — public schools that the government funds to operate — having grown from a zero baseline in 2020 to around 700 schools today.

5 Upstream ISPs



In 2025

Policy driver: The programme targets the country's government-funded schools, supporting the state's goal of bringing internet connectivity to public education nationwide

Funding model: The connectivity is fully funded by the government — the schools themselves do not pay for the service.

Operational approach to onboarding at scale: ErdemNET delivers the service over its national backbone. Because its own capacity and physical reach are limited relative to ~700 sites spread across the country, ErdemNET partners with the ISP ICN and uses ICN's infrastructure to extend connectivity into the countryside/rural areas. Transport to the schools uses PTN (Packet Transfer Technology): the network initially delivered service over Layer 3 IP MPLS and has since migrated to the newer, faster Layer 2 PTN

Lessons for the community: Partnering with a commercial ISP (ICN) for last-mile reach allowed ErdemNET to scale to hundreds of rural schools without having to build its own fibre everywhere, and migrating from Layer 3 IP MPLS to Layer 2 PTN improved performance for the connected schools.

NREN SPOTLIGHT > Building national school connectivity > MYREN (Malaysia)

MYREN's connected institutions comprise public universities, public university branch campuses, private universities, university teaching hospitals, polytechnics, community colleges and government agencies, as summarized below:

- **Public Universities: 20**
- **Public Universities (Branch Campus): 26**
- **Private Universities: 3**
- **University Teaching Hospital: 9**
- **Polytechnic: 37**
- **Community College: 106**
- **Government Agency: 4**

CHAPTER 3

Network

How the community runs its infrastructure — operations, fibre ownership, delivered bandwidth, and the reach achieved.

IN THIS CHAPTER

- 3.1** Bandwidth and Reach
- 3.2** Interface Capacity Distribution
- 3.3** Market Share

1.4×**100 Mbps
interfaces**

1,205 → 1,717

1.1×**1 Gbps
interfaces**

11,309 → 12,196

3.9×**10 Gbps
interfaces**

85 → 333

31×**100 Gbps
interfaces**

2 → 63

3. Network

The Network chapter examines how the community runs and operates its infrastructure: the operations model, the ownership of backbone fibre, the bandwidth delivered to user institutions, and the share of eligible institutions actually reached. Tracking Operations and Maintenance models across the three survey waves reveals a clear pattern: NRENs are moving away from fully-outsourced arrangements toward in-house or hybrid models, signalling growing technical maturity across the community.

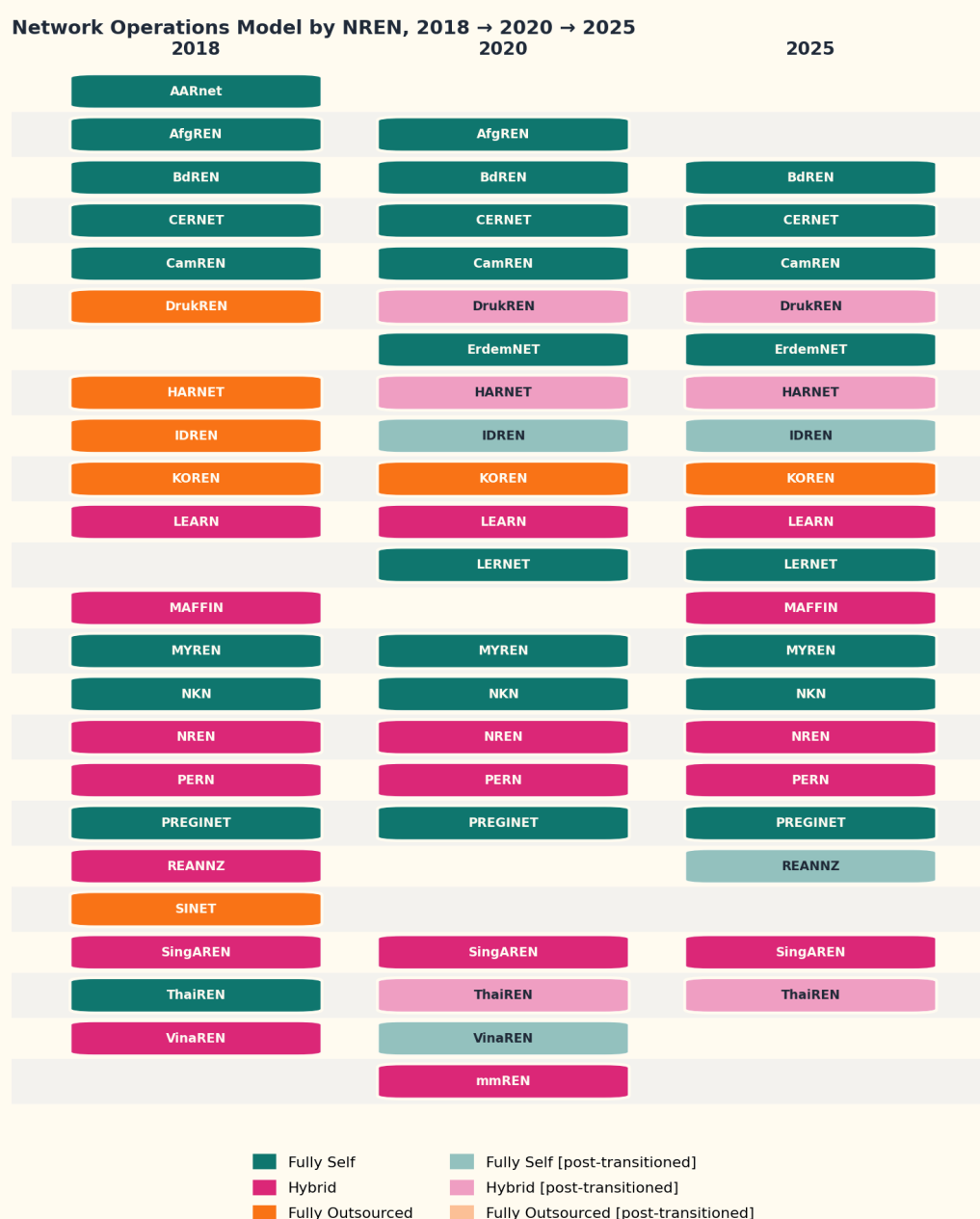


Figure 3.1. Network Operations model by NREN, 2018 → 2020 → 2025. Lighter shades indicate NRENs whose operations model has changed at least once during the survey period.

Network Operations: Fully Self-managed has held steady as the dominant model (around 10 NRENs in 2025), with Hybrid arrangements close behind. The most striking shift is the collapse of Fully Outsourced operations — five NRENs in 2018 down to just KOREN by 2025. DrukREN,

HARNET and IDREN all moved away from outsourcing between 2018 and 2020; ThaiREN moved from Self to Hybrid in the same window. REANNZ moved from Hybrid to Self by 2025.

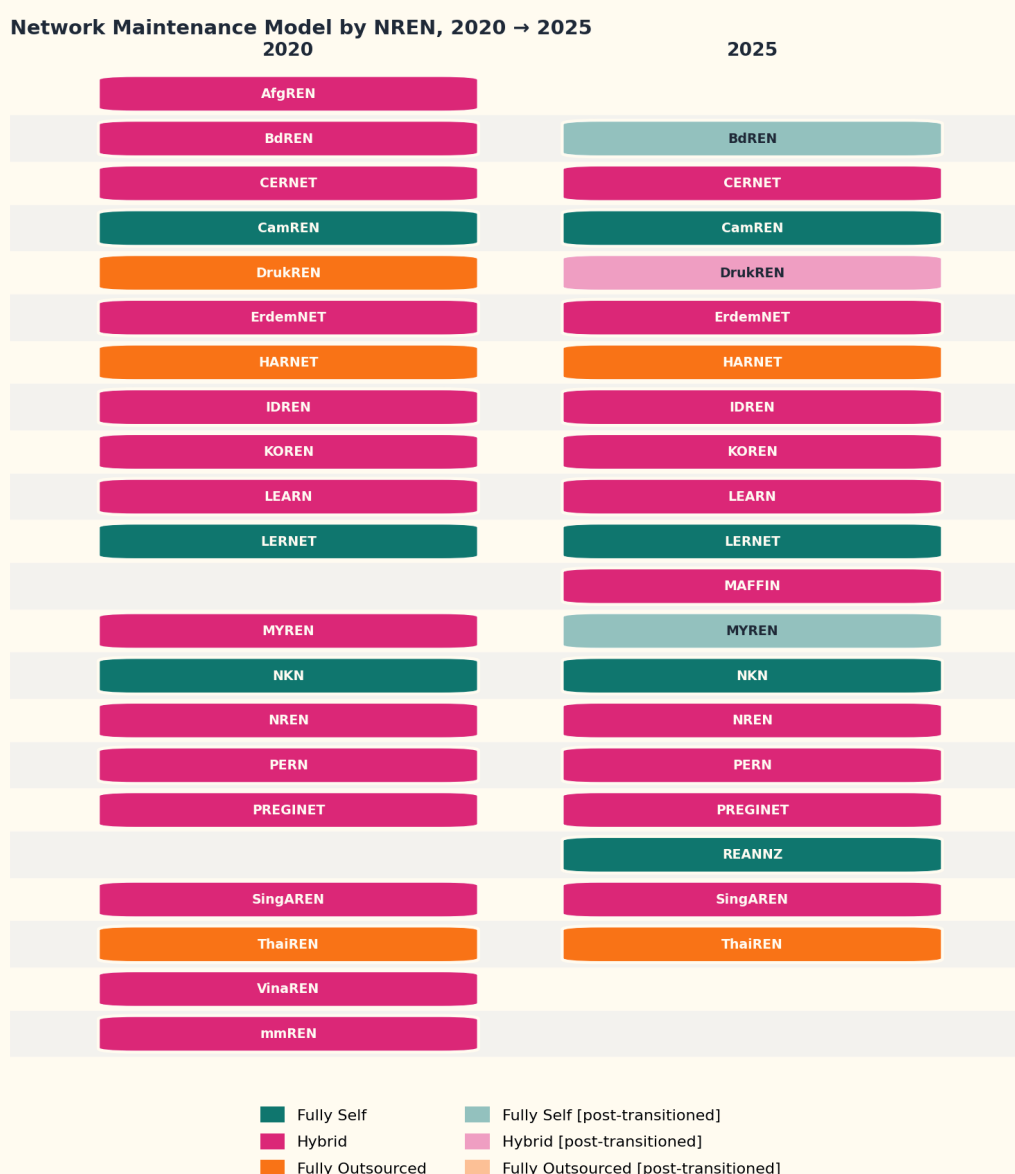


Figure 3.2. Network Maintenance model by NREN, 2020 → 2025. Maintenance was not separately surveyed in 2018. Lighter shades indicate NRENs whose maintenance model has changed.

Network Maintenance: Hybrid is the overwhelmingly dominant model (11 NRENs in 2025), reflecting the practical reality that maintenance often involves third-party fibre, equipment, or service contracts even when day-to-day operations are managed in-house. Fully Self-managed maintenance is growing (3 → 6), with BdREN and MYREN transitioning into the category. Only HARNET and ThaiREN remain in Fully Outsourced for maintenance.

On fibre ownership, the community is in clear transition. Short-Term Lease (STL) — the dominant model in 2018 — has collapsed sharply by 2025, with Blended ownership (mixing short-term lease, long-term lease, and small self-owned segments) emerging as the most common arrangement. The two charts below trace this evolution separately for backbone fibre and access fibre.

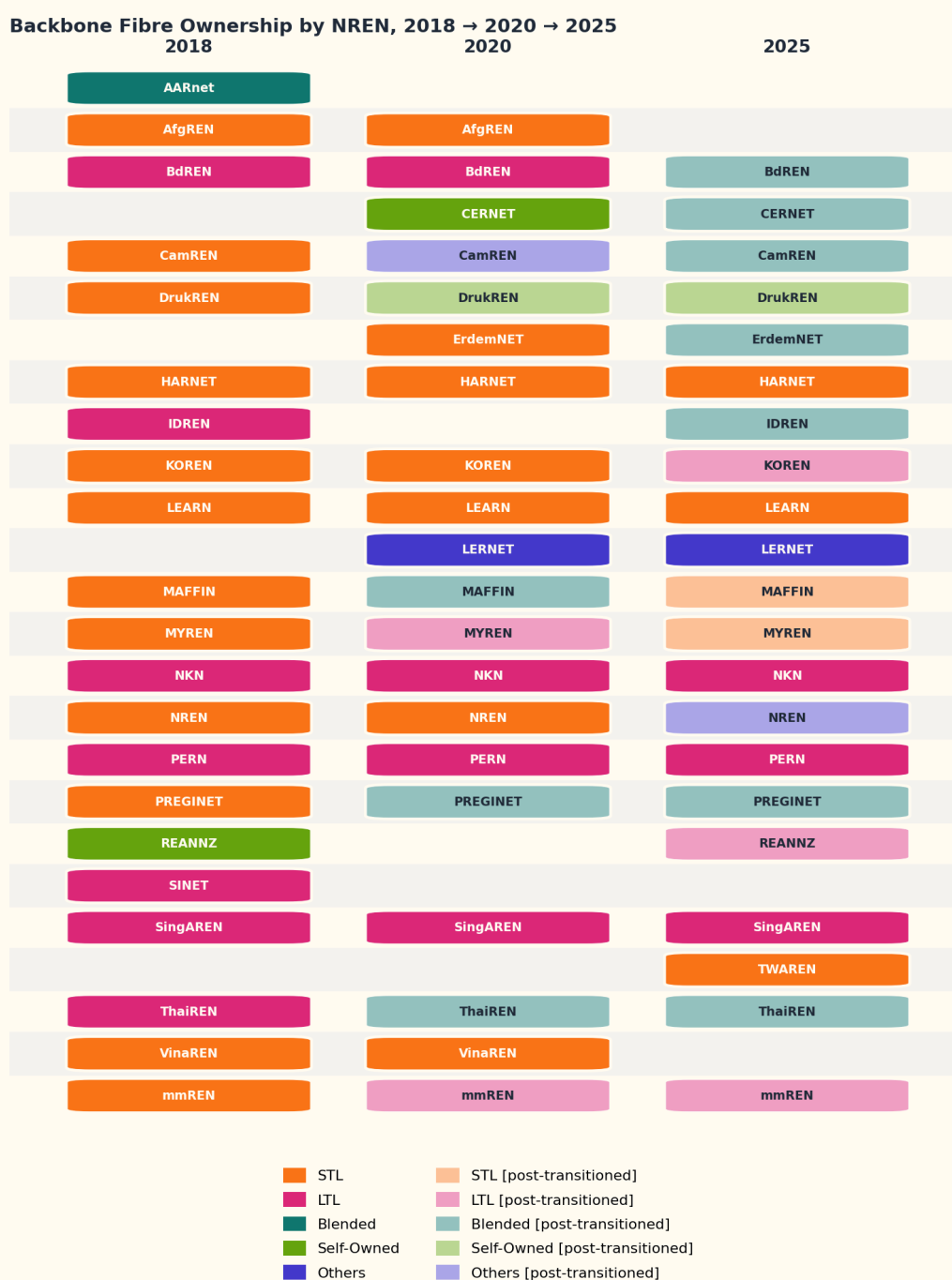


Figure 3.3. Backbone Fibre Ownership by NREN, 2018 → 2020 → 2025. Lighter shades indicate NRENs whose ownership model has changed at least once during the survey period.

Backbone fibre: STL dropped from 12 NRENs in 2018 to just 5 by 2025, while Blended grew from 1 to 7 — the most visible structural shift in the chapter. DrukREN moved to Self-Owned in 2020 and has held it. CERNET, BdREN, IDREN, ThaiREN, PREGINET, CamREN and ErdemNET have all converged on Blended models.

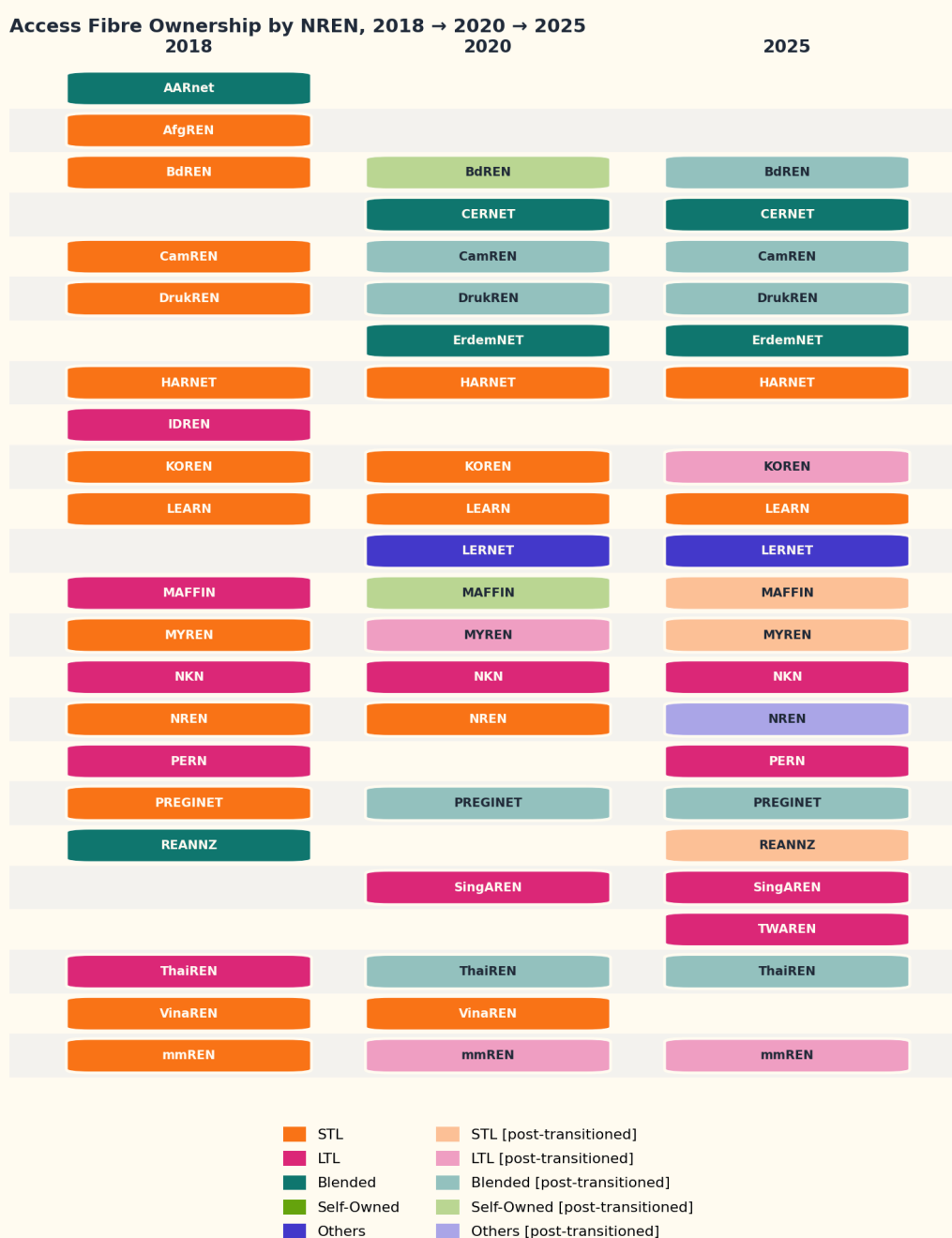


Figure 3.4. Access Fibre Ownership by NREN, 2018 → 2020 → 2025. Lighter shades indicate NRENs whose ownership model has changed.

Access fibre: a parallel pattern. STL fell from 12 NRENs to 5 across the period; Blended grew from 2 to 7. CERNET and ErdemNET went straight to Blended on their first reporting in 2020; BdREN, CamREN, DrukREN, PREGINET and ThaiREN all converged on Blended after starting elsewhere. KOREN moved to LTL on both backbone and access.

3.1 Bandwidth and Reach

The highest bandwidth delivered to a connected institution is a useful indicator of an NREN's technical frontier. Three NRENs — REANNZ, SingAREN and ThaiREN — now reach 100 Gbps; CERNET and MAFFIN reach 40 Gbps; and KOREN and MYREN operate at 10 Gbps. A meaningful tail then spreads from 100 Mbps up to 5 Gbps, reflecting the community's range.

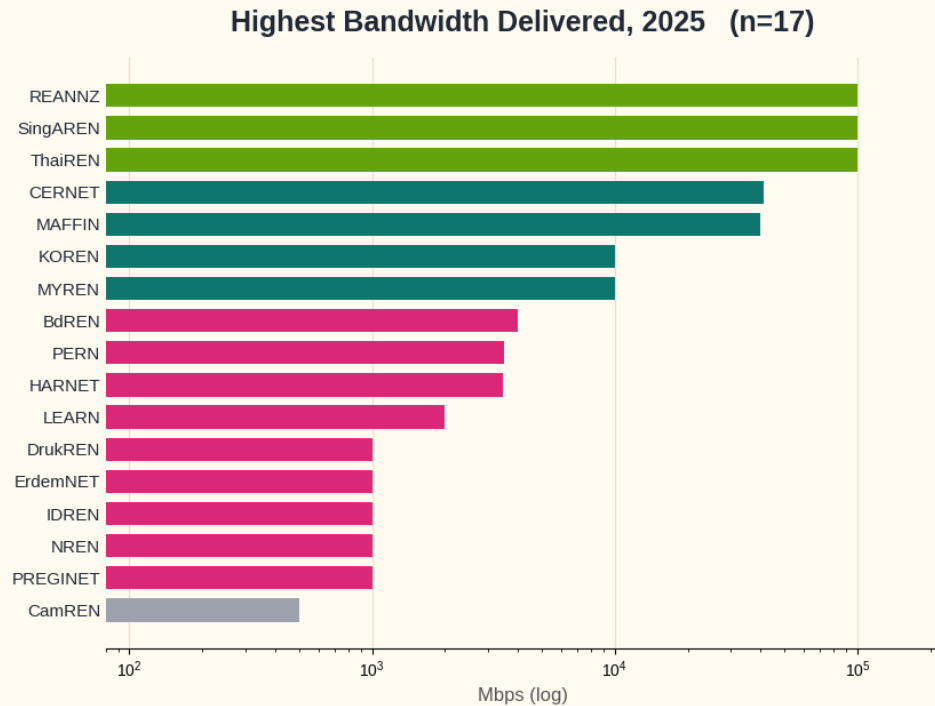


Figure 3.5. *Highest bandwidth delivered to a connected institution, 2025.*

With all three waves overlaid, the slope chart reveals not just the magnitude of bandwidth growth but its timing. ThaiREN's jump to 100 Gbps came between 2020 and 2025 — late in the period — whereas MYREN's 5× jump (2 → 10 Gbps) happened earlier, between 2018 and 2020. HARNET and LEARN both spiked to 10 Gbps in 2020 before settling back, suggesting these may have been one-off circuit configurations rather than sustained capacity. A core group (SingAREN, CERNET, KOREN, DrukREN, ErdemNET, PREGINET) shows no change across waves, anchoring the community at their respective tiers. ErdemNET and PREGINET enter the chart at 2020, having not reported in 2018.

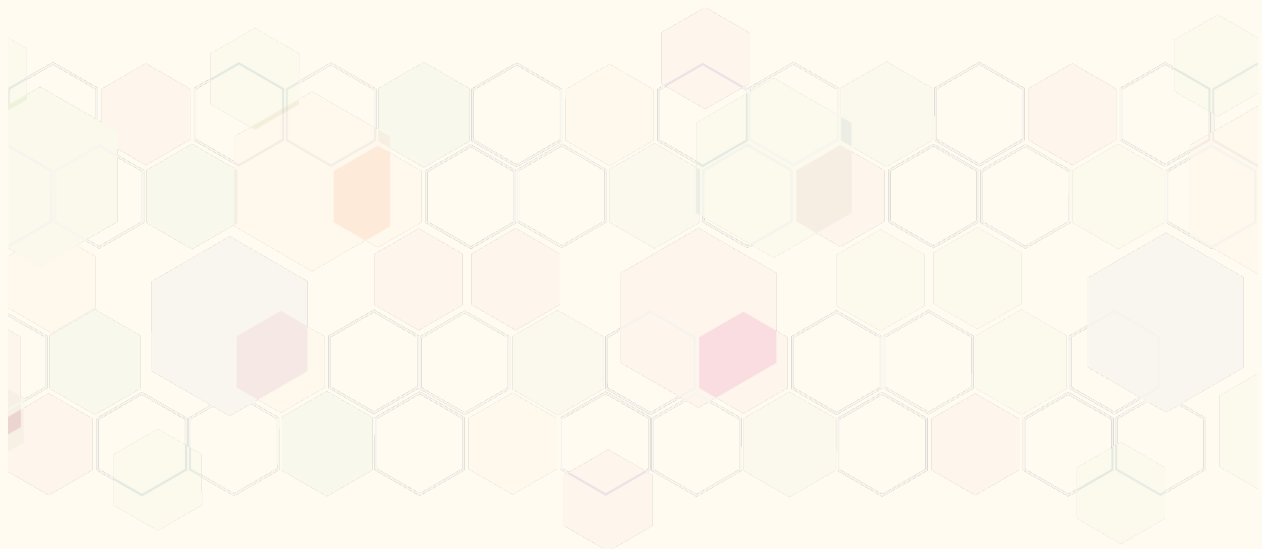




Figure 3.6. Highest bandwidth growth across the three waves ($n=17$ NRENs reporting 2025). Sage = $\geq 5\times$ growth; magenta = growth ($<5\times$); gold = no change. ErdemNET and PREGINET have no 2018 data and enter the chart at 2020.

NREN SPOTLIGHT > Reaching 100 Gbps > REANNZ (New Zealand)

Contributed by: Aaron Murrihy, Networks & Digital Services Platform Lead, REANNZ

REANNZ's move towards delivering 100 Gbps services has been driven by the growing

demands of data-intensive research and changing infrastructure strategies across New Zealand's research and education sector. Increasingly, institutions are locating both IT and research infrastructure in professional datacentres, cloud platforms and shared national facilities rather than solely on campus. At the same time, research is increasingly conducted in the field through remote instruments, sensor networks and distributed data collection. Together, these trends are creating greater demand for high-capacity connectivity between campuses, datacentres, cloud providers, research infrastructure and international collaborators.

The communities benefiting from this capacity span a wide range of data-intensive disciplines, including genomics, climate science, AI and machine learning, earthquake and geophysical research, and astronomy. More broadly, researchers are increasingly relying on shared national computing, storage and data platforms, creating greater demand for high-speed connectivity between institutions and research infrastructure.

Enabling these services has required significant investment in REANNZ's national network infrastructure. In June 2025, REANNZ completed a major refresh of its core routing platform across 28 points of presence nationwide. The new platform provides substantially higher port density and enables delivery of 25 Gbps and 100 Gbps services at a lower cost per port while reducing network power consumption by approximately 40 percent. Just as importantly, it established a clear upgrade path to 400 Gbps services, ensuring the network can continue to meet future demand from New Zealand's research and education communities.

NREN SPOTLIGHT > Reaching 100 Gbps > **SingAREN (Singapore)**

SingAREN has always strived to not only serve its local research and education community, but also the larger regional and global community. It has set-up an Open exchange point for interconnecting regional and global research and education community networks via high speed networks. Large scale global collaboration, eg. LHCONE, SKA, is the main driver for the large bandwidth of 100Gbps or more.

3.2 Interface Capacity Distribution

Beyond the headline 'highest bandwidth' figure, the survey records how each NREN's connected institutions are distributed across capacity tiers — from below 100 Mbps up to 100 Gbps. This lens reveals the deployed reality of the community: while leading NRENs reach 100 Gbps at their technical frontier, most institutions across most NRENs are connected at 1 Gbps or below. The five figures below break the 2025 distribution down by user category, showing for each NREN what share of its institutions sit at 1 Gbps or above — a useful proxy for network modernisation. Across the community, roughly 2,250 new institutional interfaces appeared between 2020 and 2025 (+17%), but the most striking shift was concentrated at the 10G and 100G tiers — a story the section closes with through a community-wide synthesis table and an invitation to three leading NRENs in that upper-tier growth.

