

Bhutan's Internet Evolution

Reflections from NSRC



Hervey Allen
Assistant Director



Why we do what we do...

...Our approach is in our mission statement

The NSRC cultivates collaboration among a community of peers to build and improve a global Internet that benefits all parties. We facilitate the growth of sustainable Internet infrastructure via technical training and engineering assistance to enrich the network of networks.

Our goal is to connect people.

Hervey Allen



The NSRC

NSRC
Network Startup Resource Center

Formed as a non-profit organization by Randy Bush and John Klensin in 1990.

Located at the University of Oregon starting in 1996

1992

1990

1996

First National Science Foundation (NSF) grant formalized by the NSRC in 1992 at MIT.

O
UNIVERSITY OF
OREGON



Massachusetts
Institute of
Technology



Eugene



- United States (15)
- Denmark (4)
- New Zealand (4)
- Australia (3)
- Canada (3)
- Senegal (2)
- Bhutan (1)
- China (1)
- Ecuador (1)
- Guam (1)
- Holland (1)
- Netherlands (1)
- Tanzania (1)
- The Gambia (1)
- Togo (1)
- UK (1)
- Uganda (1)



Assistance Over the Years

Types of assistance have included:

- Workshops
- Direct Engineering Assistance
- Conference talks
- Tutorials
- Technical and planning meetings
- Fellowship assistance
- Donations of network hardware (routers, switches, access points)
- Technical books (O'Reilly physical and electronic, others)
- Training of potential trainers (last week at GovTech headquarters)



A few numbers*

Since 2012... I have over 1650 email messages in my Bhutan folder 😊 I'm sure others have much more, but more importantly:

- Over 700 routers, switches and access points
- Airfare, registration for Bhutan Fellows from RUB, DITT and DrukREN to international networking events
- 22 Workshops with over 700 participants trained
- 7 DEA trips, with over 15 sites visited
- 18 talks at btNOG/SANOG events (including 4 keynotes), one tutorial, chairs, moderators, panels

Direct Engineering Assistance

Date	Engagement	Counterpart
10–21 Aug 2014	DrukREN / R&E network planning visit (with TEIN*CC)	DITT / RUB
10–21 Feb 2015	TWAN design assistance	Bhutan Telecom, DrukREN, MoIC
2–13 Aug 2015	TWAN design DEA + DrukREN workshop planning	DrukREN
Sep 2015	Campus DEA at 5 sites : Samtse College, CST, ILCS, Sherubtse College, JNEC	RUB colleges
14–31 Aug 2016	DrukREN DEA — routing, virtualisation & services	DITT
Aug 2024	DrukREN / GovNET DEA	GovTech
Aug 2025	DrukREN / GovNET DEA	GovTech

In 2015 NSRC worked with Engineers, system administrators and trainers and travelled to six member institutions of the Royal University of Bhutan (RUB) to assist with infrastructure upgrades necessary to join the universities through the national Research and Education Network known as DrukREN. The Department of IT and Telecom (DITT) under the Ministry of Information and Communication coordinated with the Office of the Vice Chancellor of RUB to ensure all campuses will receive connectivity to DrukREN.



NSRC Assistance

Our first invitation 2005

- Dr. Philip Smith noted our work with him in Africa at AfNOG workshops.
- Jichen Thinley contact NSRC about pre-SANOG VI training.
- SANOG VI was scheduled for Bhutan in July in Thimphu
- Myself and Brian Candler taught the **Pre-SANOG VI Network Workshop** at the Royal Institute of Management in January.



Pre-SANOG VI Network Workshop
(South Asian Network Operators Group)



Place and Date

January 10 to 15, 2005 at The Royal Institute of Management, in Thimphu, Bhutan.

Overview

[Bhutan Telecom Ltd](#) will be hosting a Pre-SANOG network training workshop from January 10-15, 2005 at the [Royal Institute of Management](#) in Thimphu. The workshop is organized and taught by instructors from the [Network Startup Resource Center](#) team, with support from the [U.S. National Science Foundation](#), the [Internet Society](#), and the [International Development Research Centre](#).

The main objective of the workshop is to help develop the technical skills and knowledge of Network and System Administrators working in various organizations throughout Bhutan. The workshop is lab-based, and involves extensive hands-on practice. Topics include a FreeBSD (open source Unix operating system) installation, Unix system administration skills, IP services such as mail, DNS, web, etc. Network security and basic routing exercises will also be covered in the workshop.

Bhutan Telecom and the NSRC hope that the skills and knowledge gained from the workshop will assist Bhutanese network administrators with their work, and also help prepare them for hosting the SANOG VI ([South Asia Networking Operators Group](#)) meeting and workshops. Bhutan Telecom will be the host of the SANOG VI meeting in Thimphu in July 2005.

Available items

- [Summary Outline](#) (with links to presentations)
- [Detailed Outline](#) (with links to presentations)
- [Workshop Web Site](#): includes updates

Presentations by Instructor

This includes originals as well as the generated PDF and PostScript files:

- [Hervey Allen](#) (United States/Chile)
- [Brian Candler](#) (England)

You can see a key of the filetypes used [here](#).

Workshop Photos

- Located [here](#).
- And, the class photo is [here](#).

Software

- Located [here](#).

Sponsored By



Site Maintained by:

[Network Startup Resource Center](#)
Sat Jan 15 09:27:54 GMT 2005

Bhutan connectivity at this point...

2005: Six years since 256 kbps satellite to the UK (British Telecom) as part of inauguration of DrukNet.