Universities: who has modernised, who hasn't

Share of each NREN's connected universities that are on 1G or higher links. Bar colour: teal ≥75%, sage 40–74%, coral <40%.



Figure 3.7. Universities — share of connected institutions at 1G or above, by NREN, 2025.

Observation. CERNET dominates the community total with 2,312 connected universities — roughly 74% of all university interfaces in 2025. The distribution within CERNET is heavily weighted to the lower tiers (576 at <100M, 1,360 at 100M) reflecting the breadth of the Chinese academic network. Beyond CERNET, PERN leads with 260 universities (with a strong upper-tier mix: 160 at 1G, 50 at 10G, 10 at 100G). ThaiREN reports a notably high-tier portfolio with 24 universities at 100G. REANNZ shows a balanced 8/8/8 distribution at 1G/10G/100G. Across the community, 48 universities are connected at 100G — concentrated in PERN, REANNZ, ThaiREN, KOREN, PREGINET, SingAREN, and CERNET.

Research institutes: a mostly modern cohort

Share of each NREN's connected research institutes that are on 1G or higher links. Bar colour: teal ≥75%, sage 40–74%, coral <40%.

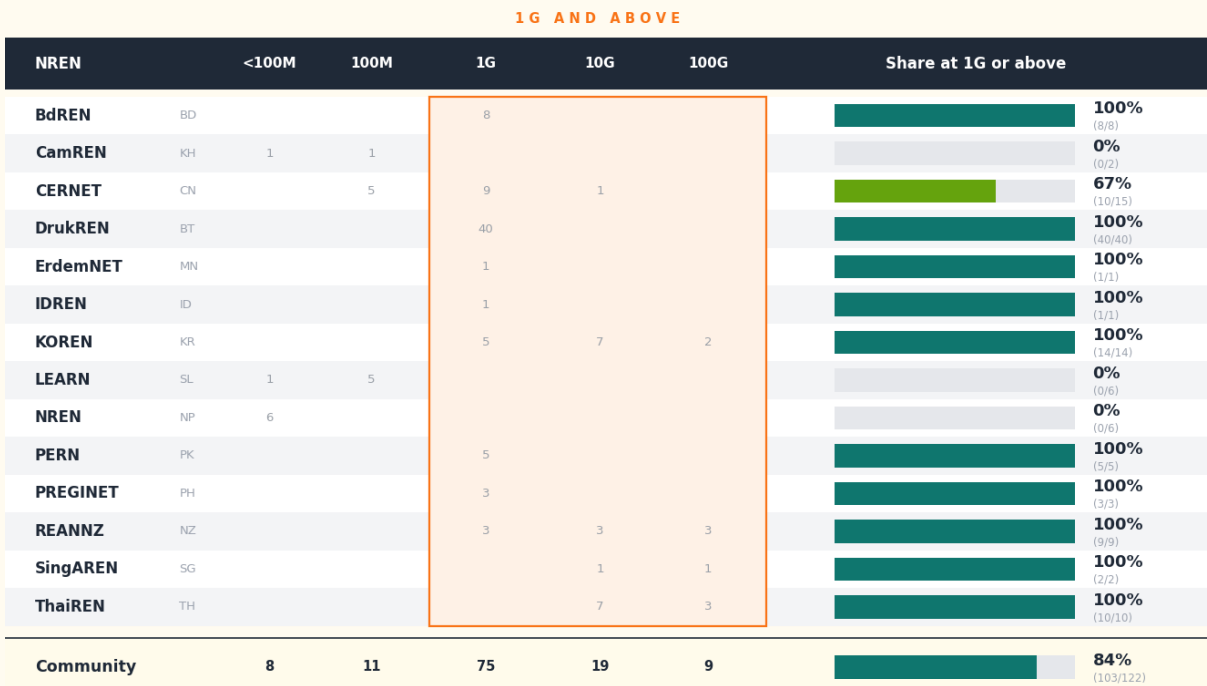
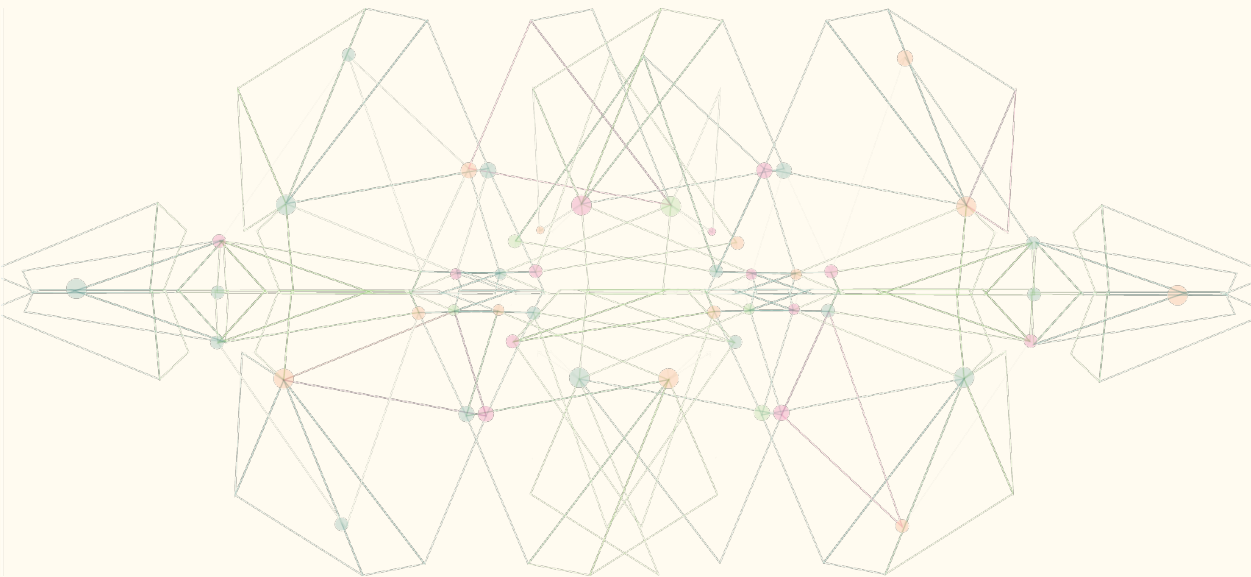


Figure 3.8. Research Institutes — share of connected institutions at 1G or above, by NREN, 2025.

Observation. DrukREN reports the largest single-NREN footprint with 40 research institutes — all on 1G. CERNET (15) and KOREN (14) follow, with KOREN spanning the upper tiers (5/7/2 at 1G/10G/100G). ThaiREN's 10 research institutes are all at 10G or 100G. REANNZ shows a balanced 3/3/3 distribution at 1G/10G/100G — proportionally the most high-tier deployment in this sector. Community-wide, 9 research institutes are connected at 100G, signalling demand for high-bandwidth research applications.



Schools & colleges: ThaiREN's footprint and the rest

Share of each NREN's connected schools & colleges that are on 1G or higher links. Bar colour: teal ≥75%, sage 40–74%, coral <40%.

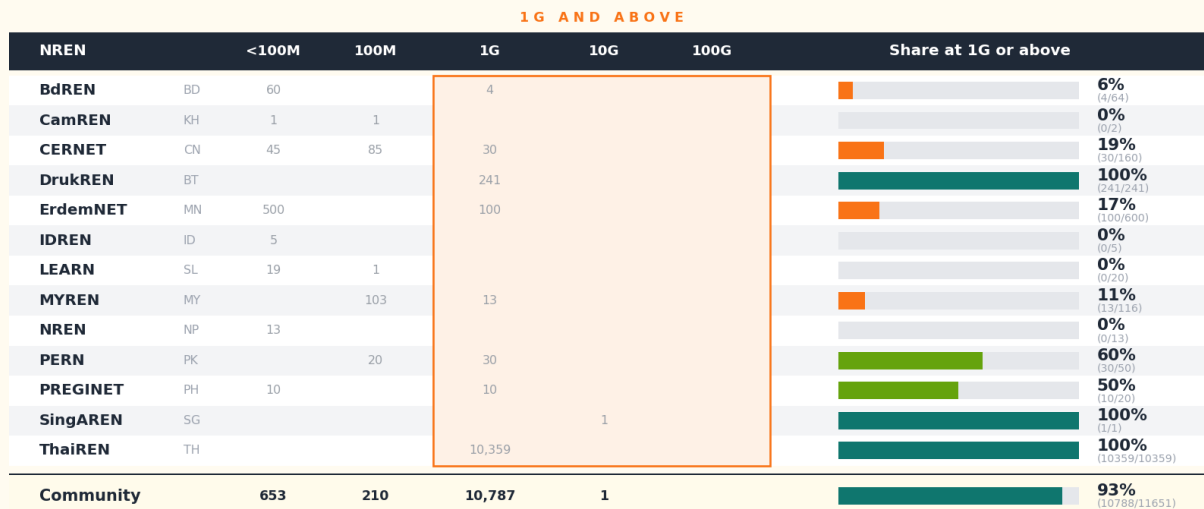


Figure 3.9. Schools & Colleges — share of connected institutions at 1G or above, by NREN, 2025.

Observation. ThaiREN's 10,359 schools dominate the community total (~89% of all reporting), all connected at 1G. DrukREN follows with 241 schools (all at 1G), CERNET with 160 (45 at <100M, 85 at 100M, 30 at 1G), and MYREN with 116 (103 at 100M, 13 at 1G). BdREN newly connected 64 schools (60 at <100M, 4 at 1G). With the exception of one SingAREN connection at 10G, all school interfaces in 2025 remain at 1G or below — confirming that school connectivity is overwhelmingly an access-tier concern.

Government organisations: the 1G+ landscape

Share of each NREN's connected government organisations that are on 1G or higher links. Bar colour: teal ≥75%, sage 40–74%, coral <40%.

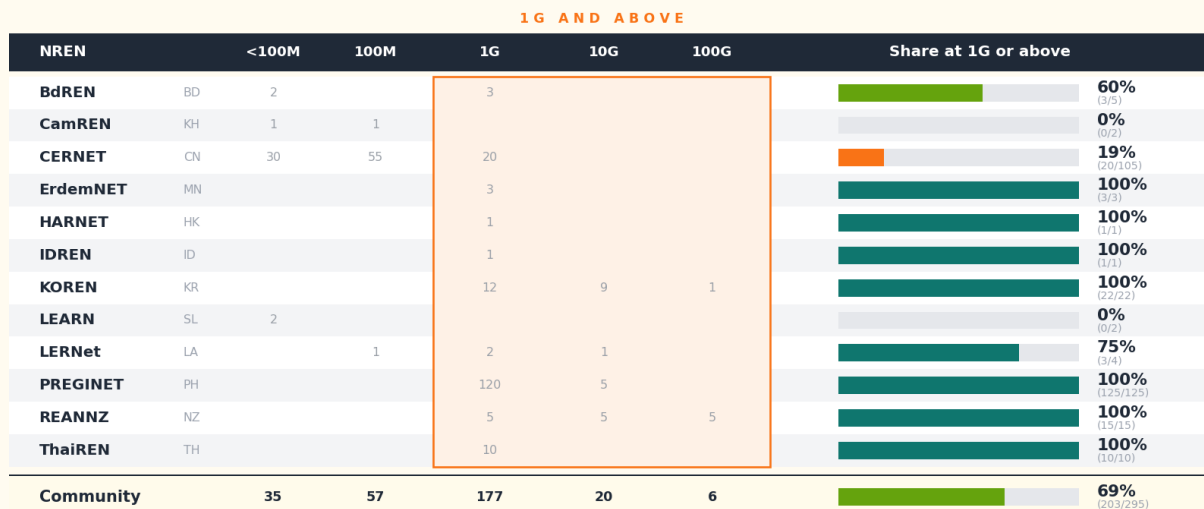


Figure 3.10. Government Organizations — share of connected institutions at 1G or above, by NREN, 2025.

Observation. PREGINET leads government connectivity with 125 institutions (120 at 1G plus 5 at 10G). CERNET (105) and KOREN (22) follow, with KOREN spanning into the upper tiers (12/9/1 at 1G/10G/100G). REANNZ is notable for its 5/5/5 distribution at 1G/10G/100G — the leading provider of 100G connectivity to government organisations, with KOREN adding one more. Community-wide totals reach 295 government interfaces in 2025, with 6 at 100G.

Other connected institutions: largely at 1G or above

Share of each NREN's other connected institutions that are on 1G or higher links. Bar colour: teal ≥75%, sage 40–74%, coral <40%.



Figure 3.11. Other connected institutions — share at 1G or above, by NREN, 2025.

Observation. The “Others” category (non-academic special interest connections — hospitals, libraries, museums, cultural institutions, etc.) totals 459 connections in 2025. ThaiREN leads with 165 institutions on 1G, followed by PERN with 125 (also on 1G), then REANNZ at 58 (29 at 1G, 29 at 10G) and KOREN at 39 (22 at 1G, 17 at 10G). DrukREN connects 28 such institutions at 1G. The 53 connections at 10G across the community — split mainly between REANNZ, KOREN, and LERNet — represent meaningful infrastructure committed to non-academic civic users.

Synthesis: pulling all five sectors together gives the community-wide view of how the bandwidth distribution shifted between the 2020 and 2025 waves.

Table 3.6. Community-wide interface capacity distribution, 2020 vs 2025 (across all sectors and all reporting NRENs).

Capacity Tier	2020	2025	Δ	Growth
<100M	813	1,355	+542	1.67×
100M	1,205	1,717	+512	1.42×
1G	11,309	12,196	+887	1.08×
10G	85	333	+248	3.92×
100G	2	63	+61	31.5×
Total	13,414	15,664	+2,250	1.17×

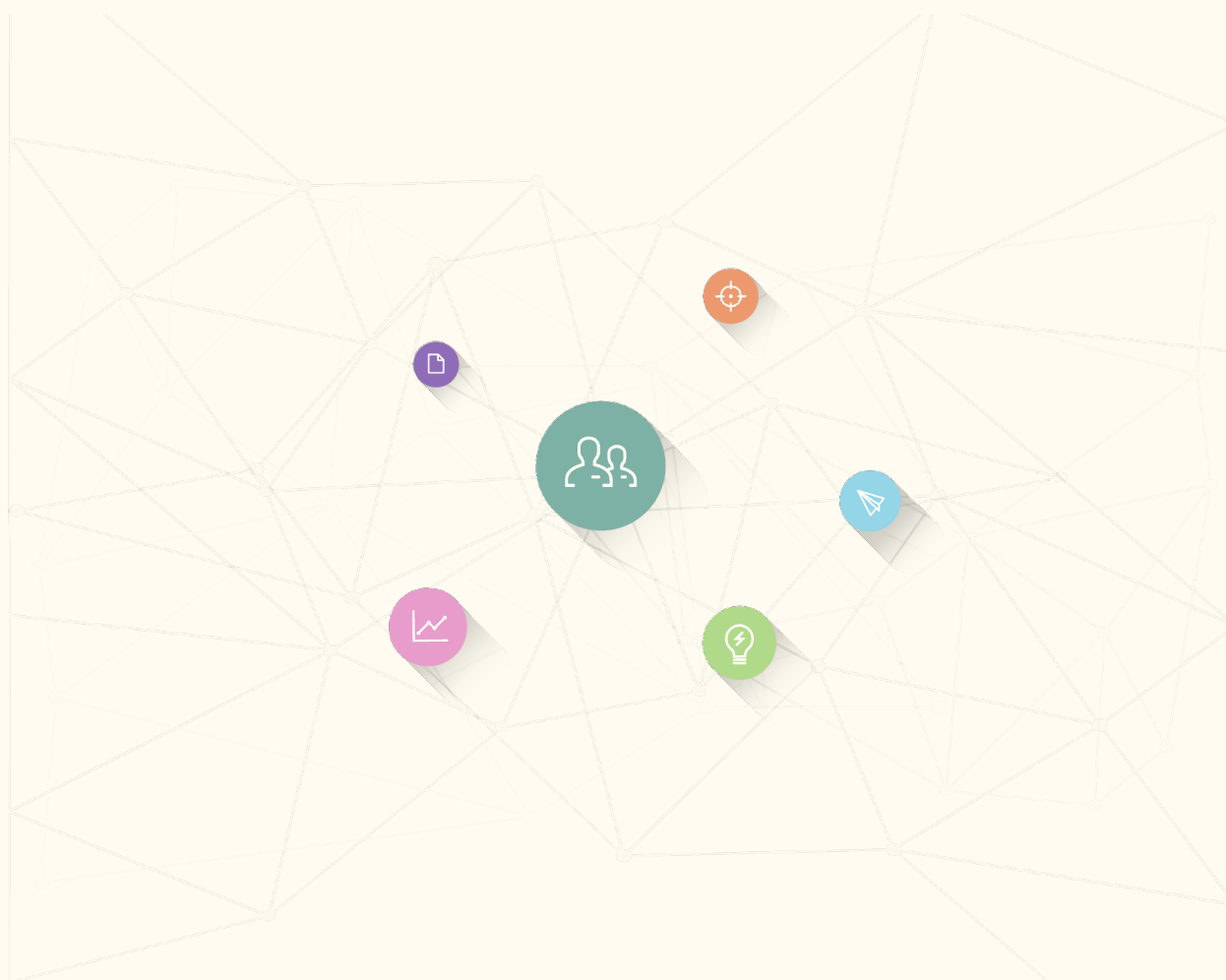
Observation. The community is climbing the bandwidth ladder where it matters most — at the upper tiers. Connections at 100 Gbps grew from just 2 in 2020 to 63 in 2025 (a 31× expansion), and 10G interfaces nearly quadrupled (85 → 333). The dominant 1G tier grew only modestly (+8%), and the lower tiers expanded steadily but unspectacularly. Overall the community added 2,250 new institutional interfaces (+17%), and the composition of that mix tilted upward.

NREN SPOTLIGHT > Delivering 10G and 100G to institutions > **REANNZ (New Zealand)**

Our numbers were wrong in the survey. The updated numbers are in the table below. REANNZ does not have any government organisations connected at 100G. I do not believe these numbers are sufficiently notable for a “spotlight” in this section, but also given the question is the same any answer would be the same as the previous section.

Sector	Number of Orgs	1G	10/25G	40/100G
University	8	3	8	5
Research	4	4	4	1
Government	5	3	4	0
Other	23	17	17	0

* Note this is the number of orgs with connections at that speed, not the number of connections at that speed. I believe this is what you were asking for.



3.3 Market Share

University market share — the proportion of eligible universities actually connected to the NREN — varies enormously across the cohort. The combo chart below sets the absolute scale of each NREN's addressable market alongside the deployed reach, and the slope chart that follows traces the 2020 → 2025 progression. DrukREN and REANNZ report full national coverage; PERN, ThaiREN, CERNET, SingAREN, MYREN and LEARN exceed half; others — notably IDREN with 4,000 universities in its market, and PREGINET with 500 — operate in very large addressable markets where roll-out is still under way.

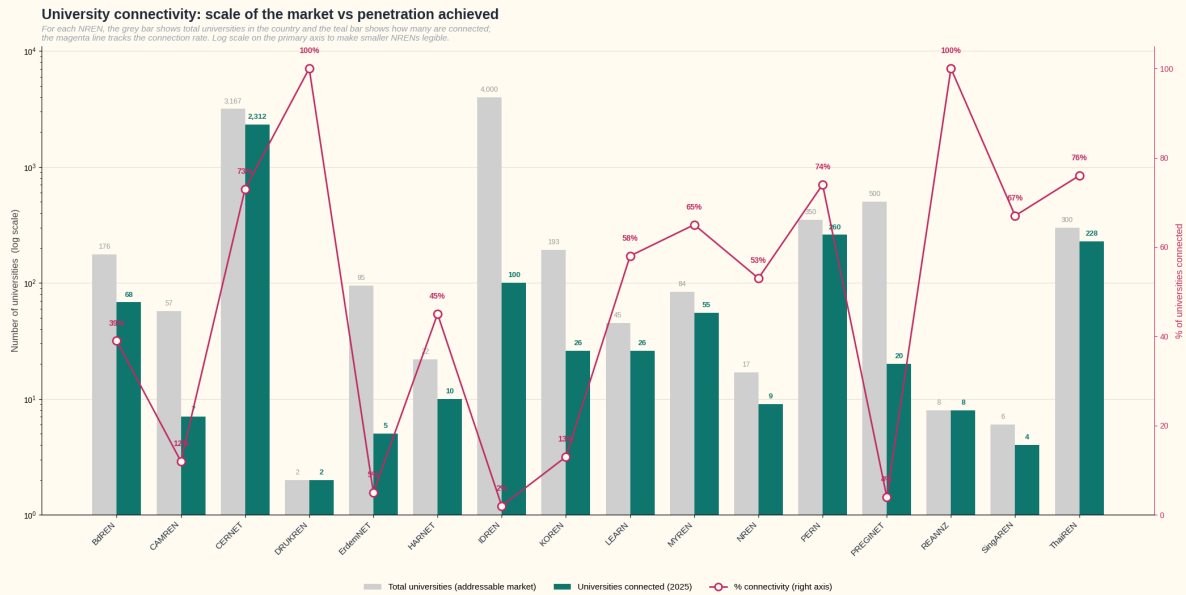
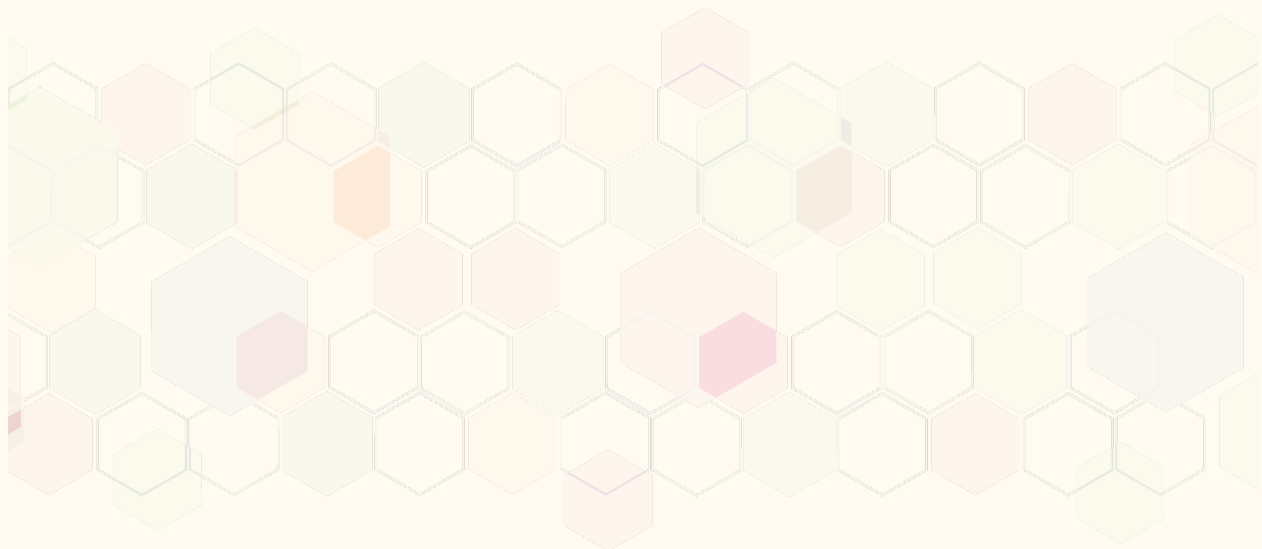


Figure 3.12. University market scale vs penetration achieved, 2025. Grey bars show total universities in each country (addressable market); teal bars show how many are connected by the NREN; magenta line shows the connection rate (right axis). Log scale on the primary axis to make smaller NRENs legible. n=16 NRENs reporting both totals and 2025 connections.



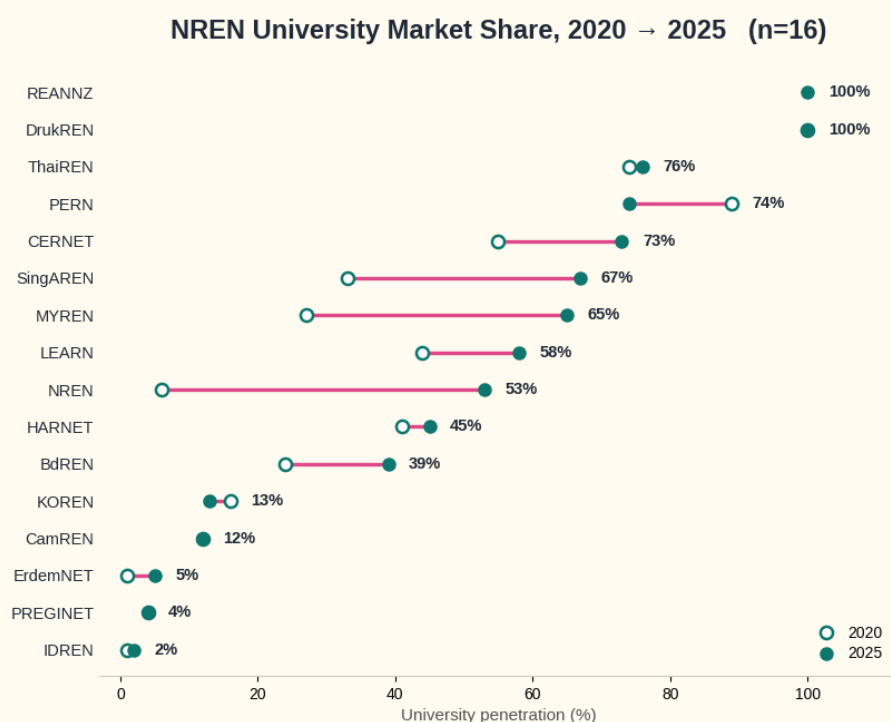


Figure 3.13. NREN market share — university penetration, 2020 → 2025.

NREN SPOTLIGHT > Achieving full national coverage > DrukREN (Bhutan)

Complete university penetration in Bhutan was achieved through a nationally coordinated approach led by the Royal Government of Bhutan, which positioned DrukREN as the dedicated National Research and Education Network (NREN) responsible for serving all tertiary education institutions. From the outset, policy decisions focused on centralising research and education connectivity under a single national platform rather than fragmented institutional arrangements. This ensured that all universities and colleges were brought onto a common, secure, and managed network, enabling consistent service delivery, cost efficiency, and equitable access to digital resources. Sustained connectivity has been supported through continued government commitment, including funding for core infrastructure and operational support. Strong institutional coordination between DrukREN, the Ministry of Education and Skills Development, and other relevant agencies has been critical in ensuring full coverage and ongoing service reliability. Organisationally, DrukREN's ability to maintain university penetration has depended on building in-house technical capacity, establishing standardised service models, and maintaining close user support relationships with institutions. The most important success factors have been strong government ownership, a centralized national model for R&E connectivity, sustained investment in infrastructure and people, and continuous capacity building. Together, these elements have ensured not only full university connectivity but also its long-term sustainability and relevance to Bhutan's higher education and research ecosystem.

CHAPTER 4

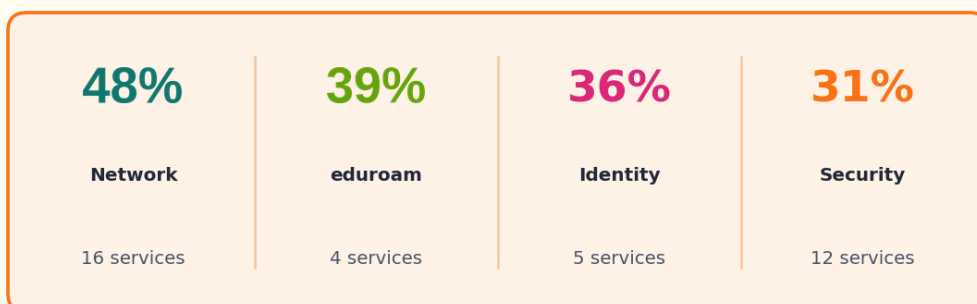
Services

The 2025 service portfolio — what NRENs deliver across eight categories, and how adoption has shifted since 2020.

IN THIS CHAPTER

- 4.1** Most Widely Deployed Services
- 4.2** Adoption by Category
- 4.3** Service Portfolio Breadth
- 4.4** Growth and Decline, 2020→25
- 4.5** Service-by-NREN Matrix

% = adoption rate (share of NRENs offering each service)



4. Services

81

services tracked across 8 categories in the Asi@Connect survey

Services are at the heart of what an NREN delivers, and this chapter places special emphasis on the 2025 service portfolio. The Asi@Connect survey covers 81 individual services across eight categories: Network, Security, Identity, Collaboration, Multimedia, Storage and Hosting, Professional, and eduroam-related services. The dual-wave structure of the data — covering both 2020 and 2025 — allows us to read growth and decline directly.

4.1 Most Widely Deployed Services

Core connectivity and operational services dominate the most-deployed list in 2025. IPv4 connectivity is essentially universal across the community; network troubleshooting and monitoring are near-universal; IPv6 connectivity is now offered by nearly nine in ten reporting NRENs, and eduroam by around four-fifths.

Top services: the technical backbone the community runs on

Top 15 services by 2025 adoption among the 19 NRENs reporting. Delta marks the change in adopter count between 2020 (n=22) and 2025 (n=19). Bar colour: teal ≥75%, sage 50–74%, coral <50%.

Service	Category	NRENs	Adoption (%)	% / change
IPv4 Connectivity	Network	19		100% ▼ 1 since 2020
Network Troubleshooting (Security)	Security	18		95% ▲ 2 since 2020
Network Monitoring	Network	18		95% ▲ 2 since 2020
Network Troubleshooting (Network)	Network	17		89% ▲ 1 since 2020
IPv6 Connectivity	Network	17		89% ▲ 3 since 2020
eduroam	Identity	16		84% — unchanged
Consultancy/Training	Professional	14		74% — unchanged
Remote Access VPN Services	Network	12		63% ▲ 4 since 2020
DNS Hosting	Storage	12		63% ▲ 3 since 2020
Web/Desktop Conferencing	Multimedia	11		58% ▼ 4 since 2020
Virtual Circuit/VPN	Network	11		58% ▲ 1 since 2020
Presence in Service Location Map	eduroam	10		53% ▲ 4 since 2020
Cloud Storage	Storage	9		47% — unchanged
Learning Management Services	Collaboration	9		47% ▲ 1 since 2020
Federated Services	Identity	9		47% ▲ 4 since 2020

Figure 4.1. Top 15 most-deployed services in 2025 with 2020 comparison. n_25=19, n_20=22.

4.2 Adoption by Category

Aggregated by category, Network services show the highest average adoption (48%), followed by eduroam (39%), Identity (36%) and Security (31%). Professional and Storage & Hosting sit just behind (30% and 28%), while Collaboration and Multimedia trail at 18% and 16% — pointing to clear opportunities for regional collaboration through Asi@Connect.

Where the community focuses: adoption by category

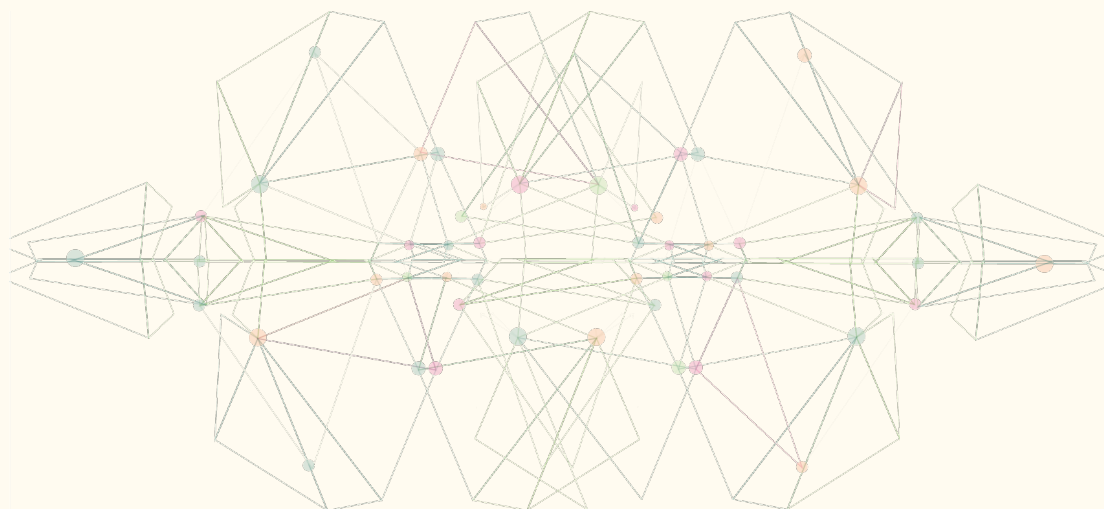
Average adoption rate across all services within each category (2025). Bar colour: teal ≥35%, sage 20–34%, coral <20%.



Figure 4.2. Average service adoption rate by category, 2025.

4.3 Service Portfolio Breadth

Looking across the eight categories, the breadth of services offered varies dramatically by NREN. CERNET and BdREN lead with the broadest portfolios — 49 and 43 of the 81 surveyed services — with PERN close behind at 42, followed by NKN, CamREN and ThaiREN, while several smaller NRENs concentrate on a tight core of essentials (IDREN and PREGINET report the fewest, 13 and 14).



Service portfolio: who offers most, who offers least

Number of distinct services offered in 2025 (out of 81 surveyed). Bar colour: teal ≥30%, sage 20–29%, coral <20%.



Figure 4.3. Service portfolio breadth — number of distinct services offered per NREN in 2025.

4.4 Growth and Decline, 2020 → 2025

The dual-wave structure makes it possible to identify where the community is moving forward and where it is contracting. Measured on the 19 NRENs that reported in both waves, Video Collaboration Services, Virtual Machines and Configuration Automation Tool show the clearest growth (each adding six adopters), followed by eduGAIN and perfSONAR (+5 each), then Remote-Access VPN, Presence in Service Location Map and Federated Services (+4 each). Genuine decline is rarer: Web/Desktop Conferencing saw the sharpest fall (four fewer adopters) and plagiarism-checking dropped three, while PERT, Scheduling Tools and Finance/Admin System each shed two. These falls may reflect members sourcing such tools directly from vendors rather than through their NREN.

Service churn: what's growing, what's fading

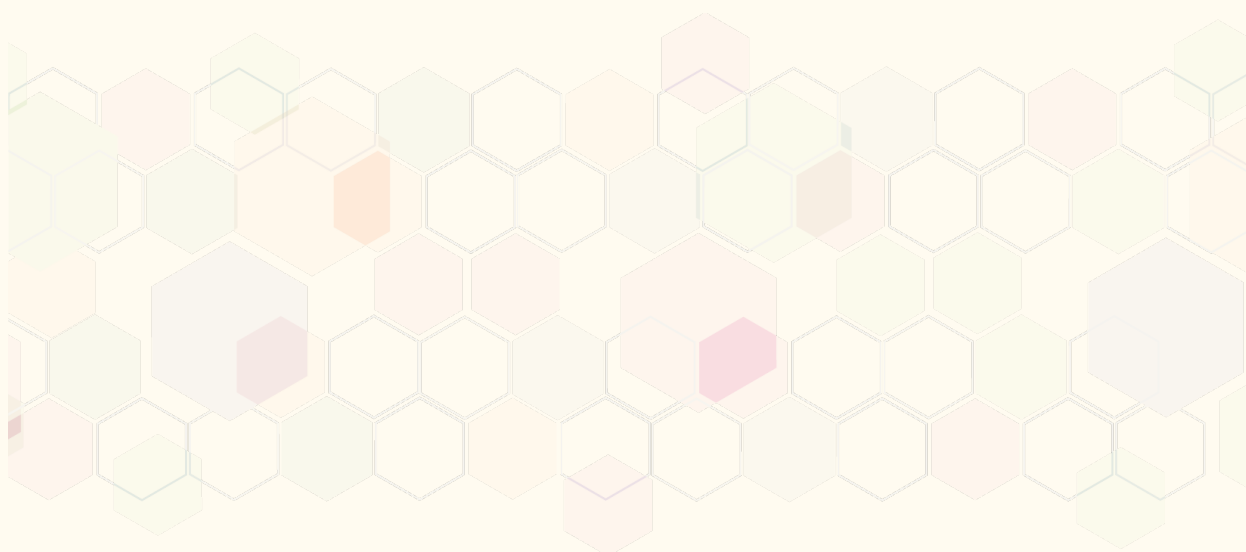
Change in the number of NRENs offering each service among the 19 reporting in both 2020 and 2025. Sage = growth, coral = decline.

Service	Category	2020 → 2025	Change in NRENs offering
Configuration Automation Tool	eduroam	3 → 9	+6
Video Collaboration Services	Collaboration	1 → 7	+6
Virtual Machines	Storage	0 → 6	+6
eduGAIN	Identity	4 → 9	+5
perfSONAR	Network	0 → 5	+5
Remote Access VPN Services	Network	8 → 12	+4
Presence in Service Location Map	eduroam	6 → 10	+4
Federated Services	Identity	5 → 9	+4
PERT	Network	3 → 1	-2
Scheduling Tools	Collaboration	2 → 0	-2
Finance/Admin System	Professional	6 → 4	-2
Plagiarism	Collaboration	4 → 1	-3
Web/Desktop Conferencing	Multimedia	15 → 11	-4

Figure 4.4. Service growth and decline between 2020 and 2025.

4.5 Service-by-NREN Adoption Matrix

For reference, the full service-by-NREN adoption matrix shows the complete picture: every service offered by at least one NREN in 2025, grouped by category. The matrix is presented across two pages — Part 1 covers Network, Identity, Security, and Storage services; Part 2 covers Professional, eduroam, Multimedia, and Collaboration services. NRENs are listed alphabetically across the top; cells are colour-cycled by category.



The full picture: every service, every NREN (part 1 of 2)

All services adopted by at least one NREN in 2025, grouped by category. Part 1 covers Network, Identity, Security and Storage (41 services).

★ = offered

Service	BjREN	CamREN	CERNET	DukREN	EdumNET	HARNET	IDREN	KOREN	LEARN	LERNET	MAFIN	MYREN	NKN	NREN	PERN	PREGNET	REANNZ	SingAREN	ThaREN
NETWORK · 16 services																			
avg 9.1 adopters per service																			
Virtual Circuit/VPN	★	★	★					★	★		★	★	★		★		★		★
SDN			★					★				★	★		★				
Remote Access VPN Services	★	★	★		★			★	★		★		★	★	★		★		★
Quality of Services	★		★		★	★		★				★	★		★				
perfSONAR	★								★			★			★				★
PERT															★				
Optical Wavelength			★	★											★			★	
Open Lightpath Exchange			★																
Network Troubleshooting	★	★	★	★		★		★	★	★	★	★	★	★	★		★	★	★
Network Monitoring	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★		★	★	★
Netflow Tool			★		★			★	★			★	★			★		★	
Multicast			★			★		★	★				★		★			★	
Managed Router Services	★		★					★				★	★		★		★		★
IPv6 Connectivity	★		★	★	★	★	★	★	★		★	★	★	★	★	★	★	★	★
IPv4 Connectivity	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★
Disaster Recovery Services	★		★									★	★		★		★		
IDENTITY · 3 services																			
avg 11.3 adopters per service																			
Federated Services	★		★			★		★	★			★			★		★	★	
eduroam	★	★	★	★		★	★	★	★	★		★		★	★	★	★	★	★
eduGAIN	★		★			★		★	★			★			★		★	★	
SECURITY · 12 services																			
avg 5.8 adopters per service																			
Web Filtering		★	★			★				★	★		★				★		★
Vulnerability Scannin	★		★									★			★				
Security Auditing	★		★										★		★				
PGP Key Server			★																
Online Payment			★																
Network Troubleshooting		★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★
Intrusion Detection			★								★		★		★				
Identifier Registry			★										★						
Firewall-on-demand		★	★		★	★		★	★		★		★						
DDoS Mitigation			★				★	★			★		★		★		★		★
CERT/CSIRT		★	★	★					★		★		★		★				
Anti-spam Solution	★	★	★									★							★
STORAGE & HOSTING · 10 services																			
avg 5.9 adopters per service																			
Web Hosting	★	★	★		★					★					★		★		★
Virtual Machines	★			★					★						★	★			★
SaaS	★		★						★										
Hosting/Colocation	★		★		★	★										★		★	★
Hot-Standby			★		★														
File Sender	★	★									★	★		★			★	★	
DNS Hosting	★	★	★	★	★		★		★		★				★	★	★		★
Disaster Recovery	★		★																
Content Delivery	★				★						★								
Cloud Storage	★	★	★					★	★						★	★	★		★
Services offered (this part)	25	15	36	10	13	13	7	18	18	7	15	16	22	11	26	10	16	13	18

Figure 4.5. Service × NREN adoption matrix, 2025 — Part 1: Network, Identity, Security, Storage (41 services).

The full picture: every service, every NREN (part 2 of 2)

All services adopted by at least one NREN in 2025, grouped by category. Part 2 covers Professional, eduroam, Multimedia and Collaboration (33 services).

★ = offered

Service	BdREN	CamREN	CEENET	DuREN	EdumNET	HARNET	IDREN	KOREN	LEARN	LERNET	MAFIN	MYREN	NKN	NREN	PERN	PREGNET	REANNZ	SingAREN	ThaREN
PROFESSIONAL · 9 services avg 5.8 adopters per service																			
Web Development	★	★	★		★					★				★					
User Portals			★					★							★				
Software Licenses	★		★		★	★					★			★	★				
Software Development	★	★	★		★					★									
Procurement Services			★	★		★									★				
Hosting of User Conference	★	★	★				★			★				★					
Finance/Admin System		★	★	★				★											
Dissemination of Information															★		★	★	
Consultancy/Training	★	★	★	★	★			★	★	★		★	★	★	★	★	★	★	
EDUROAM · 4 services avg 7.5 adopters per service																			
eduroam Hotspot - Public	★						★							★				★	
Configuration Automation Tool	★	★							★	★		★		★	★		★	★	
Statistics [F-ticks] Configured	★									★		★		★	★		★	★	
Presence in Service Location Map	★						★		★	★		★		★	★		★	★	★
MULTIMEDIA · 4 services avg 4.5 adopters per service																			
Web/Desktop Conferencing	★	★	★	★	★		★	★	★	★		★							★
Video Streaming				★	★														★
Multicast													★						
Event Recording/Streaming	★										★			★					
COLLABORATION · 16 services avg 3.8 adopters per service																			
VoIP	★				★								★						
Video Collaboration Services	★	★	★	★										★	★				★
SMS Messaging	★												★						
SIS (Students Information Service)		★																	
Research Gateway											★	★				★			★
Project Collaboration Tools											★				★			★	
Plagiarism															★				
Mailing Lists							★	★	★	★	★		★			★			
Learning Management Services	★	★		★	★				★	★				★	★				★
Journal Access	★		★								★				★	★			★
Instant Messages					★		★						★						
e-Portfolios															★				
Email Server Hosting	★	★	★		★										★				
Database Services		★	★								★							★	★
CMS Services	★														★				★
Class Registration Services					★														
Services offered (this part)	18	12	13	7	11	2	6	5	6	10	7	6	6	11	16	4	6	6	9

Figure 4.6. Service × NREN adoption matrix, 2025 — Part 2: Professional, eduroam, Multimedia, Collaboration (33 services).

NREN SPOTLIGHT > Extending eduroam beyond the campus > BdREN (Bangladesh)

Contributed by: Jamilur Rahman, Manager (Systems & Cloud), BdREN

Extending the Charm

Extending eduroam beyond the campus perimeter has been one of BdREN's most deliberate strategic pushes over the past three years, driven by a simple observation: the airport, not the classroom, is often where academics and researchers feel the lack of connectivity most acutely. Travellers in transit need to join a lecture, submit a paper, or simply stay in touch with their

institution — and eduroam's federated, credential-based model is well suited to serve that need without local sign-up friction.

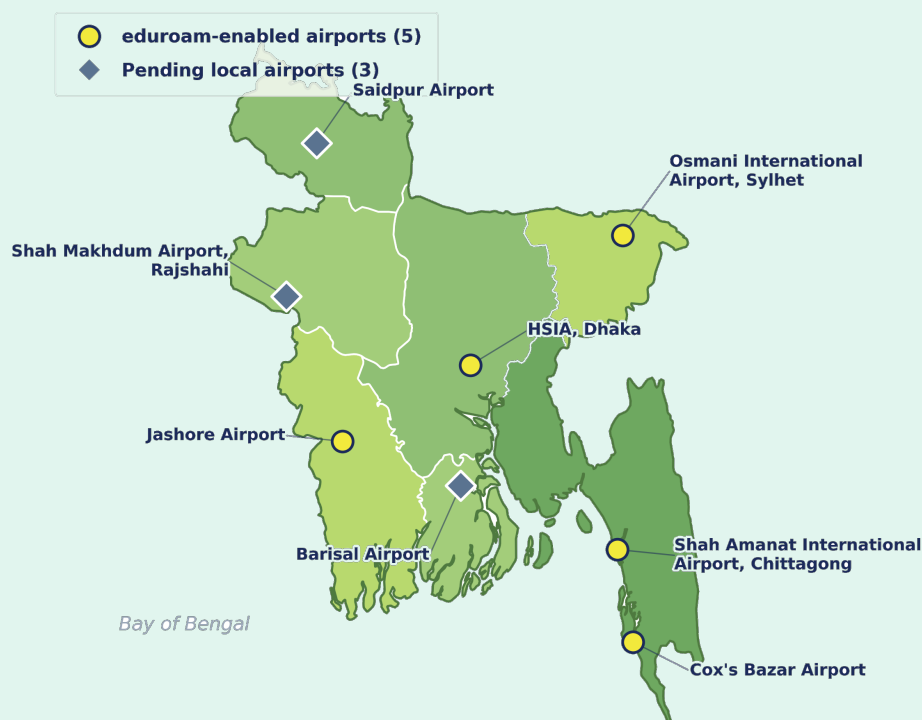
What we did

BdREN launched eduroam at Hazrat Shahjalal International Airport (HSIA), Dhaka, on 31 May 2023 — the first airport deployment in South Asia and, at the time, only the second in Asia. That initial rollout has since matured: coverage now extends into previously uncovered zones inside HSIA, including the CIP terminal and other lounges, and the service has been replicated at Bangladesh's two other international gateways, Osmani International Airport (Sylhet) and Shah Amanat International Airport (Chittagong). All three international airports are now live, alongside 40 campuses nationwide and two domestic airports — Jashore and Cox's Bazar — while two others, Saidpur, and Shah Makhdum (Rajshahi), are in the pipeline for the next phase of expansion.

How we did it

Airport Wi-Fi infrastructure was built around captive portals rather than WPA2/WPA3-Enterprise; Wireless Controllers sat behind private address space; and address translation meant authentication exchanges stalled at “Access-Challenge” and never completed to “Access-Accept”. We resolved this by deploying a dedicated RADIUS server at each airport, configured strictly as a client toward BdREN's National RADIUS Server. We worked directly with the serving ISP at each airport and the Civil Aviation Authority of Bangladesh to align network topology with enterprise-authentication requirements — a coordination effort that was as much regulatory as it was technical.

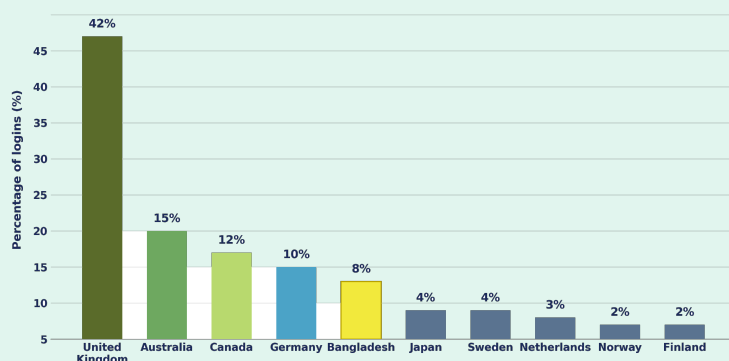
eduroam Availability in Bangladesh Airports



eduroam availability across Bangladesh's airports: five enabled, three in the pipeline

eduroam Logins at Total 5 Airports

Country-Wise Distribution (Top 10 Countries)

**Top 10 countries**

On the operational side, we built an in-house self-service eduroam account portal that lets faculty and students at member institutions register, verify by institutional email, and reset credentials without touching our helpdesk — a configuration-automation layer purpose-built for our member base, serving the same goal of low-friction, low-overhead onboarding that CAT delivers at national scale.

F-Ticks reporting and presence in the eduroam Service Location Map were added over the same period, giving BdREN and the wider federation visibility into usage. Monthly eduroam logins across the airports have grown steadily since 2023, with HSIA carrying the large majority of traffic given its size and international footfall.

Earnest request

The request we would pass on to peer NRENs is that airports are worth prioritizing precisely because this is where roaming researchers are at their most helpless, landing with no connectivity to the outside world. Knowing that the moment they touch down — anywhere in the world — they will be connected is a source of pride, honour, and esteem for the community, and a powerful selling point for every NREN in promoting REN connectivity. We are looking forward to that day.

NREN SPOTLIGHT > Extending eduroam beyond the campus > NREN (Nepal)

Contributed by: *Rajan Parajuli, PhD, Executive Director, NREN (Nepal)*

While we continue to develop in other service areas, NREN has been proactive in promoting eduroam services in the country. Today, all our member institutions—including a few medical academies—are connected to eduroam. A major milestone for us is the availability of eduroam services at Tribhuvan International Airport (TIA), with active plans in the pipeline to expand this coverage to other airports and public spaces. This strategic expansion was made possible through a partnership with the Airport Authority, where TIA shares its internet bandwidth and provides its Access Points (APs) to broadcast the eduroam SSID. Although it required persistent advocacy to align the airport authority with our mission to support R&E communities, we are proud to operate eduroam at TIA with zero costs.

NREN SPOTLIGHT > Extending eduroam beyond the campus > REANNZ (New Zealand)

Contributed by: *Aaron Murrihy, Networks & Digital Services Platform Lead, REANNZ*

REANNZ sees eduroam as more than a convenience service. Expanding eduroam beyond campuses has been an important part of our work to improve digital equity, ensuring learners can access educational resources wherever they are.

Working alongside the Ministry of Education and partners including Aotearoa People's Network Kaharoa (APNK), REANNZ has helped extend eduroam to more than 160 public libraries across New Zealand, creating trusted community spaces where students can connect using the credentials issued by their school, university or research organisation. The programme was developed in response to digital equity challenges highlighted during and after COVID-19, including the barriers faced by students without reliable internet access or suitable places to study.

This approach is continuing to extend eduroam into everyday locations. In Otago, coverage now reaches Dunedin Airport and 185 University of Otago student flats, helping reduce data costs for students while ensuring researchers, staff and visitors can connect the moment they arrive. Alongside growing adoption by research organisations, these developments are helping transform eduroam from a campus-based service into a broader network of connected learning and research spaces across Aotearoa.



ASI@CONNECT COMPENDIUM OF NRENs • 2025

CHAPTER 5

Advanced, Identity & eduroam Services

The frontier — implementation pipeline, identity federation, eduroam coverage, and the first look at AI-enabled services.

IN THIS CHAPTER

- 5.1** The Community Pipeline
- 5.2** Service-by-Service Pipeline
- 5.3** Demand Satisfaction
- 5.4** Implementation Growth
- 5.5** Top Implementers
- 5.6** Full Status Matrix
- 5.7** Identity Federation
- 5.8** eduroam Coverage & Services
- 5.9** AI-Enabled Services

108advanced
implementations**+32%**since
2020

5. Advanced, Identity and eduroam Services

108

Advanced service implementations in 2025 — up 32% from 2020

Beyond the core service portfolio, the Asi@Connect survey tracks 22 advanced services — research databases, HPC, public cloud, telemedicine, IoT, blockchain, and others — using a three-state classification per NREN: Demanded, Implemented, or Planned. The dual-wave structure shows the community in motion: 108 total implementations in 2025, up from 82 in 2020 — a +32% increase — with a substantial planning pipeline.

Sections 5.1 through 5.6 examine the advanced-services landscape. Sections 5.7 and 5.8 then turn to Identity Federation — where eduGAIN connectivity, federated services portfolios, and the Identity/Service Provider population are profiled — and to eduroam coverage and operational services, where the Asia-Pacific footprint is mapped country by country. Section 5.9 closes the chapter with the first compendium-level look at AI-enabled services across the community.

5.1 The Community Pipeline

Aggregate totals show implementation catching up with demand: Implemented responses grew from 82 in 2020 to 108 in 2025 (+32%), while total demand eased slightly (147 → 136). Tracing the 147 "Demanded" items from 2020 forward five years, 48% are now Implemented and a further 13% are Planned — so roughly 61% of the demand recorded in 2020 has either been delivered or is on track; a quarter (25%) is still demanded but not yet built or planned, and 14% has dropped from the pipeline entirely. This is a strong delivery record for the community. (This five-year trace follows the 2020 demand cohort forward — a different lens from the 2025 demand-satisfaction snapshot in §5.3, which measures current demand.)

Advanced services: demand is being delivered

Top: community totals across 22 advanced services, 2020 vs 2025. Bottom: where the 147 "Demanded" items from 2020 stand five years on — 48% now implemented, 13% planned, 25% still demanded, 14% dropped.

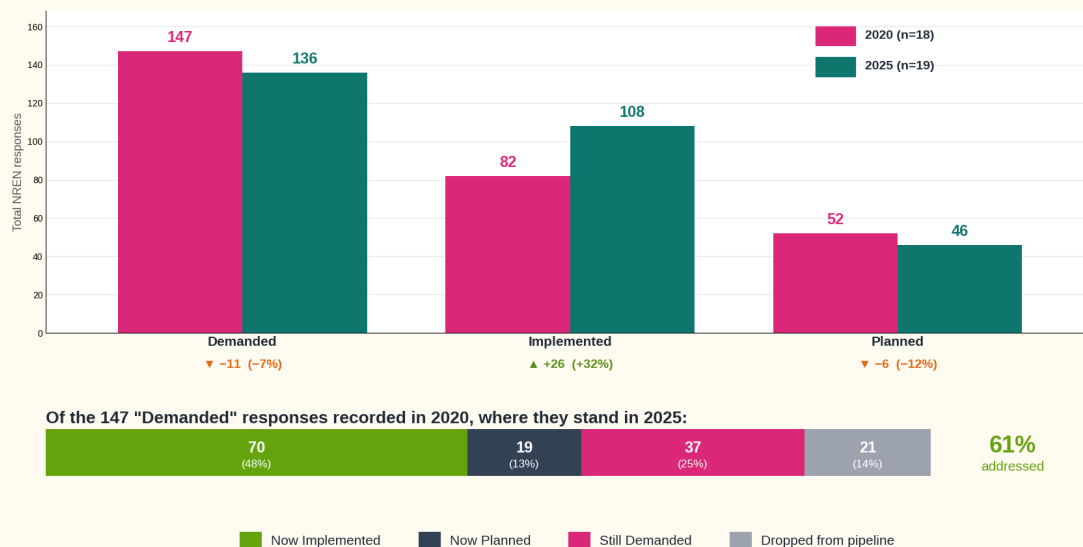


Figure 5.1. Advanced services: community totals (top) and where 2020 demand stands in 2025 (bottom).

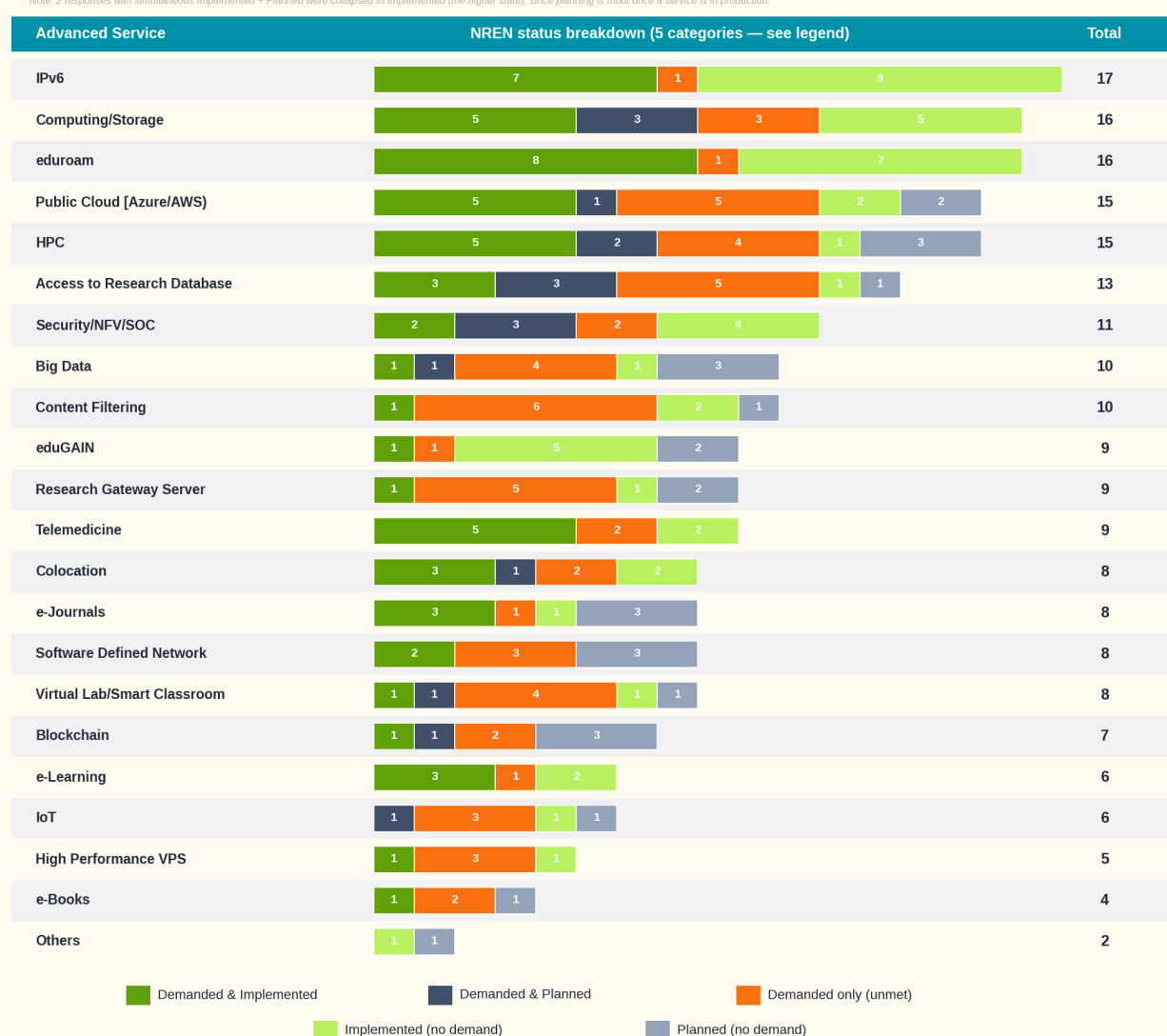
5.2 Service-by-Service Pipeline

Per service, each NREN's status falls into one of five logically distinct categories that distinguish demand-driven delivery from delivery that occurred without explicit demand: Demanded & Implemented, Demanded & Planned, Demanded only (unmet), Implemented without expressed demand, and Planned without expressed demand. eduroam and IPv6 lead implementation with most reporting NRENs already delivering. Computing/Storage, Public Cloud and HPC follow with substantial active pipelines. Services like IoT, Virtual Lab/Smart Classroom, Research Gateway Server and Content Filtering show large "demanded only" segments — these are the natural opportunities for Asi@Connect knowledge transfer and co-investment.

Advanced services pipeline: who wants what, who has what

22 advanced services in 2025, n=19 NRENs. Each row decomposes NREN responses into five mutually-exclusive categories that distinguish demand-matched delivery from delivery without expressed demand.

Note: 2 responses with simultaneous Implemented + Planned were collapsed to Implemented (the higher state), since planning is moot once a service is in production.

**Figure 5.2.** Advanced services pipeline by service in 2025, decomposed into five mutually-exclusive (D, I, P) categories.

5.3 Demand Satisfaction

Normalising the previous figure by total demand per service gives a clean view of how well each advanced service's demand is being satisfied. Community-wide in 2025, of 136 demand responses across 21 services, 43% are met by implementation, 12% are being met through active planning, and 44% remain unmet — meaning 56% of expressed community demand is either delivered or in the pipeline. The unmet 44% represents the priority surface for Asi@Connect. (This snapshot measures 2025 demand — how much of what NRENs want today is being met — as distinct from the five-year trace of the 2020 cohort in §5.1.)

At the service level the rates vary widely. eduroam and IPv6 lead the field (89% and 88% of demand met by implementation), with e-Journals, e-Learning and Telemedicine all at 71% or above. At the opposite end, Content Filtering (86% unmet), Research Gateway Server (83% unmet), IoT (75% unmet) and Virtual Lab/Smart Classroom (67% unmet) have the largest unmet-demand fractions and stand out as natural project priorities — particularly because the absolute demand counts on these services are not small (4–7 NRENs each).

Demand satisfaction: how much of what NRENs want do they actually have?

For each of the 21 advanced services with reported demand in 2025, the bar shows how that demand is being satisfied: sage = Implemented, slate = Planned, coral = Unmet. Services sorted by total demand descending.

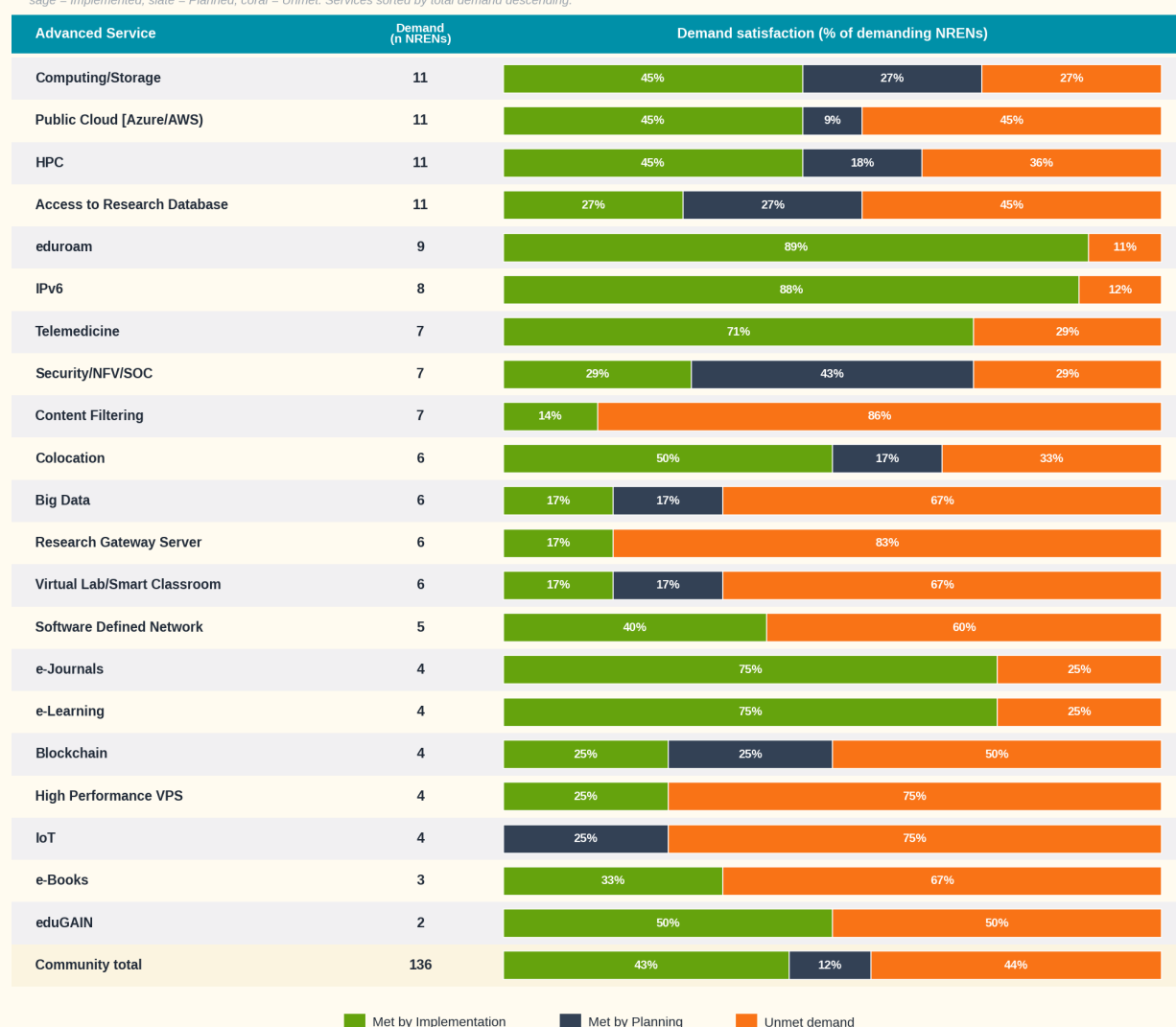


Figure 5.3. Demand satisfaction rates per advanced service, 2025: percentage of demanding NRENs whose demand is met by implementation, planning, or remains unmet.

5.4 Implementation Growth, 2020 → 2025

Per-service implementation counts give a clear picture of where the community gained ground and where it lost it. The biggest gainers are Computing/Storage and Security/NFV/SOC (both +4), followed by IPv6, eduroam and Public Cloud (all +3). A handful of services show decline: e-Books (−3), Virtual Lab/Smart Classroom (−2) and e-Learning (−1), often reflecting either migration into commodity provision outside the NREN remit, or a shift in user priorities.

Implementation growth: what the community built, 2020 → 2025

Advanced-service implementations per service on the consistent 18-NREN panel. Slate = already in place in 2020, green = added since, coral = lost. Sorted by 2025 count.



Figure 5.4. Advanced service implementation growth, 2020 → 2025 — change in number of NRENs implementing each service. Sorted by 2025 implementation count.

5.5 Top Implementers

ThaiREN remains the sustained leader, with eleven services implemented in both 2020 and 2025. REANNZ also reaches eleven in 2025, but did not report in the 2020 survey, so no trajectory is drawn for it. Below the leaders, CERNET (ten) and PERN (nine) form the next tier: PERN's rise from four to nine is the largest genuine expansion among NRENs reporting in both waves. BdREN (eight), LEARN and PREGINET (seven) and SingAREN (six) follow. The dumbbell chart shows each NREN's journey: open dot = 2020 position, filled dot = 2025 position, with the connecting line in sage for growth or coral for decline. REANNZ, lacking a 2020 baseline, appears as a single 2025 marker.

Implementation leaders: how each NREN's advanced-services portfolio evolved

Each row shows one NREN's journey: open dot = 2020, filled dot = 2025. NRENs sorted by 2025 count.
REANNZ did not report in 2020; only its 2025 position is shown.

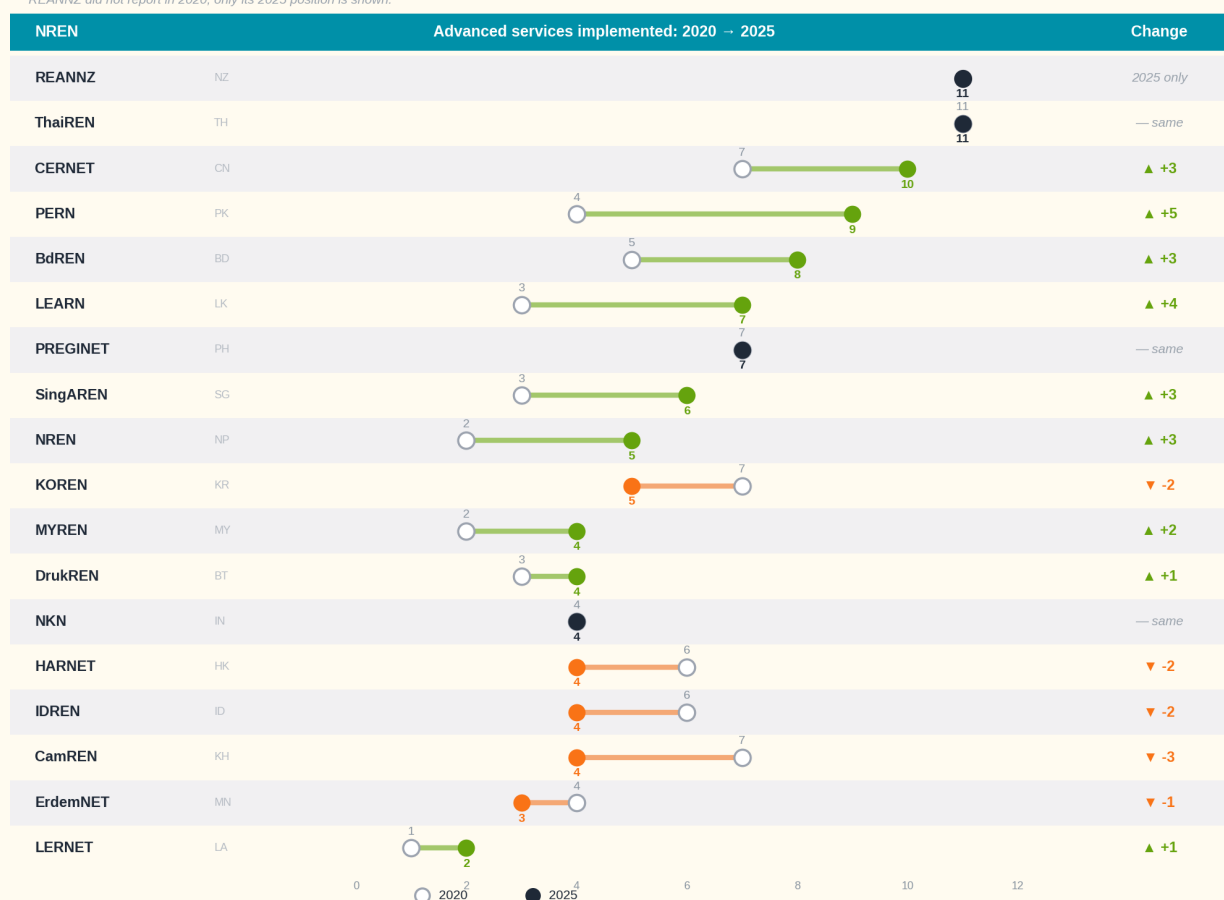


Figure 5.5. Advanced service implementers: each NREN's 2020 → 2025 trajectory in number of advanced services implemented.

5.6 Full Status Matrix

The complete matrix shows every NREN's status against every advanced service: implemented, planned, or demanded-only. The matrix makes the natural Asi@Connect collaboration opportunities visible: services that one or two NRENs have implemented and many others are planning are prime candidates for knowledge transfer through the project.

Service	B4REN	CamREN	CERNET	DukREN	EdumNET	HARNET	IDREN	KOREN	LEARN	LERNET	MAFFIN	MYREN	NKN	NREN	PERN	PREGINET	REANNZ	SingAREN	ThaIREN										
ESTABLISHED · 8 services																				73 impl · 16 plan · 19 demand									
IPv6	★	★	★	★	★	★	★	★	★			★	★	★	★	★	★	★	★										
eduroam	★	★	★	★		★	★		★	★	★	★		★	★	★	★	★	★										
Computing/Storage	★		★	★	★		★	★	★	★		★	★	★	★	★	★	★	★										
Public Cloud [Azure/AWS]			★	★		★	★	★	★	★	★		★	★	★	★	★	★	★										
Telemedicine			★	★	★		★			★				★	★	★			★										
eduGAIN	★			★					★			★		★	★		★	★	★										
HPC	★	★	★			★	★	★	★	★	★		★	★	★	★	★		★										
Security/NFV/SOC	★		★	★	★				★				★	★	★		★	★	★										
DEVELOPING · 5 services																				21 impl · 9 plan · 15 demand									
Colocation	★			★					★						★	★	★	★	★										
e-Learning				★	★				★					★	★				★										
Access to Research Database	★		★	★			★		★	★	★	★	★	★	★			★	★										
e-Journals	★		★	★					★		★			★	★				★										
Content Filtering	★		★	★	★		★		★				★		★	★	★												
EMERGING · 9 services																				14 impl · 19 plan · 26 demand									
Big Data			★		★		★		★	★			★	★	★		★		★										
High Performance VPS	★				★				★					★	★														
Research Gateway Server	★	★			★		★		★	★				★	★				★										
Software Defined Network			★		★			★					★	★	★	★			★										
Virtual Lab/Smart Classroom	★		★	★			★			★			★	★	★														
Blockchain	★		★		★	★							★	★	★														
e-Books	★								★					★	★														
IoT		★	★							★			★	★	★														
Others															★		★												
★ Implemented ★ Planned ★ Demanded-only																													

NREN SPOTLIGHT › Leading on advanced services › **REANNZ (New Zealand)**

Contributed by: Aaron Murrihy, Networks & Digital Services Platform Lead, REANNZ

REANNZ's breadth of service development reflects the evolution of our role from primarily being a network provider to becoming **a strategic connector and enabler for** research education and innovation. The integration of New Zealand eScience Infrastructure (NeSI) into REANNZ in

July 2025 brought together advanced networking, international research connectivity, computing, data storage, identity, data transfer and research support services under a single organisation. As a result, REANNZ now plays a larger role in both connecting New Zealand researchers to the world and providing the infrastructure and services that enable research at home.

This direction aligns with REANNZ's five-year strategy, which focuses on strengthening New Zealand's research infrastructure, connecting communities and accelerating the adoption of new capabilities across the sector. Many of our newer services build on expertise and platforms already proven elsewhere in the global research and education community, allowing us to bring those benefits to New Zealand researchers more quickly.

When deciding where to invest next, we start with the needs of our members and work with the broader sector to design the infrastructure and technologies they need for the future. We look for areas where a shared national service can solve common challenges, reduce duplication, and enable research that would otherwise be difficult for individual institutions to undertake on their own. The goal is not to deliver the largest number of services, but to focus on those that provide the greatest benefit to the community, and the greatest impact to the country as a whole.

5.7 Identity Federation

Identity federation is the connective tissue that lets a researcher's home credentials unlock services across institutions and borders. The 2020 → 2025 trend lines reveal three interlocking stories: a maturity ladder where reporting NRENs are visibly advancing, a portfolio of federated services where planning intent vastly outweighs current delivery, and a population of Identity Providers (IdPs) and Service Providers (SPs) that has roughly doubled across the community.

5.7.1 Federation Maturity Status

The federation status of each NREN follows a clear progression: Not Planned yet → Under Plan → Under Test → National Federation → eduGAIN. These five states are mutually exclusive in the survey data, with one operational nuance — NRENs at eduGAIN are by definition also operating a National Federation, since eduGAIN membership requires it. The chart below treats this implicit fact as explicit. The community-level shift between 2020 and 2025 is meaningful: 'Not Planned yet' dropped from 5 NRENs to 2, eduGAIN connectivity grew from 5 to 7, and Bangladesh's BdREN advanced two full steps from Under Test to eduGAIN — the most visible movement in the cohort. New entrants to the ladder in 2025 are NREN-Nepal (Under Test) and ErdemNET (Under Plan). REANNZ also appears at eduGAIN, but did not participate in the 2020 survey, so its earlier federation status is unknown — its appearance reflects first reporting, not a confirmed new arrival.

NREN-by-NREN federation maturity journey, 2020 → 2025

Each row shows one NREN's position on the federation ladder. Open dot = 2020, filled dot = 2025; arrow indicates advancement. NRENs at eduGAIN are shown with the National Federation dot also active, since it is a prerequisite.

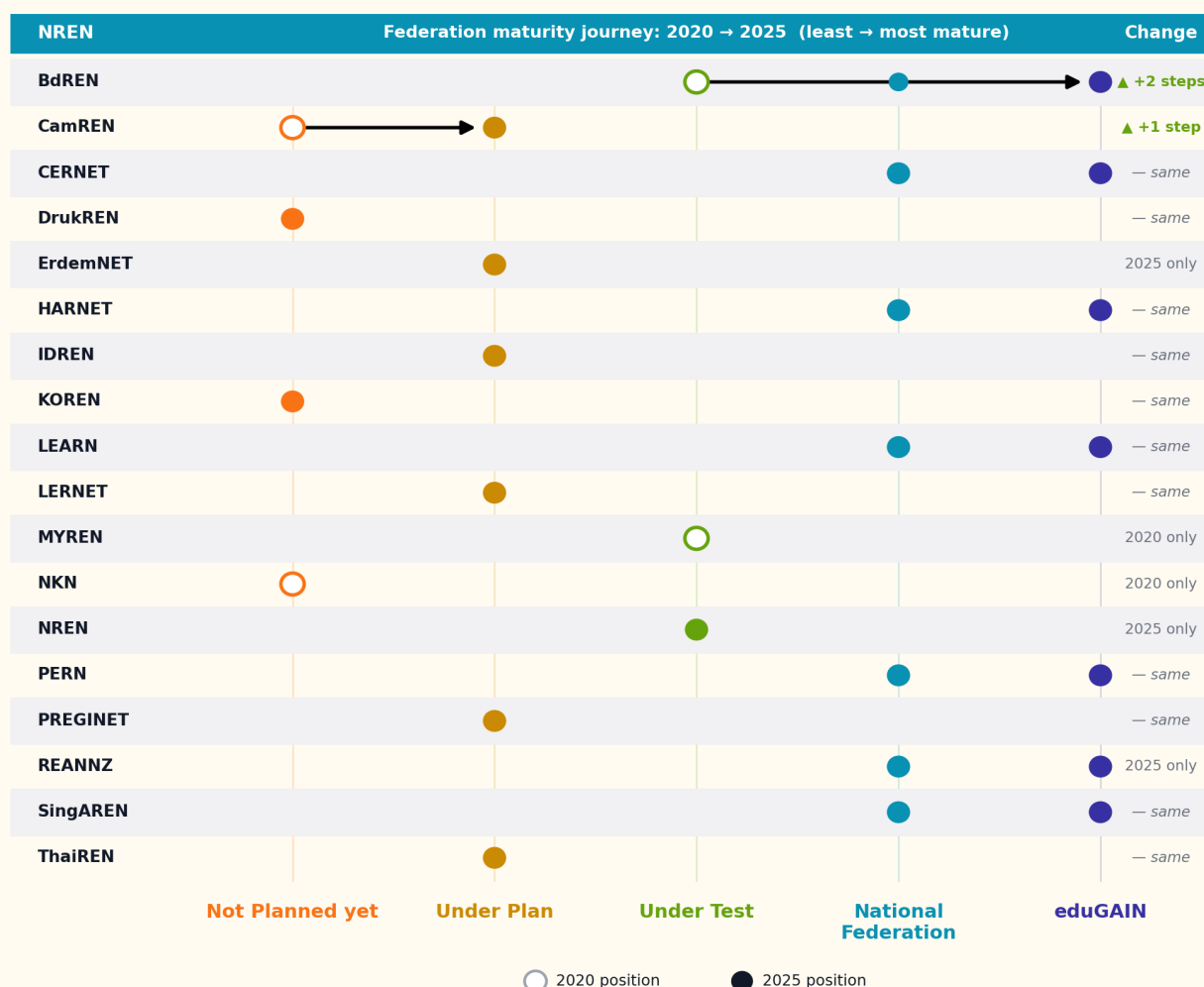


Figure 5.7. Per-NREN federation maturity journey, 2020 → 2025. Open dot = 2020 position, filled dot = 2025 position; sage arrow indicates advancement. NRENs at eduGAIN also have the National Federation dot lit, since it is a prerequisite.

5.7.2 Federated Services

Seven services are tracked in the 'Federated Services' framework, where each NREN's status for each service is one of: Provided (operational federated service), Planned (on the roadmap), or no engagement. The matrix below shows every NREN's posture across all seven services in both waves. Sage arrows indicate progression — an NREN that moved from Planned in 2020 to Provided in 2025; muted arrows show continuity (same status both years); coral would mark regression (none observed). The pattern is striking: BdREN converted Big File Sender and Digital Library from Planned to Provided; CERNET converted Cloud Storage; ErdemNET remains the sole provider of Trusted Digital Certificate; LEARN newly delivered Research Repository, Big File Sender, Digital Library, and Video Collaboration. Several NRENs (CERNET, PERN, BdREN, IDREN, LERNET, NKN) maintain extensive planning portfolios, suggesting a substantial pipeline of federated services awaiting delivery.

Federated Services per NREN: who provides, who plans

Each NREN shows status across 7 distinguished services in 2020 and 2025, where marker shows status and arrows show evolution.

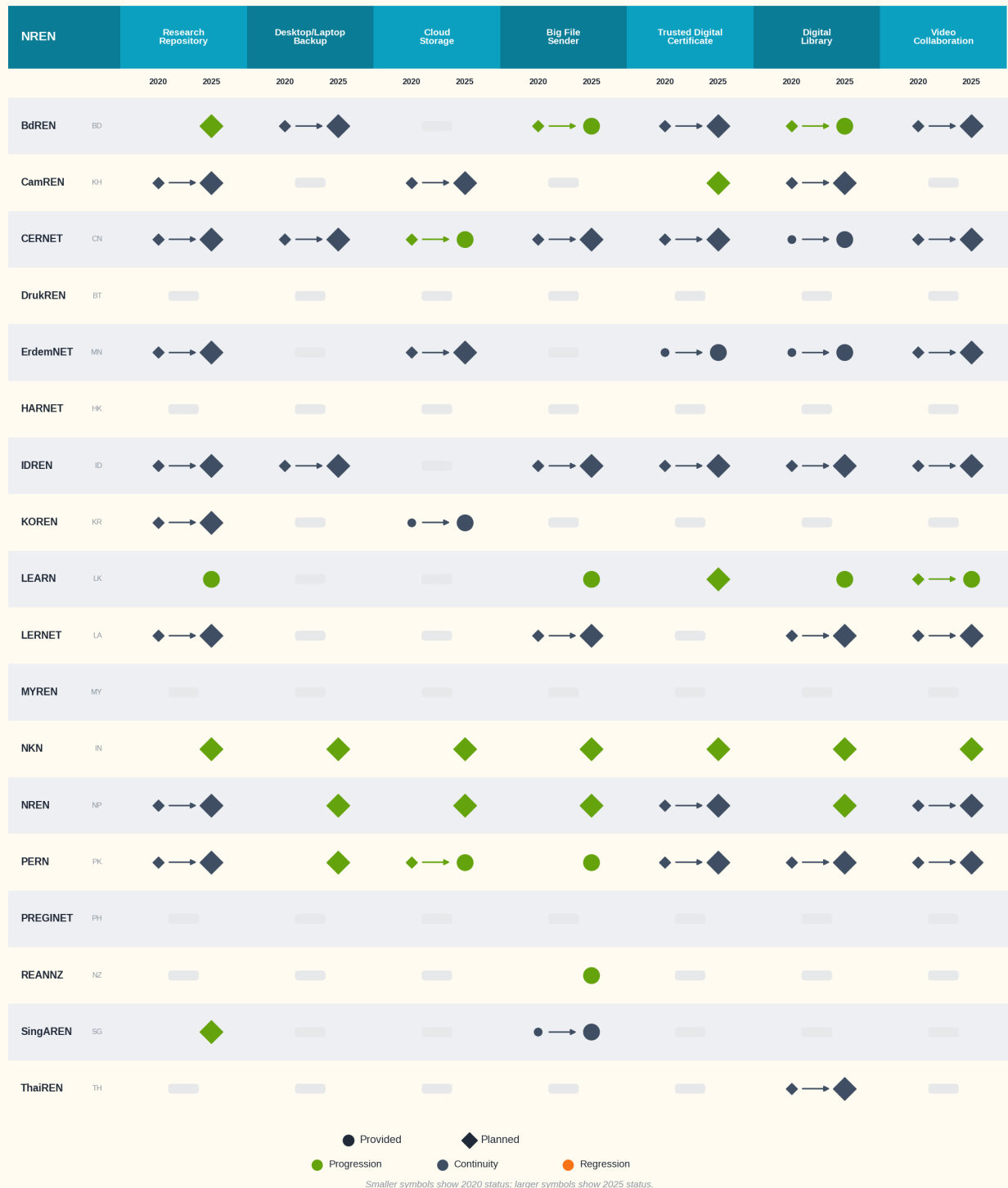


Figure 5.8. Federated Services per NREN, 2020 vs 2025. ○ = Provided, ◆ = Planned. Arrow colours encode the transition between waves (sage = progression, muted = continuity, coral = regression).

5.7.3 Identity Provider and Service Provider Population

Beyond status flags, ten NRENs report the actual number of Identity Providers (IdPs) and Service Providers (SPs) they operate. The community totals tell an unambiguous growth story: IdPs nearly doubled, from 620 across 9 NRENs in 2020 to 1,219 across 9 NRENs in 2025 (+97%). SPs grew similarly, from 138 to 273 (+98%). CERNET dominates the population — 938

IdPs and 156 SPs in 2025 — followed by ThaiREN (87/87), LEARN (55/1), MYREN and IDREN (40 IdPs each, both newly reporting), BdREN (24/5), SingAREN (15/5), and HARNET (14/7). BdREN's twelve-fold IdP scale-up (2 → 24) is the steepest individual climb among existing reporters.

Identity Provider and Service Provider counts per NREN, 2020 → 2025

Community totals shown in the cream row at the bottom.

NREN		Identity Providers				Service Providers			
		2020		2025	Change	2020		2025	Change
BdREN	BD	2	→	24	▲ +22	2	→	5	▲ +3
CERNET	CN	451	→	938	▲ +487	47	→	156	▲ +109
CamREN	KH	0	→	0	—	0	→	2	▲ +2
HARNET	HK	10	→	14	▲ +4	7	→	7	—
IDREN	ID	0	→	40	▲ +40	0	→	5	▲ +5
LEARN	LK	50	→	55	▲ +5	1	→	1	—
LERNET	LA	4	→	0	▼ -4	1	→	0	▼ -1
MYREN	MY	0	→	40	▲ +40	0	→	3	▲ +3
NREN	NP	14	→	0	▼ -14	0	→	0	—
PERN	PK	6	→	6	—	2	→	2	—
SingAREN	SG	8	→	15	▲ +7	3	→	5	▲ +2
ThaiREN	TH	75	→	87	▲ +12	75	→	87	▲ +12
Community total		620	→	1219	▲ +599	138	→	273	▲ +135

Figure 5.9. Identity Provider and Service Provider counts per NREN, 2020 → 2025. Community totals shown in the cream row at the bottom.

NREN SPOTLIGHT > Identity federation and eduGAIN > CERNET (China)

Contributed by: *WeiQi Zhao, International Collaboration Coordinator, CERNET*

CARSI is a federated identity and resource-sharing service provided by CERNET for all member institutions. In 2019, CARSI became a full member of the global identity federation eduGAIN. To date, CARSI has integrated nearly 1,000 universities and research institutions, aggregating more than 300 types of resources and services covering journals, books, teaching and training programmes, specialized datasets, research tools, as well as popular AI resources.

NREN SPOTLIGHT › Identity federation and eduGAIN › **LEARN (Sri Lanka)**

Contributed by: *Deepthi Gunasekara, Senior Network/Systems Engineer, LEARN*

Overview and Federation Scale The LEARN Identity Access Federation (LIAF) functions as the central trust and authentication framework for Sri Lanka's research and education sector. While the official compendium tracker records LEARN as operating 55 Identity Providers (IdPs), active ecosystem onboarding has successfully scaled that footprint to 57 connected institutional IdPs.

Value-Added Identity & Access Services LEARN has moved beyond basic federation to deploy an advanced suite of digital identity and secure campus mobility solutions:

- **eduID:** Provides a persistent, lifelong, unique digital identity for students and staff, facilitating secure Single Sign-On (SSO) access to academic resources independent of changing institutional affiliations.
- **eduroam:** Enables seamless, encrypted global wireless roaming, allowing researchers and students to automatically connect at any participating campus using their home institutional or eduID credentials.
- **eduVPN:** Delivers a secure, privacy-preserving VPN infrastructure integrated into our federated network access, ensuring researchers can access internal university resources safely when connecting from public or insecure environments.
- **laMaaS (Identity Access Management as a Service):** Centralises IdP hosting and configuration management to significantly reduce the administrative and technical burden on resource-constrained member universities.

Free Capacity Development & Service Promotion To bridge technical equity gaps and actively drive community onboarding, LEARN runs specialised capacity development programmes completely free of charge for engineering, ICT, and administrative staff at member institutes. These regular training tracks and deep-dive technical workshops are purposefully designed to accelerate the organic adoption of identity federation services, cloud-native Identity Access Management (IAM), and the deployment of open-source services (FOSS) across Sri Lankan campuses.

Production Service Milestones & Security Roadmap The 2025 Compendium explicitly notes LEARN's high technical agility in converting long-term roadmap intent into operational reality. LEARN successfully delivered four active, production-ready federated frameworks to the region: *Research Repository*, *Big File Sender*, *Digital Library*, and *Video Collaboration*—including vCR, our high-availability, free alternative to commercial communication tools.

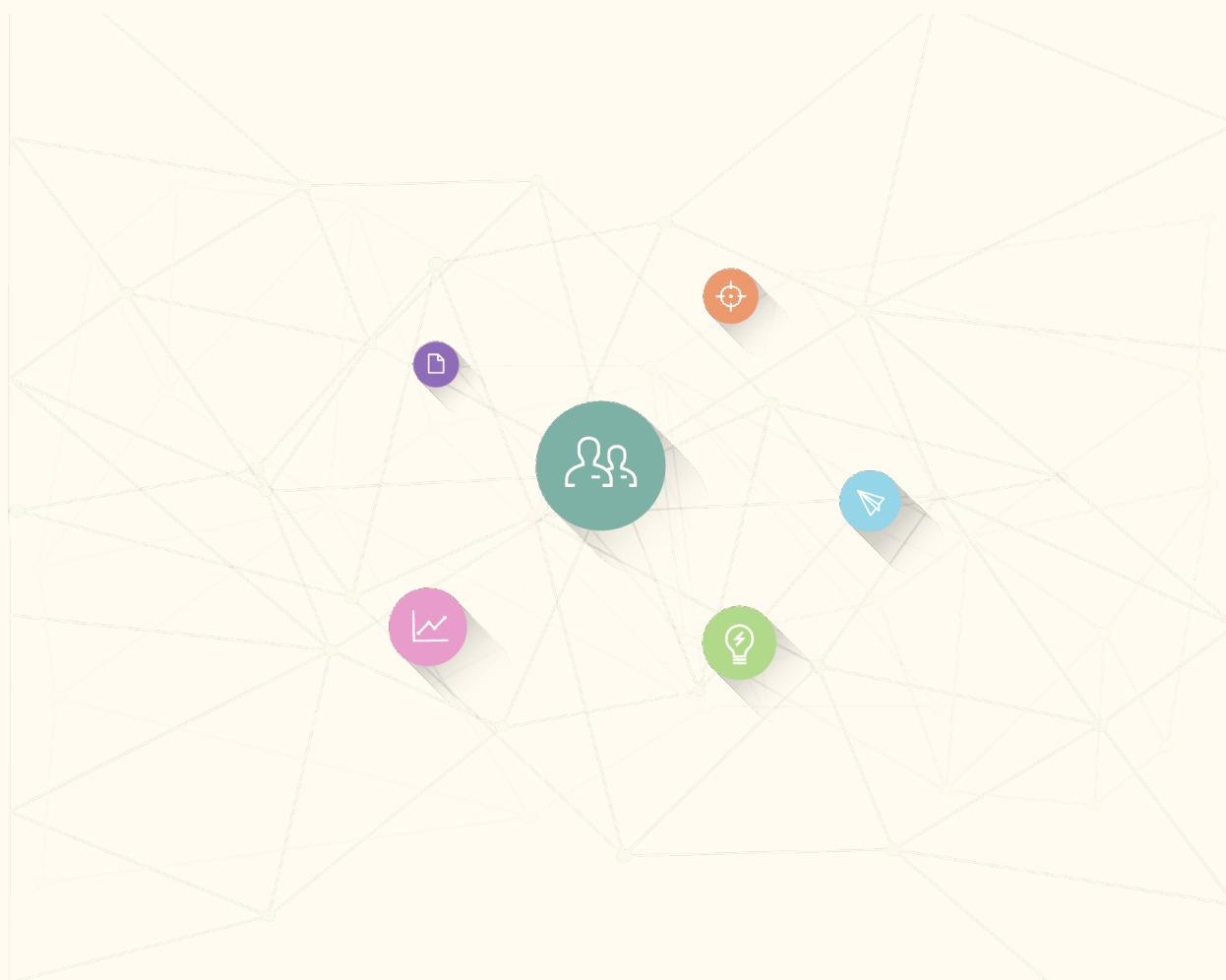
To sustain this growth, the LEARN Technical Assistance Centre (TAC) provides dedicated troubleshooting and implementation blueprints to help members deploy updated Shibboleth environments on modern operating systems. Looking ahead, our security roadmap is currently evaluating Multi-Factor Authentication (MFA) for IdP Version 5 within a controlled testbed environment to ensure complete community-wide hardening prior to release.

5.8 eduroam Coverage & Services

eduroam — the global federated Wi-Fi roaming service — provides one of the most concrete and widely used benefits of being an NREN. Survey respondents report two related metrics: the campus footprint of their eduroam deployment (binned into four size brackets), and a set of four operational support services (Hotspot Beyond Institutes, Configuration Automation Tools, F-Ticks statistics, and Service Location Map presence). Both metrics show community-wide growth between 2020 and 2025.

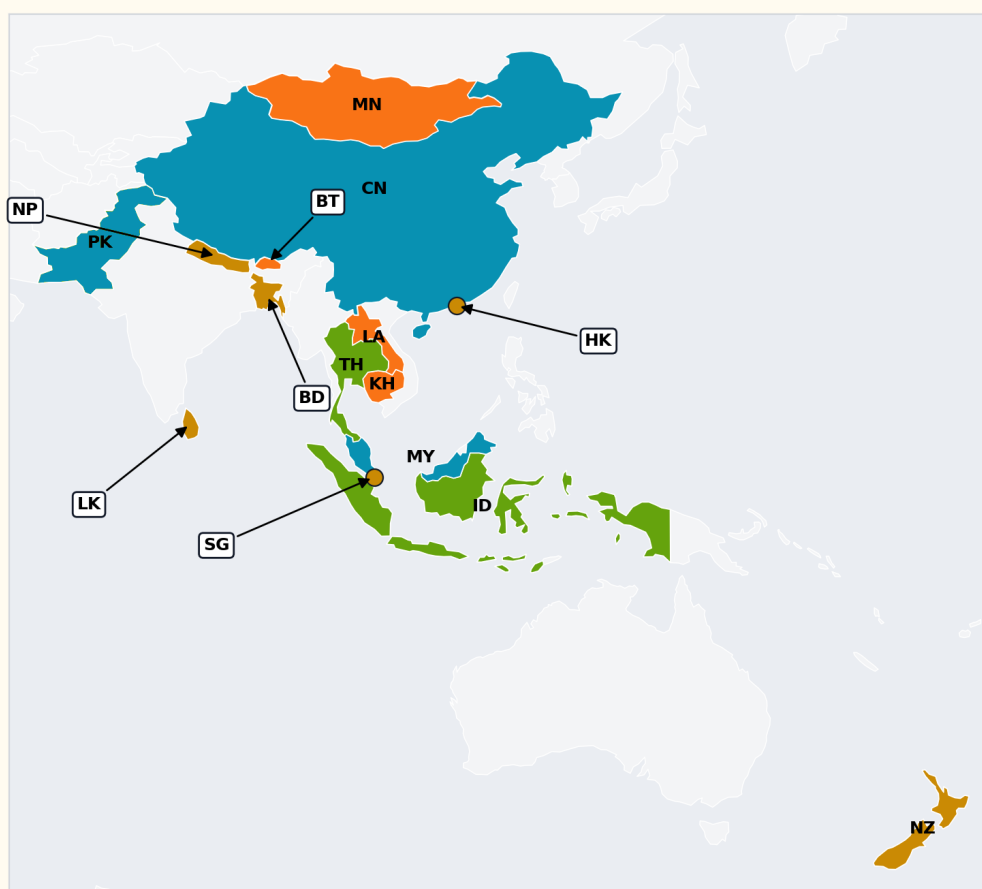
5.8.1 Campus Coverage

Across the Asia-Pacific region, 15 NRENs reported a campus-coverage bracket in 2025, against 15 in 2020. The map below shows the 2025 distribution by country. CERNET (China), MYREN (Malaysia) and Pakistan (PERN) anchor the top tier with 100–500 campuses each — MYREN's leap from the 10–50 bracket in 2020 is the single largest jump in the cohort. Indonesia (IDREN) and Thailand (ThaiREN) occupy the 50–100 band. The 10–50 bracket holds steady, gaining new entrants REANNZ (NZ) and SingAREN alongside continuing NRENs, while the ≤ 10 bracket holds Mongolia (ErdemNET) together with CamREN, DrukREN and Laos (LERNET).



eduroam campus coverage across the Asia-Pacific region, 2025

Each country shaded by the highest eduroam campus-coverage bracket reported by an NREN there. Labels are ISO-style country codes.



Reporting countries: 15 of 20 Asi@Connect member countries

■ ≤ 10 campuses
 ■ 10-50 campuses
 ■ 50-100 campuses
 ■ 100-500 campuses

○ Dot = territories too small to colour at this scale (Hong Kong, Singapore).

Leader lines used for cramped labels (Nepal, Sri Lanka, Bhutan, Bangladesh, Singapore, Hong Kong).

Figure 5.10. eduroam campus coverage across the Asia-Pacific region, 2025. Country shades indicate the bracket reported by the local NREN. Small territories (Hong Kong, Singapore, Bhutan) are marked with dots and leader-line labels.

To make the changes between 2020 and 2025 explicit at the NREN level, the chart below presents each NREN's bracket position in both waves as a journey. Open dots mark the 2020 bracket, filled dots the 2025 bracket, and the sage arrow signals upward movement. MYREN's +2-step jump stands out; IDREN, ThaiREN, PERN and NREN-Nepal each advance one step; ErdemNET, REANNZ and SingAREN are new entries in 2025. PREGINET is the sole NREN that reported a bracket in 2020 but not in 2025.

Per-NREN eduroam campus-coverage journey, 2020 → 2025

Open dot = 2020 bracket, filled dot = 2025 bracket; sage arrow indicates upward movement.

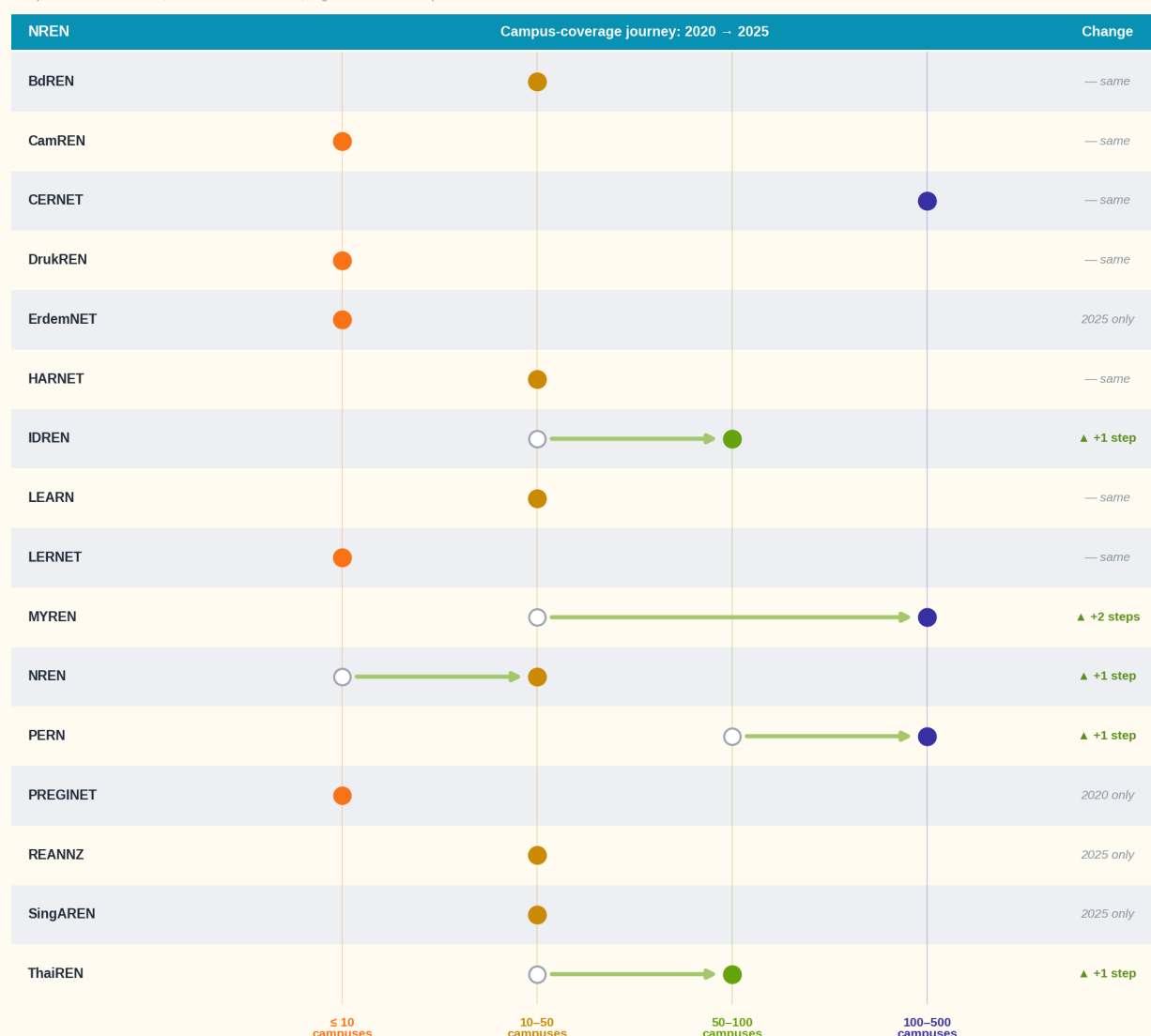


Figure 5.11. Per-NREN eduroam campus-coverage journey, 2020 → 2025. Open dot = 2020 bracket, filled dot = 2025 bracket; sage arrow indicates upward movement.

5.8.2 Associated Services

Four operational services support the eduroam stack: Hotspot Beyond Institutes (allowing roaming users to authenticate at non-academic hotspots), Configuration Automation Tools (CAT, the standard configuration distribution mechanism), F-Ticks Configured (the eduroam statistics-reporting protocol), and Presence in the Service Location Map. Community delivery grew in every category between 2020 and 2025: Hotspot 1 → 4, CAT 3 → 8, F-Ticks 4 → 7, Service Location Map 6 → 10. The matrix shows which NRENs deliver what. BdREN and LEARN stand out as having gained multiple services in this period, while REANNZ — joining in 2025 — already reports all four operational; PERN maintains continuity on three of the four services (CAT, F-Ticks, and Service Location Map presence) across both waves. Several large eduroam operators (CERNET, HARNET, ErdemNET) do not report any of these supporting services — possibly because they use bespoke implementations rather than the standard stack.

eduroam Associated Services per NREN, 2020 → 2025

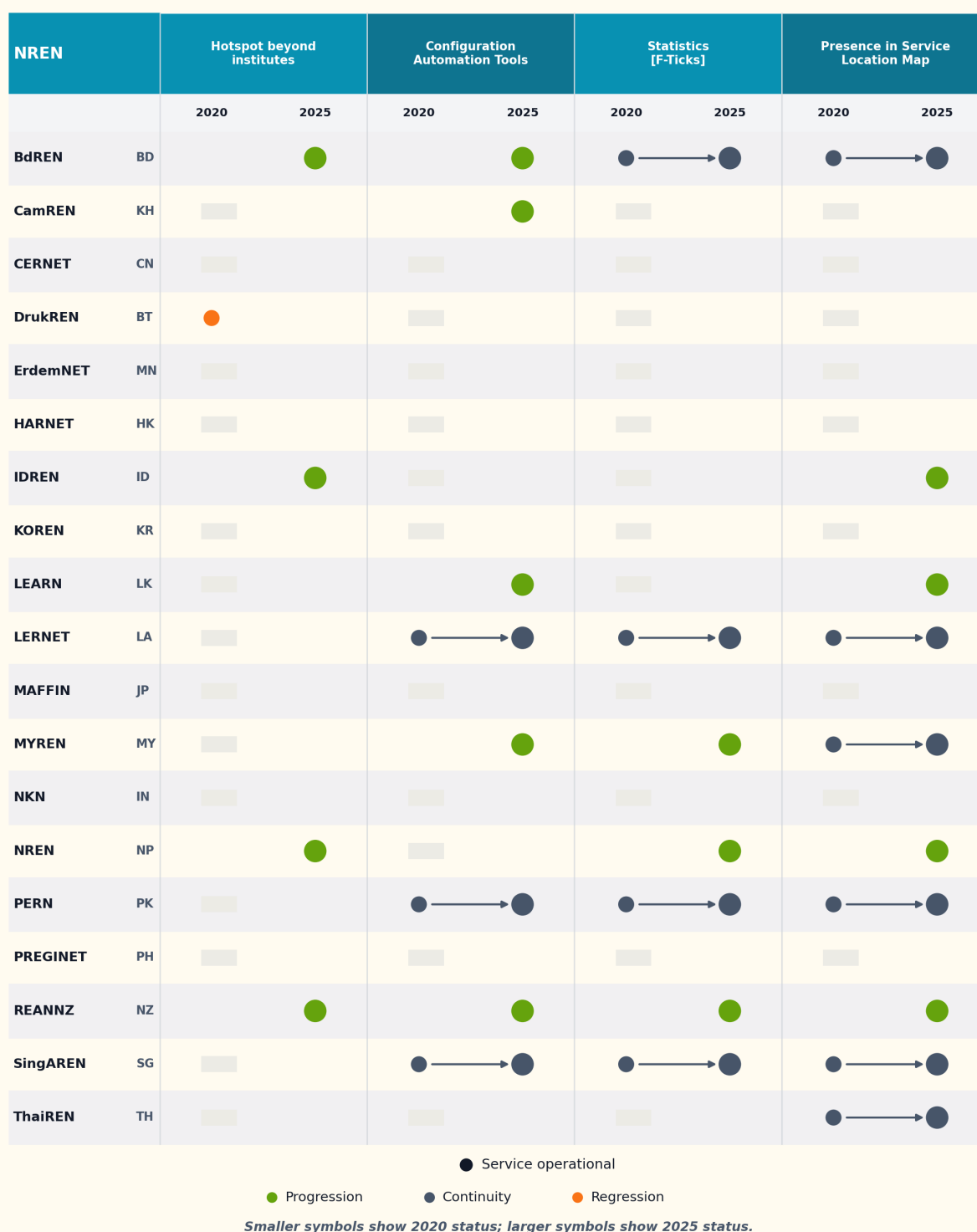
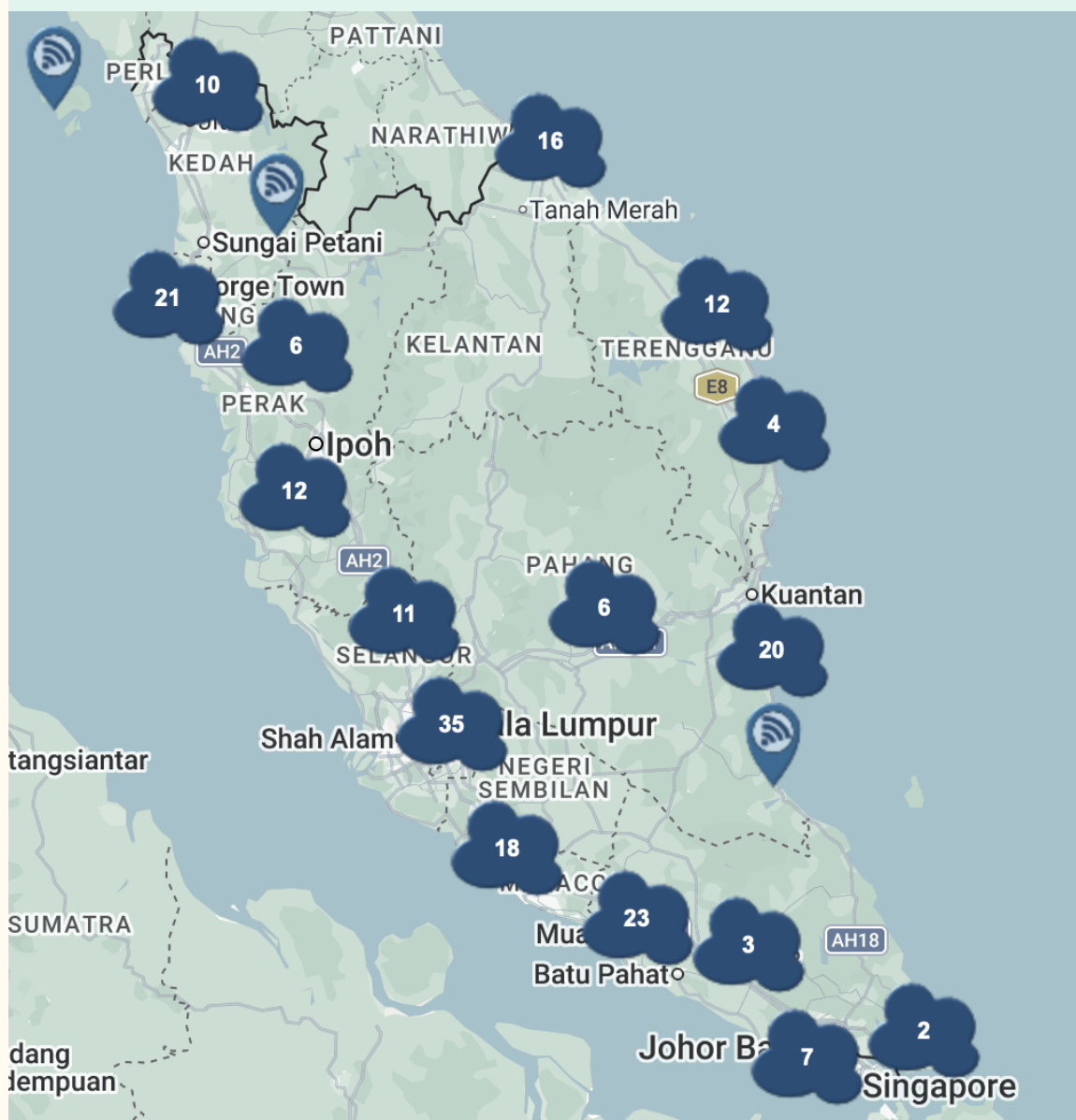


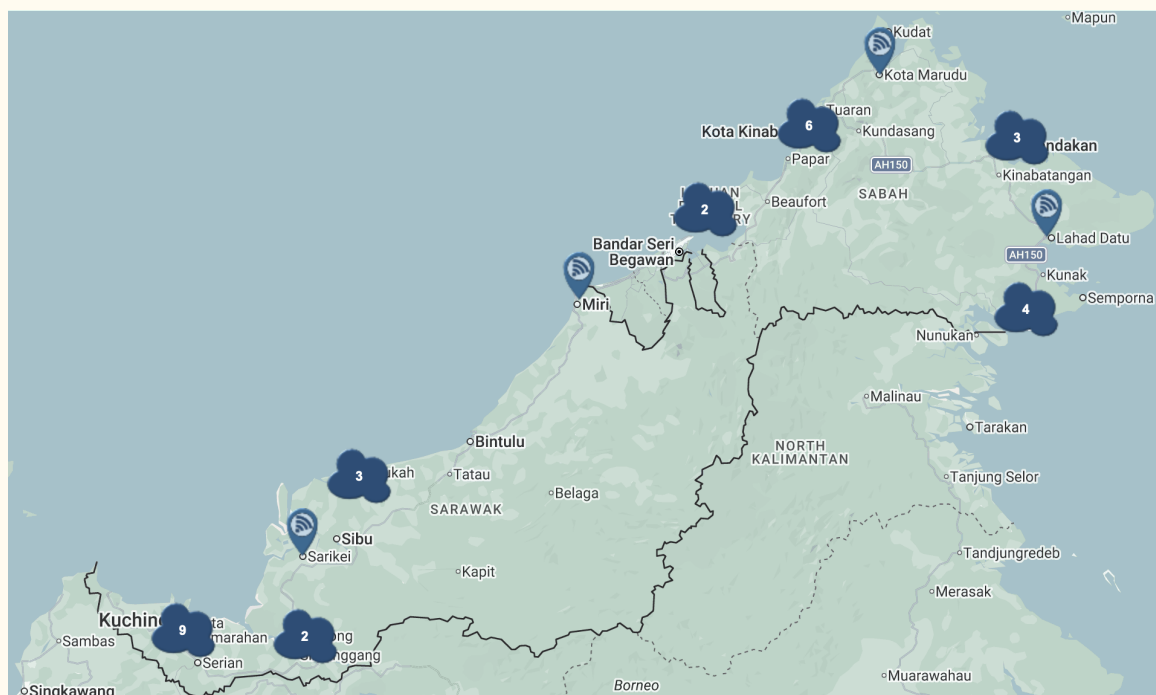
Figure 5.12. eduroam Associated Services per NREN, 2020 → 2025. ○ = service operational. Arrow colours: sage = newly delivered, muted = continuity, coral = lost in 2025.

NREN SPOTLIGHT > Scaling eduroam > MYREN (Malaysia)

The list of MYREN eduroam Participants is attached to this email.



(Peninsular Malaysia)



(East Malaysia: Sabah, Sarawak and Wilayah Persekutuan Labuan)

NREN SPOTLIGHT > Scaling eduroam > REANNZ (New Zealand)

The eduroam service has been operated by REANNZ for over a decade and the associated services were built up over time. REANNZ had been an early adopter of DjNRO, the software that runs the eduroam member portal to gather location data and publish a location map, and has become a significant contributor to the project.

Seeing the value of correctly configuring eduroam on end-user devices, both in terms of user experience and security, we had been actively championing CAT within our membership

We also saw the need to demonstrate to members the value eduroam brings to them (as well as to the whole community), so we started collecting usage data early on and share monthly reports with our members.

To make it easier to extend eduroam to smaller organisations and beyond campus, we had to reconsider how eduroam is operated by participating organisations. While eduroam was traditionally deployed with institutions being responsible for deploying and operating their own RADIUS servers, this creates a barrier to entry for smaller organisations, as these may not have the skills required. To address this, REANNZ has started offering eduroam as a service, consisting of three components: eduroam Managed SP, eduroam Managed IdP, and eduroam Visitor Access (eVA).

The eduroam Managed SP service makes it easier for small deployments to avoid running a RADIUS server and point their APs directly at the service operated by REANNZ.

The eduroam Managed IdP service addresses the issue that, with the move to cloud-based identity, for many organisations it is no longer feasible to operate an on-premises RADIUS IdP server, as there is no on-premises Identity Management System to use as authentication backend. The service (based on LetsWifi software) instead authenticates users as part of onboarding and issues eduroam configuration profiles with embedded X509 certificates. Part of

the service is a RADIUS IdP server that authenticates users by validating the profiles / the X509 certificates. This allows organisations joining eduroam to avoid having to run a RADIUS server and is compatible with modern identity solutions.

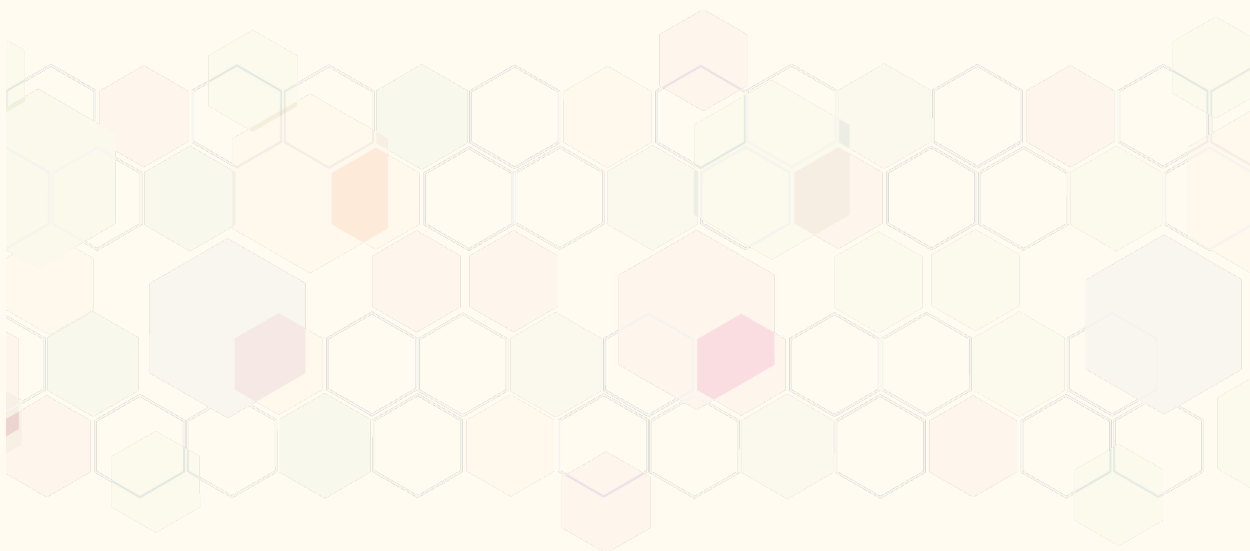
The third component of the eduroam as a service portfolio is eduroam Visitor Access (eVA). While eduroam Managed IdP and Hosted SP simplify participation for member organisations, eVA addresses users who do not already have an eduroam identity through a home institution. Developed and maintained by SURF, eVA provides a secure and federated way to manage guest access for campus visitors, conference attendees and other temporary users. The service is a key building block for institutions looking to deliver a unified, eduroam-only wireless experience without maintaining separate guest access solutions.

5.9 AI-Enabled Services

The 2025 survey introduced AI as a tracked category. Adoption is at an early but rapidly evolving stage: of 19 responding NRENs, 16 currently use AI in some form. The data covers three dimensions — the intensity of AI usage (as a share of activities), the impact of generative AI (self-assessed), and the specific tools deployed across the community.

5.9.1 AI Adoption Snapshot

Each NREN self-reports two related metrics: the share of organisational activities currently using AI (binned into four bands from 5–10% up to 50–100%), and the perceived impact of generative AI on its operations (Little / Moderate / Extensive). The chart below shows both dimensions side-by-side, NREN by NREN. Four NRENs — MAFFIN, NREN-Nepal, PREGINET and SingAREN — sit in the highest intensity band (50–100%), and all four also report Extensive impact, a consistent alignment. BdREN, IDREN, LEARN and MYREN cluster at 25–50% intensity, with LEARN and BdREN reporting Extensive impact and IDREN and MYREN at Moderate. The most interesting case is DrukREN — only 5–10% intensity but Extensive impact — suggesting that even limited deployments can deliver substantial value where they're well-targeted. LERNET reports the lowest position on both dimensions.



AI adoption snapshot per NREN, 2025

Usage intensity (left) and self-reported generative-AI impact (right).



Figure 5.13. AI adoption snapshot per NREN, 2025: usage intensity (left) and self-reported generative-AI impact (right).

5.9.2 AI Tools in Use

Fourteen distinct AI tools are reported across the community. ChatGPT (OpenAI) and Google Gemini are nearly universal among AI-using NRENs (12 and 11 NRENs respectively); Microsoft Copilot and GitHub Copilot follow the next tier (9 and 7). DeepSeek (6 NRENs) joins this mainstream cluster, while Claude (Anthropic), Grok, and Midjourney are used by smaller groups. The remaining six tools — Rovo, Other.ai, Canva Magic Studio, Perplexity, ElevenLabs and Invideo — are each used by a single NREN. The rightmost column captures how broadly each NREN engages with the available toolkit: LEARN (Sri Lanka) stands out with 93% coverage (13 of 14 tools, including all five custom services that appear only in its row), followed by ThaiREN at 57%. The community average sits at 30%, with most NRENs concentrating their stack on the top three to five mainstream tools.

NREN × AI-tool matrix, 2025

○ marks each tool an NREN reports using. Top row shows community-wide popularity per tool; rightmost column shows each NREN's overall engagement breadth.

NREN		Rovo	Otherai	Canva Magic Studio	Perplexity	ElevenLabs	Invideo	Grok	DeepSeek	Claude	Midjourney	GitHub Copilot	Google AI	Microsoft Copilot	OpenAI	% of tools used
NRENs using		1	1	1	1	1	1	4	6	5	3	7	11	9	12	30% avg
BdREN	BD								●	●		●			●	29%
CamREN	KH								●				●	●	●	29%
CERNET	CN															0%
DrukREN	BT												●		●	14%
ErdemNET	MN												●	●	●	21%
HARNET	HK															0%
IDREN	ID							●	●			●	●	●	●	43%
KOREN	KR														●	7%
LEARN	LK		●	●	●	●	●	●	●	●	●	●	●	●	●	93%
LERNET	LA												●			7%
MAFFIN	JP															0%
MYREN	MY												●		●	14%
NKN	IN															0%
NREN	NP							●	●	●	●		●	●	●	30%
PERN	PK													●		7%
PREGINET	PH											●	●	●	●	29%
REANNZ	NZ	●								●		●		●		29%
SingAREN	SG											●	●		●	21%
ThaiREN	TH							●	●	●	●	●	●	●	●	57%

Figure 5.14. NREN × AI-tool matrix, 2025. ○ marks each tool an NREN reports using; the 'NRENs using' row at the top shows community-wide popularity per tool; the rightmost '% of tools used' column shows each NREN's overall engagement breadth, with a community average of 30%.

NREN SPOTLIGHT > Putting AI to work > LEARN (Sri Lanka)

Contributed by: Wathsala Dayananda, Operations Manager, LEARN

LEARN has taken a proactive leadership role in championing the responsible and ethical use of AI across the research and education community. According to the 2025 Compendium, LEARN stands out as operating the most diverse AI toolkit in the region, achieving a 93% tool coverage rate by deploying 13 out of the 14 tracked AI applications, including five custom services unique to our team. While measuring the exact, rigid percentage of everyday work hours driven by AI is

fluid and difficult to quantify precisely, this expansive tool diversity demonstrates that AI has become a deeply embedded, ubiquitous asset across our entire operational fabric.

Delivering Tangible Value Across Three Dimensions:

Organisational Productivity: Staff utilise advanced pro-version AI capabilities within Google Workspace, alongside mainstream tools like ChatGPT and Google Gemini, to automate routine administrative tasks, streamline complex reporting, and maximise day-to-day workflow efficiency.

Network Operations & Engineering: Our technical teams leverage specialised coding assistants—including Microsoft Copilot, GitHub Copilot, and DeepSeek—to accelerate software-defined scripting, automate log analysis, and rapidly troubleshoot core routing configurations.

User Services & Outreach: By integrating generative media tools and custom text/media services, LEARN is able to rapidly scale, produce, and distribute high-quality educational materials and digital support assets for our member institutions.

Responsible Adoption & Regional Scaling Our deployment strategy balances rapid technical acceleration with structural responsibility. This journey began with the AIDE (AI for Innovative Design and Education) initiative alongside the UNESCO Chair at the Asia Pacific University, Malaysia, which provided crucial foundational training for our staff.

Building outward, LEARN spearheaded the regional AP-GAINED (Asia Pacific - Generative AI for NREN Empowerment and Development) and AP-GAINED+ frameworks to deliver practical training models and human capability readiness to the broader APAC NREN ecosystem. Locally, we continue to bridge digital equity gaps by running AI fundamentals projects for undergraduates, school teachers, and Technical and Vocational Education and Training (TVET) students under the *AI for All* initiative. Crucially, we actively steer national AI policy discussions in close coordination with the government and key stakeholders, ensuring that rapid operational adoption is always safely anchored by strong ethical guardrails.

Reference Websites:

AP-GAINED project: <https://www.ap-gained.asia/>

AI for All: <https://ai4all.aisrilanka.org/>

ASI@CONNECT COMPENDIUM OF NRENs • 2025

CHAPTER 6

Research Engagement

How the Asia-Pacific R&E community shows up — the economies engaged, how participation has grown across APAN, and the skills built.

IN THIS CHAPTER

- 6.1** Engagement across the community
- 6.2** Participation over time
- 6.3** Skills and capacity development

20

economies
engaged across APAN

357

peak meeting
turnout (APAN 55)

6. Research Engagement

20

Economies engaged across the eight APAN meetings tracked, with participation peaking at 357 delegates

Engagement with the wider research community — through the Asia Pacific Advanced Network (APAN) and related fora — is a useful proxy for how closely each NREN is tied into the regional and global research ecosystem. This section draws on participation records for eight APAN meetings (APAN 47 and 48, then APAN 55 through 60) and on a self-reported profile of participants' skill levels. The main points are:

- **Engagement is broad but uneven.** Twenty economies took part across the tracked meetings, but a handful — Japan, Thailand, South Korea, Pakistan and Nepal — account for most of the participation.
- **Meeting size swings with the host.** Turnout peaked at 357 at APAN 55 in Kathmandu and eased to 131 at APAN 60; the local host fields the largest contingent — Pakistan supplied 150 of the 196 participants when it hosted APAN 58 in Islamabad.
- **The pandemic years are a gap.** No participation is recorded for APAN 49–54, the period of virtual meetings, so the series jumps from 2020 to 2023.
- **The skills picture splits by training need.** Reading each economy's self-reported mix, beginner-heavy communities ($\geq 40\%$ beginners) point to basic training and intermediate-heavy ones ($\geq 40\%$ intermediate) to advanced training, while an expert-heavy mix ($\geq 40\%$ experts) marks a mature base.

6.1 Engagement across the community

Counting participation across the eight tracked meetings, Japan (341), Thailand (ThaiREN, 256) and South Korea (KOREN / KREONET, 210) are the most engaged, followed by Pakistan (PERN, 190), Nepal (NREN, 171) and Sri Lanka (LEARN, 135), with Malaysia (MYREN, 102) close behind. Both Thailand and Pakistan owe their standing largely to hosting — Thailand fielded 171 participants as host of APAN 57 in Bangkok, and Pakistan 150 as host of APAN 58 in Islamabad — in contrast with the steady, broad-based engagement of Japan and South Korea. A long tail of economies — from China (CERNET) and Hong Kong (HARNET) down to Afghanistan (AfgREN) and New Zealand (REANNZ) — take part more occasionally.

Japan, Thailand and South Korea lead regional research engagement

Total APAN meeting participation by economy across the eight tracked meetings (APAN47–48 and APAN55–60). Top three in sage.

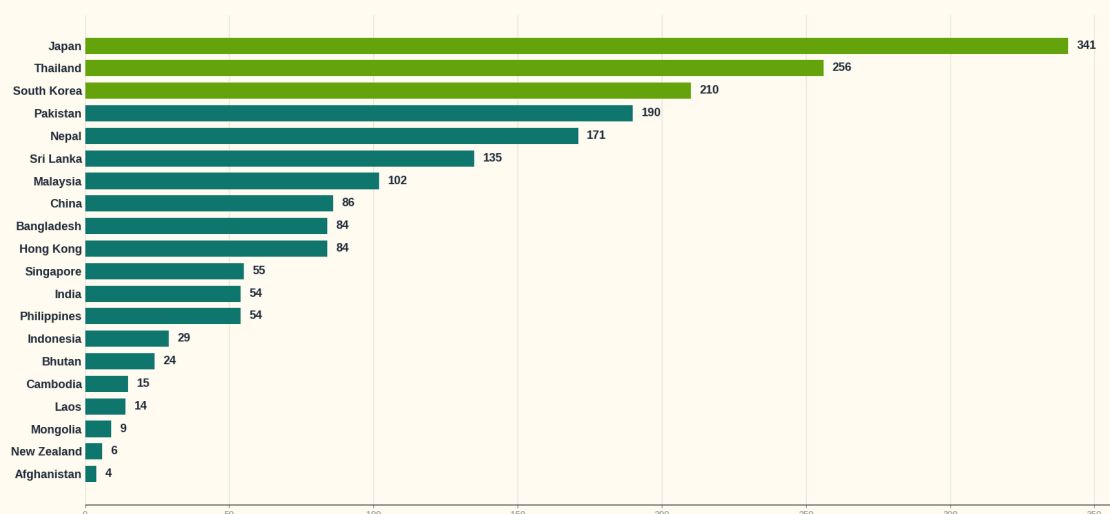


Figure 6.1. Total APAN participation by economy across the eight tracked meetings (APAN 47–48 and 55–60).

6.2 Participation over time

Meeting by meeting, attendance is volatile. It ran at 300 and 207 for APAN 47 and 48, jumped to a peak of 357 at APAN 55 (Kathmandu, 2023), dipped to 165 at APAN 56, rebounded to 304 at APAN 57 (Bangkok, 2024), then ran at 196 and 263 for APAN 58 and 59 before easing to its lowest, 131, at APAN 60. The APAN 57 and APAN 58 peaks are both host-driven — Thailand fielded 171 participants in Bangkok and Pakistan 150 in Islamabad. The gap between APAN 48 and 55 reflects the pandemic-era meetings (APAN 49–54), which are not in the dataset.

Attendance peaked at APAN 55 in Kathmandu; meeting size swings with the host

Total participation from the tracked economies at each APAN meeting. The pandemic-era meetings (APAN 49–54) are absent from the dataset.

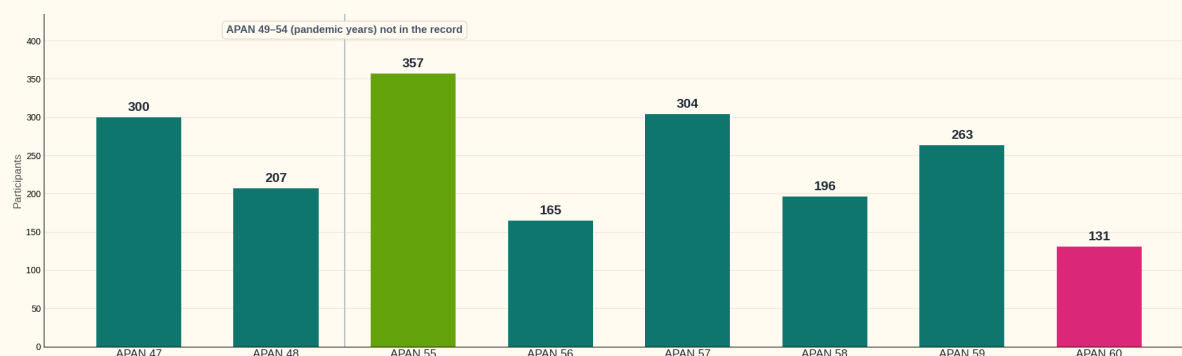


Figure 6.2. Total participation from the tracked economies at each APAN meeting.

Much of this volatility is a host effect. The largest single-meeting contingents line up with the host or a nearby economy — South Korea at APAN 47, Nepal's striking surge at APAN 55 in Kathmandu, Thailand's 171 as host of APAN 57 in Bangkok, Pakistan's 150 as host of APAN 58 in Islamabad, and Japan at APAN 59 — so each meeting tends to be led by a different community.

Each meeting is led by a different community — Nepal at APAN 55 (Kathmandu), Thailand at APAN 57 (Bangkok) and Pakistan at APAN 58 (Islamabad) are the clearest host surges

Participation at each meeting split across the six most-engaged economies and all others. The largest single-meeting contingents tend to coincide with local hosting.

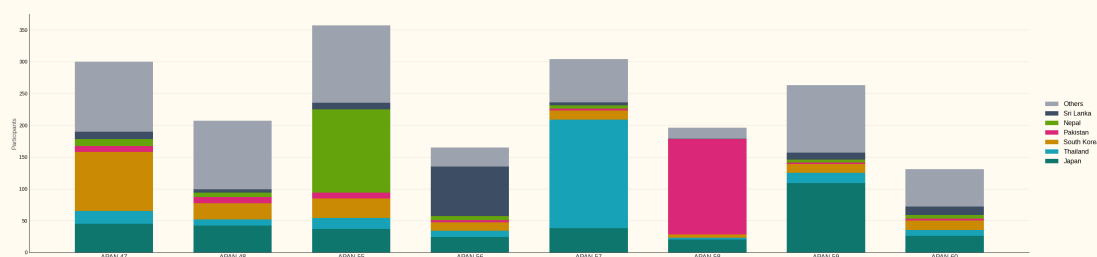
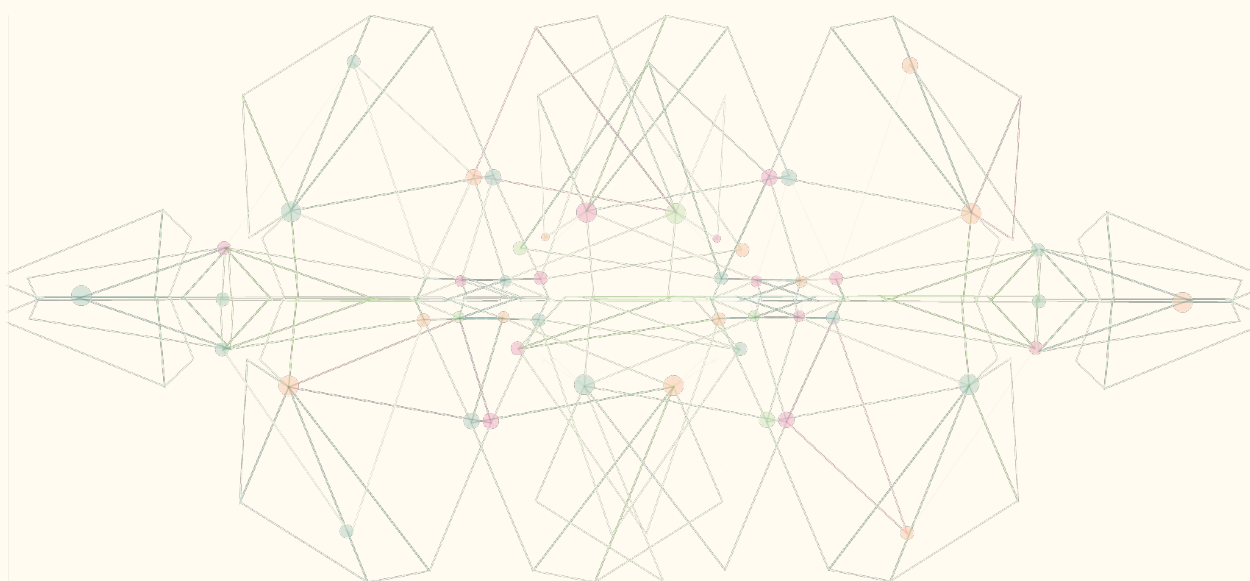


Figure 6.3. Participation at each meeting split across the six most-engaged economies and all others.

6.3 Skills and capacity development

Beyond headcount, participating economies were asked to describe the skill mix of their community as the share of expert, intermediate and beginner practitioners. Treating this self-reported profile with caution, a simple reading sorts each community by where the weight of its mix sits: a profile with at least 40% beginners points to basic, foundational training, while one with at least 40% intermediate practitioners points to high-level, advanced training that can lift that middle tier toward expert. A community with at least 40% experts — and fewer than 40% in each of the other two bands — is taken to have a mature expert base. Economies whose NRENs returned no usable 2025 expertise profile are left unassessed.

On that reading, the sixteen economies with a usable 2025 profile sort by training need. Four — Cambodia, China, Indonesia and Mongolia — are beginner-heavy and point to basic, foundational training, while six — Bangladesh, India, Pakistan, the Philippines, Singapore and Thailand — are intermediate-heavy, where high-level training would help lift that middle tier toward expert; Bhutan and Laos qualify on both counts. The remaining four — Malaysia, Nepal, South Korea and Sri Lanka — already report a mature expert base. Four engaged economies are left unassessed: Afghanistan, Hong Kong, Japan (whose participating NREN, MAFFIN, did not complete the questionnaire) and New Zealand returned no usable 2025 expertise profile. The map locates where each kind of capacity-building would do the most good.



What kind of capacity-building each community needs most

Each economy in the 2025 survey is grouped by where its self-reported skill mix concentrates; the legend gives the threshold for each need. Grey = not assessed (no 2025 expertise profile).



Dots mark territories too small to colour at this scale (Hong Kong, Singapore). Covers the 16 engaged economies that returned a 2025 expertise profile; the other 4 are shown grey.

Figure 6.4. Each economy's training need from its 2025 self-reported skill mix — basic training where beginners are at least 40% of the mix, high-level where intermediate practitioners are at least 40%, and a mature expert base where experts are at least 40% (other bands below 40%). Assessed among economies returning a usable 2025 profile; grey = not assessed.

NREN SPOTLIGHT > Engaging the global research community > KOREN (South Korea)

Contributed by: Jaeho Lee, Executive Director, KOREN (NIA)

KOREN has actively engaged in the APAN community through Engineering Workshops, technical working groups, and network demonstrations. This sustained participation has strengthened partnerships with regional NRENs and created opportunities for Korean researchers to conduct international collaborative research and technology validation.

Through its international connections to APAN and TEIN, KOREN provides Korean researchers with high-speed access to global research infrastructures, enabling large-scale scientific data transfer, remote experiments, and cross-border collaboration.

The knowledge and operational experience gained through APAN activities have been directly reflected in KOREN's research infrastructure. This includes expanding international connectivity, enhancing research testbeds, and supporting emerging research areas such as AI, 6G, Open RAN (O-RAN).

KOREN will continue to strengthen collaboration with global NRENs and contribute to building an open and interoperable research ecosystem that accelerates international research and innovation.

NREN SPOTLIGHT > Engaging the global research community > **LEARN (Sri Lanka)**

Contributed by: *Andrea Rajiyah, Senior Administration Executive cum PA, LEARN*

LEARN's continued participation in APAN has been very useful in building the knowledge and exposure of both LEARN staff and the Sri Lankan research and education community. Over the years, APAN meetings have allowed our team to learn from other NRENs, understand how they manage their services, and bring back ideas that can be adapted to the local environment.

The Asi@Connect Compendium also reflects this engagement, noting Sri Lanka/LEARN's participation across the tracked APAN meetings and identifying Sri Lanka as having a mature expert base in the skills and capacity development section. This shows that LEARN's engagement has been consistent and that the local community has developed a strong base of expertise through continued exposure, participation, and knowledge sharing.

One practical example is LEARN's leadership in Asia Pacific - Generative AI for NREN Empowerment and Development (AP-GAINED) project, a regional initiative focused on empowering the Asia-Pacific NREN community through Generative AI. The initiative was not designed only as a technology activity but as a capacity-building effort focusing on human capability, institutional readiness, regional collaboration, and sustainable knowledge sharing. This workshop was not only conducted in Sri Lanka and Bangladesh but also at APAN59 Japan, APAN60 Hong Kong and APAN61 Bangladesh.

This is a good example of how APAN-related engagement can move beyond attendance at meetings. It creates opportunities for LEARN to work with regional partners, understand common capacity gaps, develop practical training models, and support knowledge sharing across the wider NREN community. These experiences also help LEARN bring back useful lessons for Sri Lankan universities and research institutions, particularly in areas such as AI adoption, digital services, research support, and institutional capacity development.

For Sri Lankan researchers and universities, this kind of regional engagement is important because it connects them to specialist communities beyond the country. It helps them become aware of new technologies, regional projects, and research networking services that can support teaching, research, and innovation. In this way, LEARN's regular engagement with APAN contributes not only to staff development but also to strengthening Sri Lanka's connection with the Asia-Pacific research and education networking ecosystem.

APAN participation shows a regional community that is broad — twenty economies engaged across the tracked meetings — but led by a familiar handful, with each meeting's turnout shaped strongly by where it is held. The skills picture is thinner and self-reported, yet points clearly enough to a set of economies where investment in expertise would pay off. Read alongside the traffic and services chapters, engagement rounds out the portrait: connectivity and capacity are necessary, but it is sustained participation in the regional fora that turns infrastructure into collaboration.

Interpretation note: *participation figures cover the eight APAN meetings recorded in the e-Compendium (APAN 47–48 and 55–60); APAN 49–54 are absent. Expertise shares are self-reported by participating economies and are not independently verified; the training-need grouping is a screening heuristic, not a definitive assessment.*

CHAPTER 7

Network Traffic

Traffic carried across the Asia-Pacific R&E community, 2013–2025 — scale, growth, and structure by NREN, link type and economy.

IN THIS CHAPTER

- 7.1** Trend analysis
- 7.2** Volume by individual NRENs
- 7.3** Volume by type of link
- 7.4** Volume by each economy
- 7.5** Data appendix

30,658

TB carried
in 2025

3x

the 2018
level

7. Network Traffic Across the Asia-Pacific R&E Community

30,658 TB traffic volume (2025) <i>total carried in 2025</i>	3.4× Volume growth since 2014 <i>aggregate, 2014–2025</i>	16× Peak-bandwidth growth <i>aggregate since 2014</i>	183 Gbps Top peak bandwidth <i>JAPAN, 2025</i>
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Overview

This chapter summarises the scale and growth of research-and-education network traffic carried across the Asi@Connect community between 2013 and 2025, based on figures reported by TEIN NOC and reflected in the e-Compendium portal. Traffic is described by total volume (terabytes carried per year) and peak bandwidth (the maximum throughput reached, taken as the higher of the inbound and outbound peaks); the two directions are not otherwise analysed separately. The main findings are:

- **Sustained, accelerating growth.** Total volume rose about 3.4-fold since 2014 to roughly 30,658 TB in 2025, while aggregate peak bandwidth climbed even faster — around 16-fold, to about 363 Gbps. Both measures are clearly increasing.
- **Traffic is highly concentrated.** The three largest networks (JAPAN, CERNET and KREONET) carry roughly 78% of all volume, and the top five about 88%.
- **Access now leads by link type.** The access layer dominates and continues to grow, reaching the full community total once the Japan trunks are counted as access, while backbone traffic is lower and transit has effectively disappeared since 2016 as direct interconnection matured.
- **A pronounced economic divide.** Developed and upper-middle-income economies together account for about 97% of 2025 volume, leaving a wide gap to the lower-middle-income, least-developed and regional networks.

The sections that follow develop each of these themes in turn: the overall trend, then traffic volume carried by individual NRENs, by type of link, and by the economic grouping of the economies served.

7.1 Trend analysis

This section examines the network traffic carried by National Research and Education Networks (NRENs) participating in the Asi@Connect community over 2013–2025, drawing on figures published through the Asi@Connect e-Compendium portal for 23 NRENs. Traffic is described by total volume (annual data carried, in terabytes) and by peak bandwidth (the maximum throughput reached, in gigabits per second). The section looks first at the overall trend, then at traffic volume carried by individual NRENs, by type of link, and by the economic grouping of the economies served.

Two conventions apply throughout: a reported value of zero is treated as no traffic for that network and year, and the partial year 2026 is excluded. Figures describe the total traffic carried; incoming and outgoing flows are not analysed separately.

Both measures have risen substantially. Total volume grew from roughly 5,446 TB in 2013 to about 30,658 TB in 2025 — around 3.4-fold since 2014, a compound rate near 12% per year —

while aggregate peak bandwidth climbed even faster, reaching about 363 Gbps in 2025. The volume trend and the aggregate peak-bandwidth overlay are shown together below.

Volume grew about 3.4× since 2014; aggregate peak bandwidth rose about 23× to 363 Gbps

Total annual traffic volume (bars, left) and aggregate peak bandwidth (line, right), 2013–2025.

Peak is the higher of inbound/outbound for each NREN, summed across the community.

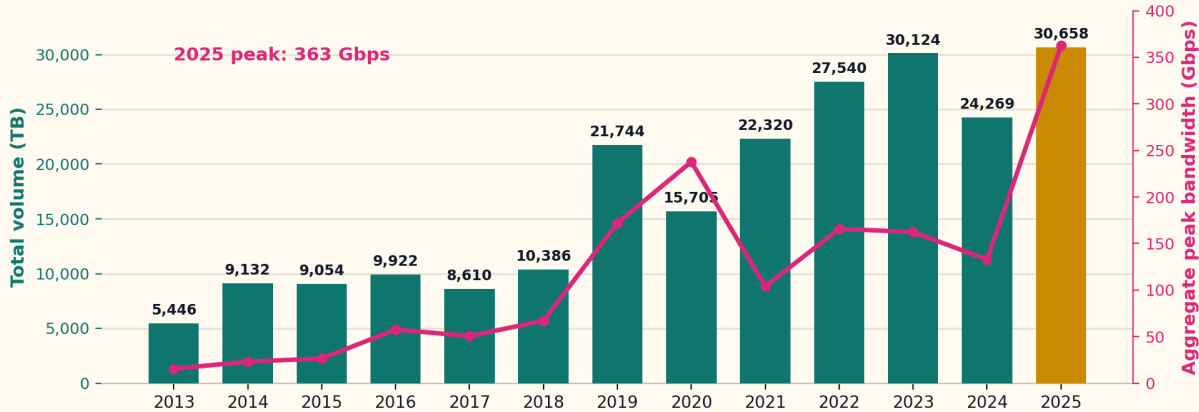


Figure 7.1. Total traffic volume in TB (bars, left axis) and aggregate peak bandwidth in Gbps (line, right axis), 2013–2025.

Growth was not uniform. Volume was comparatively flat from 2013 to 2018, stepped up sharply in 2019, and has since settled into a higher, somewhat volatile band, reaching a high of 30,658 TB in 2025 (with 2023 close behind at 30,124 TB). Peak bandwidth followed a broadly similar but steeper path, reflecting heavier instantaneous demand on the busiest links.

7.1.1 Peak bandwidth by network

Peak demand is dominated by a few networks. In 2025 JAPAN reached about 183 Gbps — far above the rest — and the three highest-peaking NRENs together accounted for roughly 81% of all peak bandwidth. The chart below ranks each network by its 2025 peak (logarithmic scale).

JAPAN's 2025 peak of about 183 Gbps dwarfs the rest of the field

Peak bandwidth by NREN in 2025 (Gbps, logarithmic scale), taken as the higher of the inbound and outbound maxima. Sage marks the top three (=81% of aggregate peak); networks with negligible or zero 2025 peak are omitted.

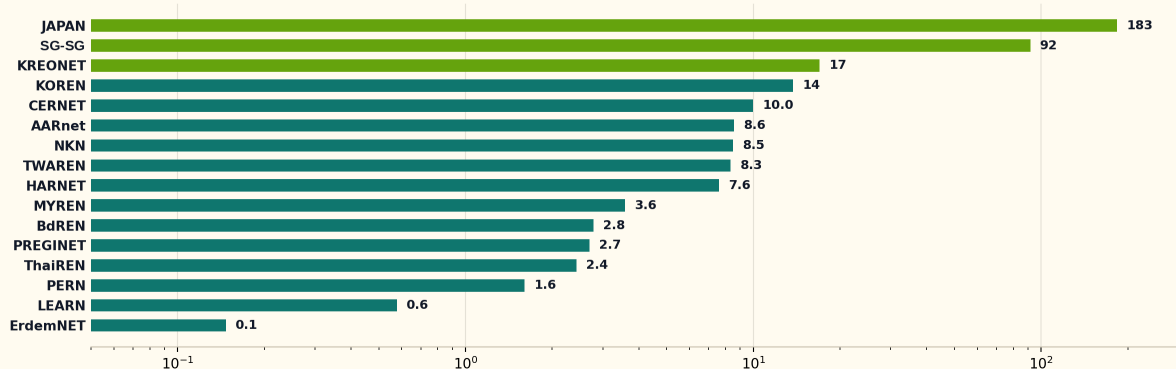


Figure 7.2. Peak bandwidth by NREN in 2025 (Gbps, logarithmic scale; the higher of inbound and outbound).

Note: SG-SG traffic carried both SingAREN and SG-EU-LON traffic from July 2019 to November 2025.

Viewed over time, the leading networks' peaks have escalated dramatically. Every one advanced severalfold between 2013 and 2025 — JAPAN around fifty-fold — several from a near-standing start, as the chart below shows.

JAPAN's peak reaches 183 Gbps; every leader climbed sharply since 2013

Peak bandwidth in 2013 (open) versus 2025 (sage) for the eight highest-peaking NRENs, with growth factors (Gbps, log scale).

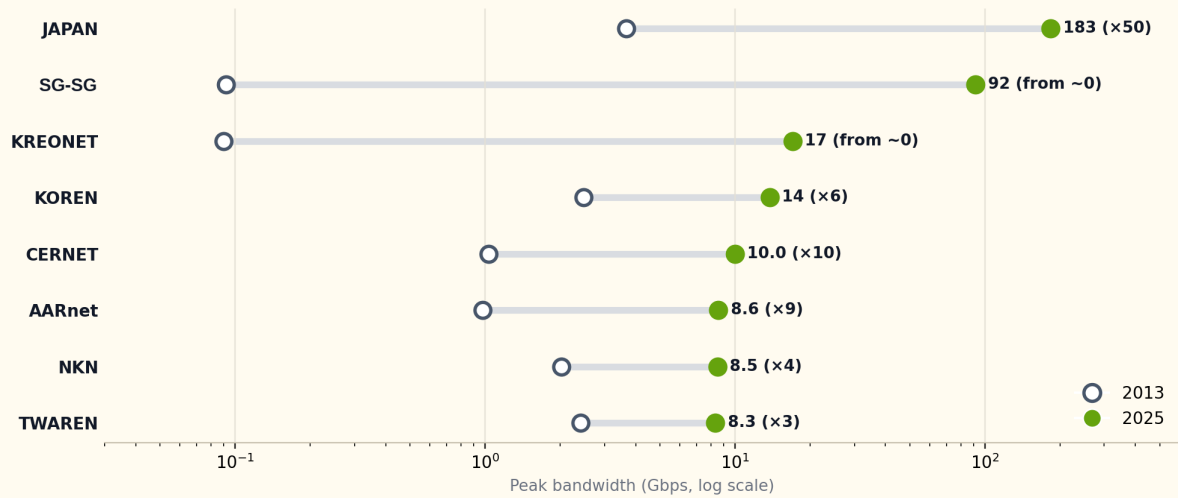


Figure 7.3. Peak bandwidth in 2013 versus 2025 for the leading NRENs, with growth factors (Gbps, logarithmic scale).

Note: SG-SG traffic carried both SingAREN and SG-EU-LON traffic from July 2019 to November 2025.

7.2 Traffic volume carried by individual NRENs

Total traffic volume is highly concentrated among a small number of networks. In 2025 the three largest — JAPAN, CERNET and KREONET — together carried roughly 78% of all traffic, and the top five about 88%. The chart below ranks each network by its 2025 volume (logarithmic scale).

JAPAN, CERNET and KREONET carry roughly 78% of 2025 volume

Total traffic volume by NREN in 2025 (TB, logarithmic scale). Sage bars mark the top three; top five carry about 88%. 6 NRENs reporting zero in 2025 are omitted from the log ranking.

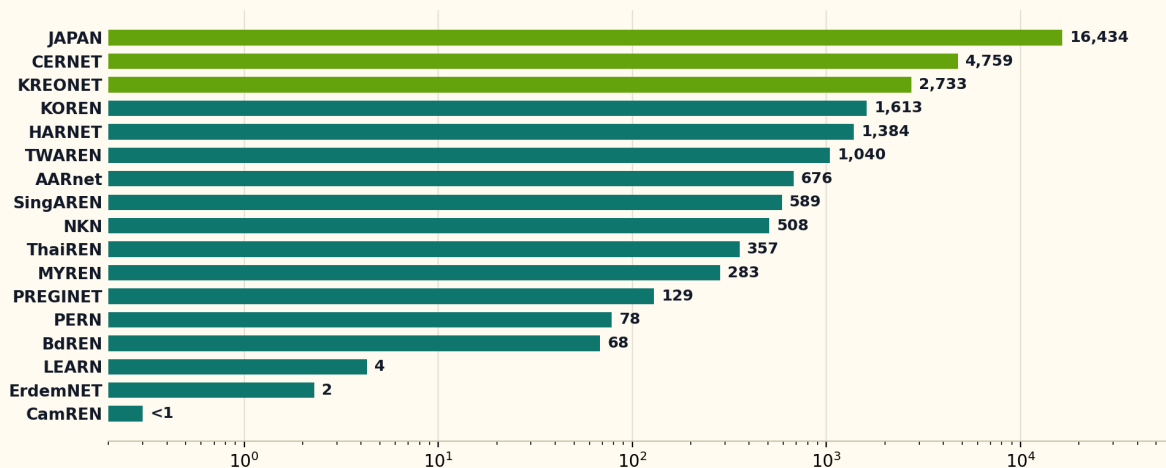


Figure 7.4. Total traffic volume by NREN in 2025 (TB, logarithmic scale).

The same concentration is evident cumulatively: a handful of networks account for the bulk of regional traffic, with the cumulative share crossing 80% within the first four networks.

Cumulative share crosses 80% within the first four networks

Per-NREN 2025 volume (teal bars, left) and cumulative share of the regional total (magenta line, right). Networks reporting zero in 2025 omitted.

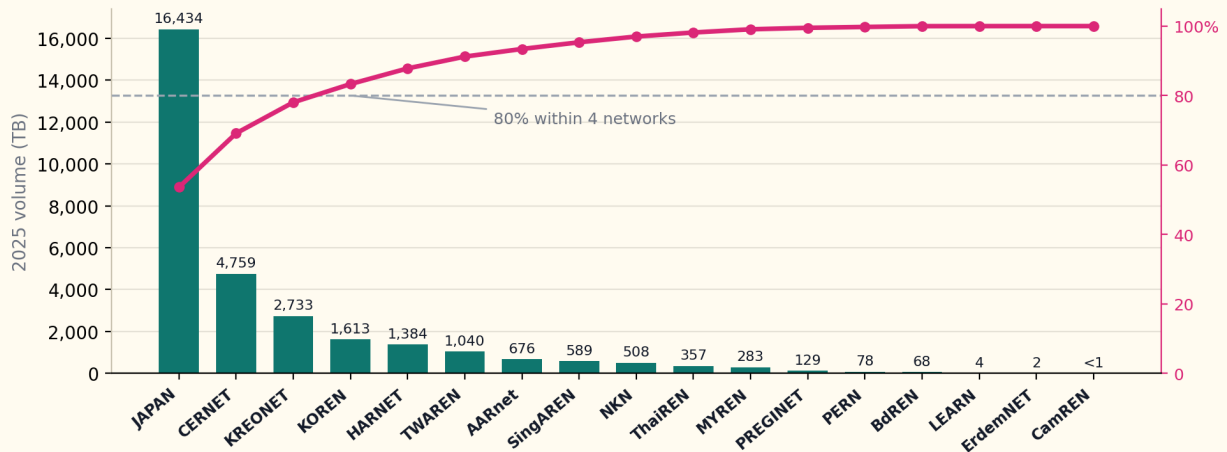


Figure 7.5. Volume concentration in 2025: per-NREN volume (bars) and cumulative share (line).

7.2.1 Per-NREN trends

The panels below trace each NREN's total annual traffic volume across 2013–2025, arranged alphabetically; the figure beside each name is its 2025 total. They show a range of trajectories: steady climbers such as JAPAN, CERNET and KREONET; networks that peaked mid-decade and then receded; and several that recorded little or no traffic in recent years. JAPAN aggregates the SG–JP and HK–JP links reclassified as access; DrukREN is shown with no data because it routes all of its traffic through NKN, which did not report statistics.

A few networks climb steadily; many peak mid-decade, then recede

Total annual traffic volume per NREN, 2013–2025 (TB), in alphabetical order. Each panel has its own vertical scale; the open dot marks 2013, the sage dot 2025. The figure beside each name is its 2025 total. JAPAN aggregates the SG–JP and HK–JP links; DrukREN routes all traffic through NKN.

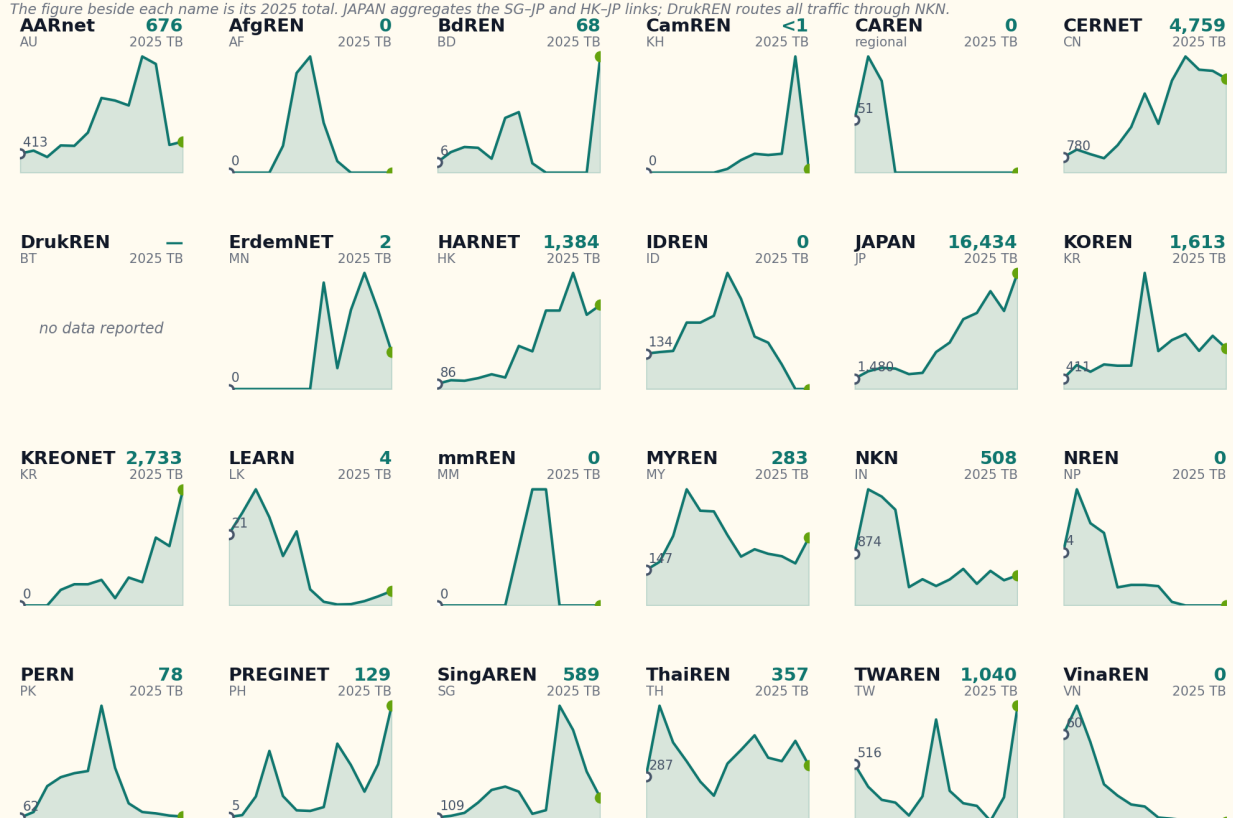


Figure 7.6. Total annual traffic volume for each NREN in alphabetical order, 2013–2025 (TB). JAPAN aggregates the SG–JP and HK–JP links reclassified as access; DrukREN routes all traffic through NKN.

7.3 Traffic volume carried by type of link

Traffic can also be examined by the segment of the network it traverses. The statistics distinguish five link types: access links (edge connections between member institutions and their NREN), backbone links (the core inter-node spine), gateway links (interconnections to external networks), transit links (traffic passing through on the way elsewhere), and other links (a residual category carrying measurable traffic mainly before 2020). The table summarises 2025 volume and peak bandwidth for the four types still active that year.

Link type	Volume (TB)	Peak (Gbps)	Primary role
Access	30,658	221.0	Edge / member access
Backbone	8,850	95.1	Core inter-node
Gateway	5,819	93.2	External interconnect
Transit	0	8.5	Pass-through

By volume the access layer now carries the most traffic at roughly 30,658 TB — equal to the community total once the Japan trunks are counted as access — while the backbone handled about 8,850 TB, gateway about 5,819 TB, and transit and other links effectively none. The chart below shows how each link type has grown over the period.

Access links now carry the most traffic; transit has vanished

Total annual traffic by link type, 2013–2025 (TB). A flow may traverse several segments; access equals the community total, while backbone, gateway and others are additional layers, so the categories are not additive.

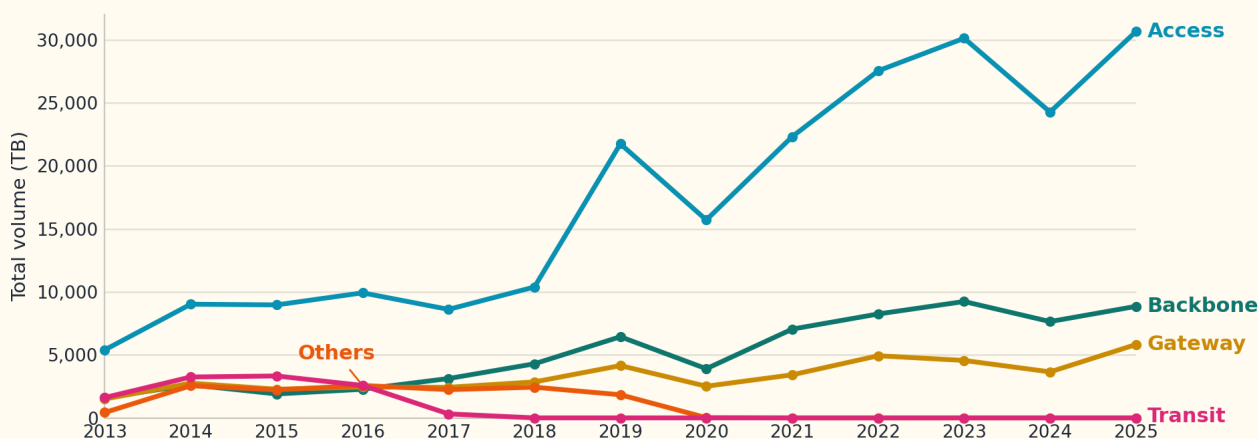


Figure 7.7. Total traffic by link type, 2013–2025 (TB).

Two structural shifts stand out: the access layer now dominates and continues to grow, while transit collapsed after 2015 — from a peak above 3,000 TB to virtually nothing since — consistent with a move away from third-party transit toward direct interconnection, a common sign of a maturing regional fabric. The access layer also records the highest peak bandwidth (about 221 Gbps), reflecting the high-capacity Japan trunks now counted there.

7.4 Traffic volume carried by each economy

Grouping NRENs by the economic classification of the economies they serve exposes a structural divide across five bands: developed (DC), upper-middle-income (UMIC), lower-

middle-income (LMIC), least-developed (LDC), and regional or special-purpose networks (Others).

Group	Member NRENs	Active 2025	2025 share
Developed (DC)	HARNET, KOREN, KREONET, AARnet, SingAREN, TWAREN, JAPAN	7 of 7	79.8%
Upper-middle income (UMIC)	CERNET, ThaiREN, MYREN	3 of 3	17.6%
Lower-middle income (LMIC)	ErdemNET, PREGINET, VinaREN, NKN, LEARN, IDREN, PERN	5 of 7	2.4%
Least developed (LDC)	BdREN, NREN, AfgREN, CamREN, mmREN	2 of 5	0.2%
Regional / other	CAREN	0 of 1	0.0%

In 2025 the developed-economy group carried about 80% of all volume and the upper-middle-income group about 18% — together roughly 97%. The lower-middle-income and least-developed groups together accounted for under 3% of 2025 volume, despite comprising twelve of the 23 member networks. The chart below shows how each group's share of total traffic has shifted over time.

The developed-economy share rose from about 55% in 2013 to roughly 80% in 2025

Each economic group's share of total regional traffic, 2013–2025. Lower-income groups are barely visible here — see the next figure for absolute volumes.

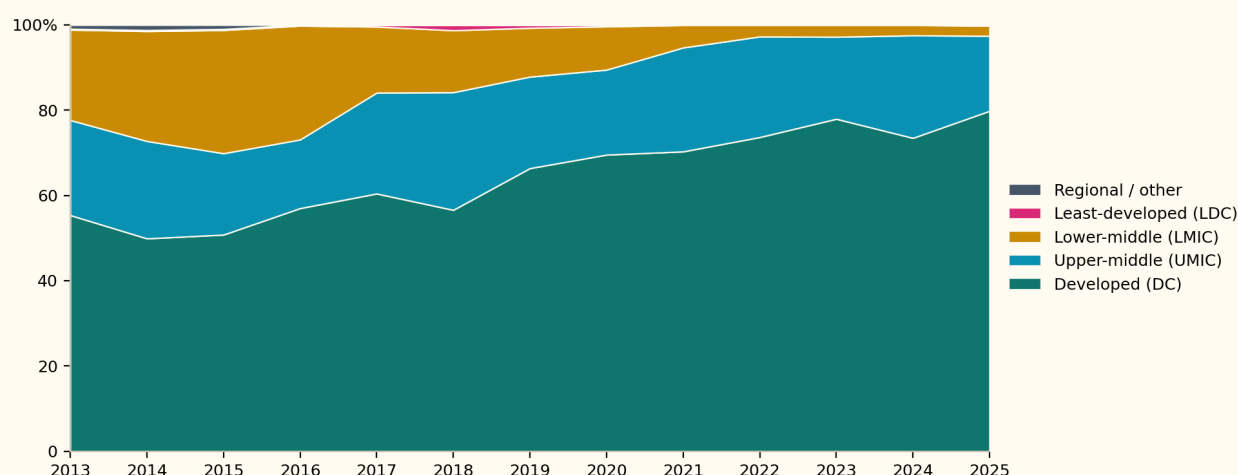


Figure 7.8. Share of total regional traffic held by each economic group, 2013–2025.

The developed-economy share rose from about 55% in 2013 to roughly 80% in 2025, while the upper-middle-income group eased from about 22% to 18%. The lower-middle-income share fell from around 21% to about 2% as several of its networks recorded little or no traffic in later years. Because the two smallest groups are barely visible above, the next chart shows their volumes directly on a logarithmic scale.

Lower-income groups' volumes stayed small and declined after mid-decade

Traffic of the lower-middle-income and least-developed groups, 2013–2025 (TB, logarithmic scale).

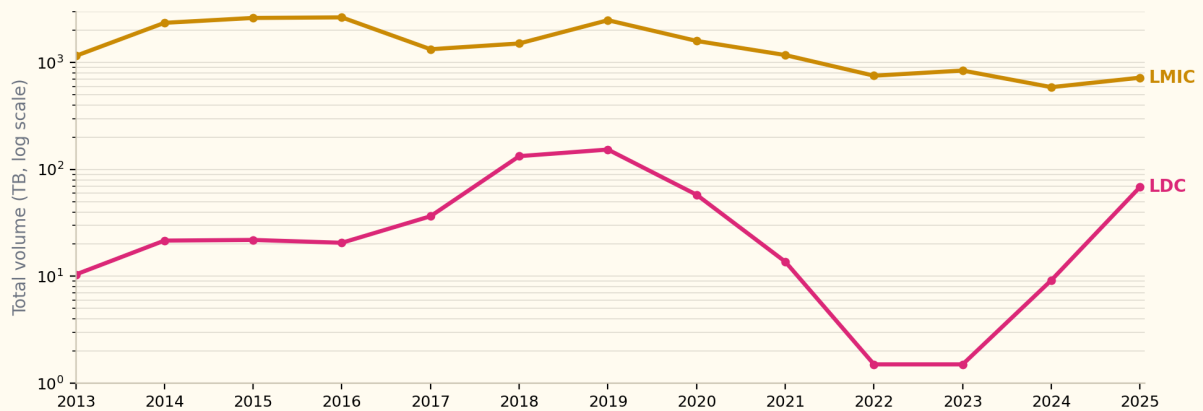


Figure 7.9. Traffic of the lower-middle-income and least-developed groups, 2013–2025 (TB, logarithmic scale).

In absolute terms the regional total is carried overwhelmingly by the developed and upper-middle-income groups, as the stacked and ranked views below confirm.

In absolute terms, developed and upper-middle-income groups carry the bulk

Total traffic by economic classification, 2013–2025 (TB). The same volatility seen community-wide is driven mainly by the two largest groups.

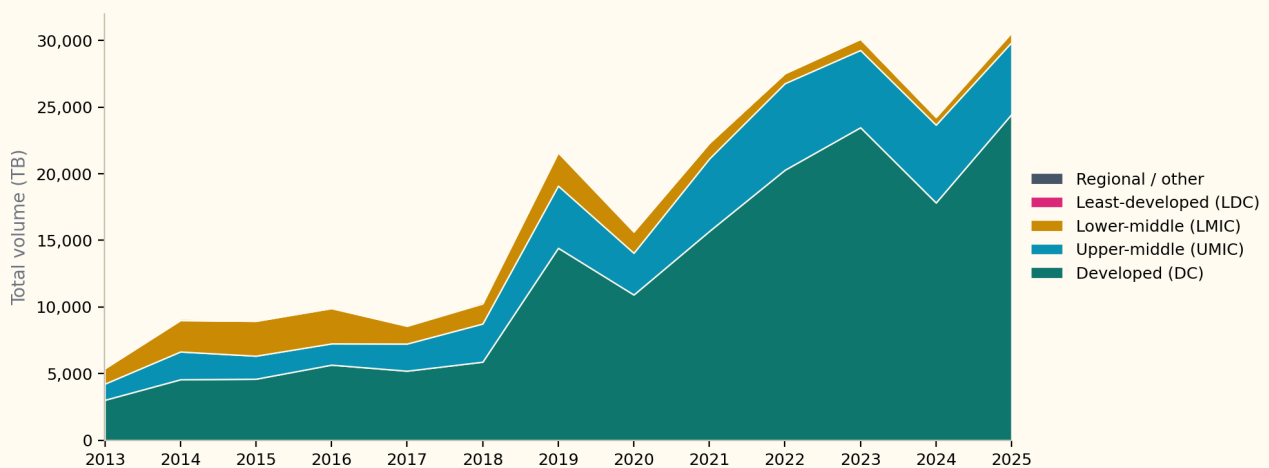


Figure 7.10. Traffic by economic classification, 2013–2025 (TB).

Developed and upper-middle-income members carry about 97% of 2025 traffic

Traffic volume by economic group in 2025 (TB), with each group's share of the regional total.

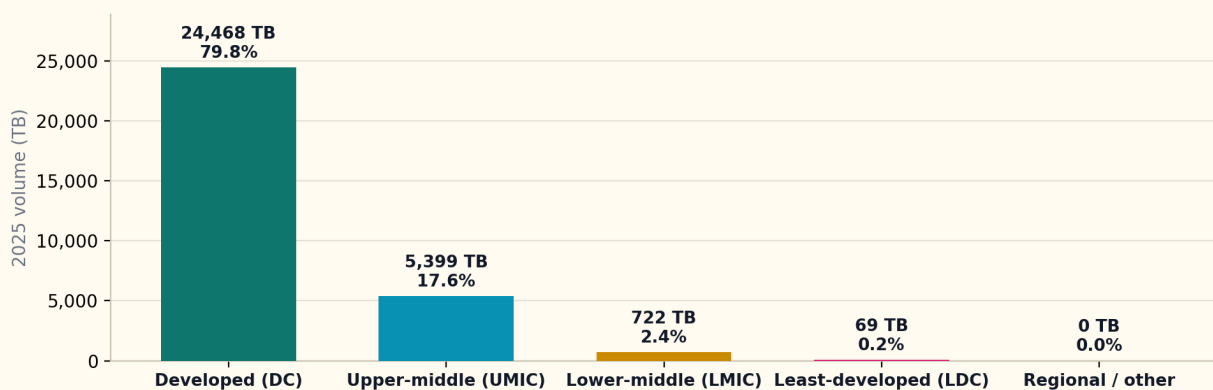


Figure 7.11. Traffic volume by economic group in 2025, with each group's share of the regional total.

7.5 Traffic composition and upstream capacity

Beyond how much traffic flows, the survey records the maximum upstream bandwidth each NREN consumes by category, from which its traffic-type mix can also be read: a category counts as carried when its reported upstream bandwidth is greater than zero. On that basis in 2025, research-and-education (R&E) and internet-exchange traffic are the most widespread — carried by 15 of the 19 reporting NRENs each — followed by commodity or general-internet traffic (14) and content-delivery (CDN) traffic (9). Eight NRENs run the full four-way mix: REANNZ, HARNET, PREGINET, SingAREN, LEARN, ThaiREN, BdREN and ErdemNET. Research-and-education upstream bandwidth is led by New Zealand's REANNZ (about 220,000 Mbps) and Hong Kong's HARNET (about 200,000 Mbps), with Japan's MAFFIN next at 100,000 Mbps; most other NRENs report R&E upstream in the low thousands of Mbps or below. CERNET, LERNET and NKN did not report any upstream bandwidth in 2025.

What each NREN carries: traffic types and maximum upstream bandwidth, 2025

A traffic type is shown as carried (filled dot) when that category's reported upstream bandwidth is greater than zero. Bandwidth in Mbps; sorted by R&E bandwidth.

NREN	Traffic types				Maximum upstream bandwidth by category (Mbps)			
	Comm	R&E	CDN	IX	Commodity	R&E	CDN	Internet Exch.
REANNZ	●	●	●	●	30,000	220,000	60,000	430,000
HARNET	●	●	●	●	25,450	200,000	52,000	200,000
MAFFIN	●	●	●	●	—	100,000	—	—
PREGINET	●	●	●	●	20,000	20,000	30,000	10,000
MYREN	●	●	●	●	100,000	10,000	—	10,000
SingAREN	●	●	●	●	200	10,000	220,000	20,000
LEARN	●	●	●	●	17,000	6,000	5,000	20,000
ThaiREN	●	●	●	●	200,000	3,000	10,000	120,000
PERN	●	●	●	●	10,000	2,500	—	2,000
BdREN	●	●	●	●	27,000	1,000	29,000	11,000
ErdemNET	●	●	●	●	2,500	1,000	1,000	1,000
IDREN	●	●	●	●	2,000	1,000	—	100,000
KOREN	●	●	●	●	10,000	1,000	—	3,000
NREN	●	●	●	●	20	45	—	1,000
CamREN	●	●	●	●	—	25	—	1,000
CERNET	●	●	●	●	—	—	—	—
DrukREN	●	●	●	●	10,000	—	10,000	10,000
LERNET	●	●	●	●	—	—	—	—
NKN	●	●	●	●	—	—	—	—

Figure 7.12. Traffic types carried and maximum upstream bandwidth by category for each NREN in 2025.

Summary

Across 2013–2025 the Asi@Connect community's traffic grew about 3.4-fold in volume to roughly 30,658 TB, while aggregate peak bandwidth rose faster still, reaching around 363 Gbps — both measures point to steadily intensifying demand. Volume is heavily concentrated among a handful of high-capacity networks; by link type the access layer dominates while transit has

receded; and a clear economic gradient leaves developed and upper-middle-income members carrying the large majority of traffic. Taken together, these trends describe a maturing ecosystem in which a few well-resourced NRENs increasingly anchor regional research-and-education traffic, while a long tail of smaller networks grows from a much lower base.

Interpretation note: figures reflect data reported to the Asi@Connect e-Compendium portal, with zero entries read as no traffic and 2026 excluded as a partial year. Traffic is reported as total volume (inbound plus outbound) and peak bandwidth (the higher of the inbound and outbound maxima for each NREN); the two directions are not otherwise analysed separately.

7.6 Traffic volume by NREN (data appendix)

Total annual traffic volume (inbound plus outbound, in terabytes) for each participating NREN at each reporting year. A value of 0 indicates no traffic was recorded for that year; “<1” indicates a value below 1 TB.

NREN	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
AARnet	413	479	340	591	583	871	1,622	1,567	1,460	2,523	2,361	603	676	14,090
TWAREN	516	315	198	173	57	229	916	278	167	144	10	221	1,040	4,264
JAPAN	1,480	2,516	3,016	2,898	2,113	2,297	5,243	6,580	9,885	10,768	13,850	11,052	16,434	88,132
AfgREN	0	0	0	0	27	99	116	50	11	0	0	0	0	302
BdREN	6	12	15	15	8	32	36	6	0	0	0	0	68	198
CAREN	51	113	89	0	0	0	0	0	0	0	0	0	0	252
CERNET	780	1,169	936	730	1,388	2,308	4,004	2,472	4,658	5,878	5,211	5,152	4,759	39,447
CamREN	0	0	0	0	0	0	<1	1	2	1	2	9	<1	15
ErdemNET	0	0	0	0	0	0	0	7	1	5	7	5	2	27
HARNET	86	146	137	180	243	191	710	621	1,292	1,292	1,912	1,223	1,384	9,417
IDREN	134	139	144	250	250	276	437	340	198	175	93	0	0	2,435
KOREN	411	953	686	975	926	930	4,600	1,505	1,942	2,181	1,513	2,110	1,613	20,347
KREONET	0	0	0	368	500	499	602	173	658	549	1,598	1,398	2,733	9,076
LEARN	21	28	34	26	15	22	5	1	<1	<1	1	3	4	161
mmREN	0	0	0	0	0	0	<1	<1	<1	0	0	0	0	1
MYREN	147	182	289	484	395	392	293	204	234	215	205	176	283	3,498
NKN	874	1,956	1,834	1,613	309	442	328	438	616	365	583	425	508	10,292
NREN	4	10	7	6	2	2	2	2	<1	0	0	0	0	34
PERN	62	145	523	655	713	745	1,701	790	272	145	124	92	78	6,046
PREGINET	5	8	28	79	29	13	12	16	87	63	34	64	129	568
SingAREN	109	148	220	469	778	860	736	196	285	2,827	2,235	1,222	589	10,675
ThaiREN	287	736	503	384	255	166	369	456	548	407	385	513	357	5,365
VinaREN	60	80	55	26	18	12	11	3	2	<1	<1	0	0	268
All NRENs	5,446	9,132	9,054	9,922	8,610	10,386	21,744	15,706	22,320	27,540	30,124	24,269	30,658	224,909

Source: Asi@Connect e-Compendium portal. Zero values treated as no traffic; 2026 excluded as a partial year. JAPAN aggregates the SG–JP and HK–JP links reclassified as access.

7.7 Network links by type

Section 7.3 grouped traffic by type of link. For reference, the table below lists the individual Asi@Connect links that make up each type, with the provisioned capacity of each and remarks noting status changes where applicable (for example, terminated or upgraded links). The classification follows the network’s operational link naming.

Link name	Full link name	Capacity	Remarks
Access links — 46			

Link name	Full link name	Capacity	Remarks
BJ-CN	BJ-10G_to_CN	10G	
HK-ASGC	HK-2.5G_to_AS GC	2.5G	
HK-HK	HK-10G_to_HK	10G	
HK-KR	HK-10G_to_KR	10G	
HK-KR	HK-100G_to_KR	100G	
HK-KREONET	HK-10G_to_KREONET	10G	
HK-MN	HK-150M_to_MN	150M	
HK-PH	HK-200M_to_PH	200M	
HK-PH	HK-10G_to_PH	10G	
HK-TH	HK-2G_to_TH	2G	
HK-TH	HK-10G_to_TH	10G	
HK-VN	HK-1G_to_VN	1G	
MB-BD	MB-45M_to_BD	45M	Terminated
MB-IN	MB-10G_to_IN	10G	
MB-LK	MB-45M_to_LK	45M	
MB-NP	MB-45M_to_NP	45M	
SG-AF	SG-155M_to_AF	155M	
SG-ASGC	SG-10G_to_AS GC	10G	
SG-ASNet	SG-10G_to_ASNet	10G	
SG-AU	SG-10G_to_AU	10G	
SG-BD	SG-45M_to_BD	45M	Upgraded to SG-1G_to_BD
SG-BD	SG-1G_to_BD	1G	
SG-ID	SG-1G_to_ID	1G	Terminated
SG-KH	SG-10M_to_KH	10M	
SG-KREONET	SG-1G_to_KREONET	1G	
SG-KREONET	SG-100G_to_KREONET	100G	
SG-LK	SG-1G_to_LK	1G	
SG-MM	SG-45M_to_MM	45M	Terminated
SG-MY	SG-1G_to_MY	1G	
SG-MY	SG-10G_to_MY	10G	
SG-PK	SG-1G_to_PK	1G	
SG-PK	SG-2.4G_to_PK	2.4G	
SG-SG	SG-10G_to_SG - SG-10G_to_EU-LON	10G	From July 2019 till Nov 2025
SG-SG	SG-100G_to_SG - SG-100G_to_EU-LON	100G	From July 2019 till Nov 2025

Link name	Full link name	Capacity	Remarks
SG-SG	SG-10G_to_SG	10G	Before July 2019 and From Dec 2025 onwards
SG-SG	SG-100G_to_SG	100G	Before July 2019 and From Dec 2025 onwards
SG-TH	SG-600M_to_TH	600M	
HK-NICT	HK-10G_to_JP-NICT	10G	
SG-NICT	SG-2.5G_to_JP-NICT	2.5G	
SG-KR	SG-100G_to_KR	100G	
SG-JP	SG-10G_to_JP	10G	
SG-JP	SG-100G_to_JP	100G	
HK-JP	HK-10G_to_JP-PoP	10G	
HK-JP	HK-100G_to_JP	100G	
SG-JP	SG-10G_to_JP-PoP	10G	
SG-IN	SG-10G_to_IN	10G	
Transit links — 1			
SG-MB	SG-2.5G_to_MB-PoP	2.5G	Terminated
Backbone links — 3			
HK-SG	HK-10G_to_SG-PoP	10G	
HK-SG	HK-100G_to_SG-PoP	100G	
BJ-HK	BJ-10G_to_HK-PoP	10G	
Gateway links — 7			
HK-TransPAC	HK-10G_to_TransPAC	10G	
MB-MAD	MB-2.5G_to_EU-MAD	2.5G	
SG-Internet2_SG	SG-1G_to_Internet2_SG	1G	Now JP to Internet2 at 100G
SG-Internet2_SG	SG-100G_to_Internet2	100G	owned by 6 partners [CAE1 + TEIN*CC]
SG-LON	SG-10G_to_EU-LON	10G	
SG-LON	SG-100G_to_EU-LON	100G	
SG-ARENA	SG-100G_to_ARENA	100G	
Other links — 3			
AU-PER	AU-2.5G_to_PER	2.5G	
AU-PER	AU-10G_to_PER	10G	
HK-CAREN	HK-1G_to_CAREN	1G	

Capacities are provisioned link rates (M = Mbit/s, G = Gbit/s). 60 links in total: 46 access, 1 transit, 3 backbone, 7 gateway, 3 other.

ASI@CONNECT COMPENDIUM OF NRENs • 2025

CHAPTER 8

Looking to the Future

Where the community is heading — priorities for collaboration, capacity building, and the role Asi@Connect can play.

IN THIS CHAPTER

Community priorities

Capacity building

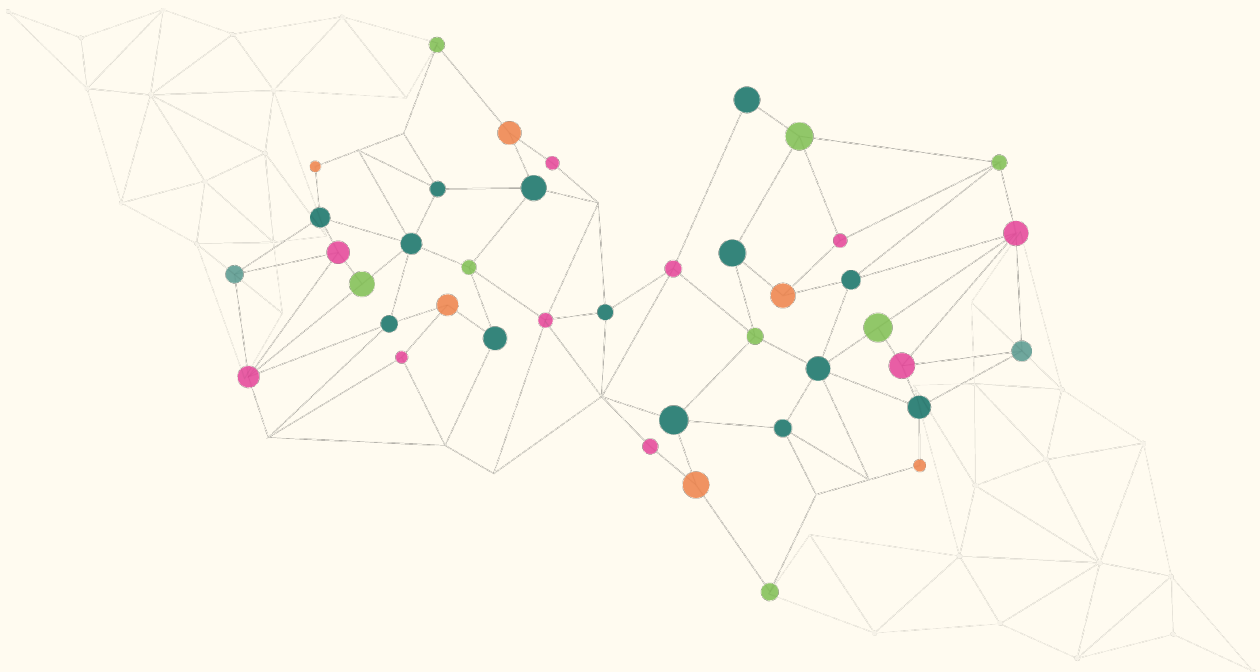
The Asi@Connect role

8. Looking to the Future

Across the previous seven chapters, several promising lights emerge. The community is maturing organisationally — moving toward more diversified funding, more documented governance, and broader service portfolios. The technical frontier has visibly advanced, with 100 Gbps connectivity now a reality and identity federation moving from planning to operation. The advanced-services pipeline points to a community pulling forward, with demand outpacing implementation in many areas — a healthy tension.

Three priorities suggest themselves for the period to the next survey. First, the gap between Demanded and Implemented in advanced services represents an obvious Asi@Connect collaboration opportunity: where one or two NRENs have already implemented a service that many more are planning, the project is ideally placed to drive knowledge transfer. Second, AI is now visibly on the agenda but adoption is uneven — the next survey should be able to track that progression in more granular detail. Third, gender balance in the technical workforce remains an area for community focus, where the ‘tech-girl’ capacity development programmes may result in the desired outcome.

Future editions can also deepen the analytical structure: per-NREN profile pages containing additional spotlight contributions and achievements from the named NRENs.



Methodology

This Compendium is based on self-reported responses to the Asi@Connect NREN survey across three waves: 2018, 2020 and 2025. Survey data was collected through the Asi@Connect e-Compendium Data Portal (<https://compendium.bdren.net.bd/asiaconnect>). Data has been compiled without independent audit; gaps reflect non-response rather than absence of activity. Where the same metric was reported on different scales across waves — notably revenue-composition shares, recorded as fractions in 2018 and percentages in 2020/2025 — figures were normalised to a common scale.

Each chapter applies a per-topic 2025-respondent rule: a chapter's analysis is restricted to the NRENs that responded on that topic in 2025. Where trends across waves are shown, a consistent-panel rule is used — only NRENs that reported in 2018, 2020 and 2025 are included in the trend line, so that growth or decline reflects genuine change in the same NRENs rather than churn in the responding population.

For services, advanced services and identity services, both the 2020 and 2025 inventories are compared like-for-like. The identity-services data spans five distinct areas — identity federation status, federated services, Identity/Service Provider counts, eduroam campus-coverage brackets, and eduroam associated services — each requiring its own analytical treatment.



Appendix — NREN Profiles

A one-glance profile for each NREN that responded to any 2025 question. Each card shows the NREN's reported key metrics for 2025 and a short distinction line drawn from the data. Dashes indicate metrics not reported by that NREN.

AARnet Australia NREN Governor: Warrick Mitchell

267 Total staff (2025)	— Connected institutions	— Highest bandwidth	— University market share
— Operations model	— Services + advanced	676 TB Research data (In+Out)	8.6 Gbps Max TEIN bandwidth

Distinction: Active Asi@Connect community member

BdREN Bangladesh NREN Governor: Mamun Ahmed

105 Total staff (2025)	157 Connected institutions	4 Gbps Highest bandwidth	39% University market share
Self Operations model	51 Services + advanced	68 TB Research data (In+Out)	1.0 Gbps Max TEIN bandwidth

Distinction: Broad service portfolio (30+ services) · Comprehensive governance framework

CamREN Cambodia NREN Governor: PO Kimtho

20 Total staff (2025)	12 Connected institutions	500 Mbps Highest bandwidth	12% University market share
Self Operations model	31 Services + advanced	<1 TB Research data (In+Out)	<0.1 Gbps Max TEIN bandwidth

Distinction: Broad service portfolio (30+ services)

CERNET China NREN Governor: Jilong Wang

— Total staff (2025)	2,604 Connected institutions	40.96 Gbps Highest bandwidth	73% University market share
Self Operations model	59 Services + advanced	4,759 TB Research data (In+Out)	10.0 Gbps Max TEIN bandwidth

Distinction: Advanced services leader (10+ implemented) · Broad service portfolio (30+ services)

DrukREN Bhutan

NREN Governor: **Karma Jamyang**

131 Total staff (2025)	311 Connected institutions	1 Gbps Highest bandwidth	100% University market share
Hybrid Operations model	21 Services + advanced	— Research data (In+Out)	— Max TEIN bandwidth

Distinction: Full (100%) national university coverage · Comprehensive governance framework

ErdemNET Mongolia

NREN Governor: **Nanjidjamts Jigjidsuren**

44 Total staff (2025)	610 Connected institutions	1 Gbps Highest bandwidth	5% University market share
Self Operations model	27 Services + advanced	2 TB Research data (In+Out)	0.1 Gbps Max TEIN bandwidth

Distinction: Active Asi@Connect community member

HARNET Hong Kong

NREN Governor: **Samuel Kwan**

12 Total staff (2025)	11 Connected institutions	3.466 Gbps Highest bandwidth	45% University market share
Hybrid Operations model	19 Services + advanced	1,384 TB Research data (In+Out)	7.6 Gbps Max TEIN bandwidth

Distinction: Active Asi@Connect community member

IDREN Indonesia

NREN Governor: **Basuki Suhardiman**

— Total staff (2025)	108 Connected institutions	1 Gbps Highest bandwidth	2% University market share
Self Operations model	17 Services + advanced	0 TB Research data (In+Out)	0 Gbps Max TEIN bandwidth

Distinction: Active Asi@Connect community member

KOREN South Korea

NREN Governor: **Jaeho Lee**

16 Total staff (2025)	96 Connected institutions	10 Gbps Highest bandwidth	13% University market share
Outsourced Operations model	28 Services + advanced	1,613 TB Research data (In+Out)	14 Gbps Max TEIN bandwidth

Distinction: Active Asi@Connect community member

LEARN Sri Lanka

NREN Governor: **Asitha Bandaranayake**

27 Total staff (2025)	56 Connected institutions	2 Gbps Highest bandwidth	58% University market share
Hybrid Operations model	31 Services + advanced	4 TB Research data (In+Out)	0.6 Gbps Max TEIN bandwidth

Distinction: *Broad service portfolio (30+ services) · Comprehensive governance framework*

LERNET Laos

NREN Governor: **Phouphet Kyophilavong**

— Total staff (2025)	— Connected institutions	— Highest bandwidth	— University market share
Self Operations model	19 Services + advanced	— Research data (In+Out)	— Max TEIN bandwidth

Distinction: *Active Asi@Connect community member*

MAFFIN Japan

NREN Governor: **Shinji Hattori**

— Total staff (2025)	5 Connected institutions	40 Gbps Highest bandwidth	— University market share
Hybrid Operations model	22 Services + advanced	— Research data (In+Out)	— Max TEIN bandwidth

Distinction: *Active Asi@Connect community member*

MYREN Malaysia

NREN Governor: **Sabki Bin Mohammad Nor**

20 Total staff (2025)	210 Connected institutions	10 Gbps Highest bandwidth	65% University market share
Self Operations model	26 Services + advanced	283 TB Research data (In+Out)	3.6 Gbps Max TEIN bandwidth

Distinction: *Active Asi@Connect community member*

NKN India

NREN Governor: **Karunakar Gupta**

— Total staff (2025)	— Connected institutions	— Highest bandwidth	— University market share
Self Operations model	32 Services + advanced	508 TB Research data (In+Out)	8.5 Gbps Max TEIN bandwidth

Distinction: *Broad service portfolio (30+ services)*

NREN Nepal

NREN Governor: **Lochan Lal Amatya**

9 Total staff (2025)	34 Connected institutions	1 Gbps Highest bandwidth	53% University market share
Hybrid Operations model	27 Services + advanced	0 TB Research data (In+Out)	0 Gbps Max TEIN bandwidth

Distinction: *Active Asi@Connect community member*

PERN Pakistan

NREN Governor: **Naveed Tahir**

36 Total staff (2025)	440 Connected institutions	3.5 Gbps Highest bandwidth	74% University market share
Hybrid Operations model	51 Services + advanced	78 TB Research data (In+Out)	1.6 Gbps Max TEIN bandwidth

Distinction: *Broad service portfolio (30+ services)*

PREGINET Philippines

NREN Governor: **Franz A. De Leon**

40 Total staff (2025)	163 Connected institutions	1 Gbps Highest bandwidth	4% University market share
Self Operations model	21 Services + advanced	129 TB Research data (In+Out)	2.7 Gbps Max TEIN bandwidth

Distinction: *Active Asi@Connect community member*

REANNZ New Zealand

NREN Governor: **Amber McEwen**

62 Total staff (2025)	39 Connected institutions	100 Gbps Highest bandwidth	100% University market share
Self Operations model	33 Services + advanced	— Research data (In+Out)	— Max TEIN bandwidth

Distinction: *100 Gbps backbone — regional frontier · Full (100%) national university coverage*

SingAREN Singapore

NREN Governor: **Francis Lee (Chair)**

5 Total staff (2025)	7 Connected institutions	100 Gbps Highest bandwidth	67% University market share
Hybrid Operations model	25 Services + advanced	589 TB Research data (In+Out)	91.8 Gbps Max TEIN bandwidth

Distinction: *100 Gbps backbone — regional frontier*

ThaiREN Thailand

NREN Governor: **Chalermpol Charnsripinyo**

38 Total staff (2025)	10,772 Connected institutions	100 Gbps Highest bandwidth	76% University market share
Hybrid Operations model	38 Services + advanced	357 TB Research data (In+Out)	2.4 Gbps Max TEIN bandwidth

Distinction: 100 Gbps backbone — regional frontier · Advanced services leader (10+ implemented)

TWAREN Chinese Taipei

NREN Governor: **Eric Yen**

16 Total staff (2025)	— Connected institutions	— Highest bandwidth	— University market share
Government Operations model	— Services + advanced	1,040 TB Research data (In+Out)	8.3 Gbps Max TEIN bandwidth

Distinction: Active Asi@Connect community member

VinaREN Vietnam

NREN Governor: **Dao Manh Thang**

11 Total staff (2025)	— Connected institutions	— Highest bandwidth	— University market share
— Operations model	— Services + advanced	0 TB Research data (In+Out)	0 Gbps Max TEIN bandwidth

Distinction: Active Asi@Connect community member