- GSM mobile had been launched (2003) by Bhutan Telecom
- Internet market open to competition (2004)



The past two weeks

Name	Organization (Country)	Route
Hervey Allen	NSRC (US)	EUG-SFO-NRT-BKK-PBH
Brian Candler	NSRC (UK)	LHR-BKK-PBH
Philip Paeps	NSRC (HK)	HKG-BKK-PBH
Tashi Phuntsho	NSRC/FLEXOPTIX (BT)	BNE-SIN-PBH
Philip Smith	NSRC (AU)	BNE-SIN-PBH

Three workshops

Name	Organization (Country)
Train the Trainer (TtT)	https://nsrc.org/workshops/2026/nsrc-drukren-ttt/
Practical Cybersecurity for Internet Operators Workshop (PCIO)	https://nsrc.org/workshops/2026/btnog13/pcio/
System Administration & Infrastructure Operations (SAIO)	https://nsrc.org/workshops/2026/btnog13/saio/

The past twenty one years



#	Date	Event	Workshop track(s)	Venue / Host
1	10–15 Jan 2005	Pre-SANOG VI	Unix / networking / IP services	RIM, Thimphu · Bhutan Telecom
2	16–23 Jul 2005	SANOG VI	Track 2: NSRC IP Services Workshop	Royal Banquet Hall, Thimphu
3	15–19 Jul 2010	SANOG 16	Workshop 3: ISP & IP Services (mail, web, DNS, proxy, Nagios) — Phil Regnault, Steve Gibbard, GZ Kabir	Paro · Bhutan Telecom
4	3–7 Dec 2012	DrukREN / DrukNet	Campus Network Design	Bhutan Telecom offices
5	13–21 Jan 2014	SANOG 23	Track 2 Virtualization & Cloud; Track 3 Security	Terma Linca, Thimphu
6	17–21 Nov 2014	btNOG 1	3 tracks (NSRC led Track 2: Virtualisation & Cloud)	CST, Phuentsholing
7	7–11 Sep 2015	DrukREN	Track 1 Campus Network Design; Track 2 Linux Sysadmin	OVC · RUB & DITT
8	14–17 Nov 2016	btNOG 3	Routing	OVC, Thimphu
9	5–9 Jun 2017	btNOG 4	Campus Network Design	OVC, Thimphu
10	4–8 Jun 2018	btNOG 5	Wireless Design; Network Design	RIM, Thimphu
11	9–16 Jan 2019	SANOG 33	Campus Network Design; System Administration	Namgay Heritage Hotel
12	3–7 Jun 2019	btNOG 6	Network Mgmt & Monitoring; Routing & Switching	Tashi Namgay Resort, Paro
13	4–8 Aug 2024	btNOG 11	Campus Network Design & Operations	RIM, Thimphu
14	17–23 Aug 2025	btNOG 12 / SANOG 43	BGP Deployment & Ops; CNDO; Virtualisation	RIM, Thimphu
15	23–28 Aug 2026	btNOG 13	Practical Cybersecurity; SysAdmin & Infra Ops	RIM, Thimphu

Organization Training Numbers*

Sector	Seats	%
Bhutan Telecom / DrukNet	139	24%
Royal University of Bhutan (colleges & institutes)	87	15%
Government — ministries, dzongkhags & agencies	74	13%
Private sector — ISPs, IT firms, industry	68	12%
GovTech / DITT / MoIC (national ICT)	54	9%
State-owned enterprises & utilities (DGPC, BPC, DHI, Druk Air, Dungsam...)	37	6%
Banking, finance & insurance	33	6%
TashiCell / Tashi InfoComm	31	5%
Health sector (hospitals, KGUMSB, traditional medicine)	17	3%
Schools, TVET & training institutes	12	2%
Not itemised (2005 workshops, non-BT)	9	2%
Media & broadcasting (BBS)	6	1%
Regional / international (Bangladesh, Nepal, Maldives, Sri Lanka, PCH)	5	1%
Other / not recorded	12	2%
Total	584	

NSRC Staff and Contractors Over the years

First came	First time in Bhutan as NSRC
2005	Hervey Allen (US) · Brian Candler (UK)
2010	Phil Regnault (DK) ·
2012	Hans Kuhn (US) · Dale Smith (US) · Andy Linton (NZ)
2014	Dean Pemberton (NZ) · Patrick Okui (UG)
2015	Steve Huter (US) · Philip Smith* (AU)
2018	Jonathan Brewer (NZ) · Mike Jager (NZ)
2019	Nimal Ratnayake (LK) · Md Abdul Awal (BD)
2024	Tashi Phuntsho (BT)
2025	Philip Paeps (HK) · Sebastian Büttrich (DK)

A pretty big, mixed group,
but missing one thing!

Women.

*First time in Bhutan, 1990's

Year	Women	Men	% Women
2005	7	44	14%
2010	6	24	20%
2012	4	19	17%
2014	13	75	15%
2015	20	40	33%
2016	6	24	20%
2017	3	13	19%
2018	9	36	20%
2019	42	82	34%
2024	9	16	36%
2025	30	45	40%
2026	35	42	43%

Changes over time



Total participants workshops over the years 712

The numbers may be a bit different, but it's close, and easily a bit low.

Additional engagements include conference Talks, Direct Engineering Assistance and Training of engineers at locations as well As interaction with engineers across the Government and other groups.

Year	Event	Workshop	Participants
2005	Pre-SANOG VI	Unix / networking / IP services	28
2005	SANOG VI	Track 2: NSRC IP Services	23
2010	SANOG 16	Workshop 3: ISP & IP Services	30
2012	DrukREN	Campus Network Design	27
2014	SANOG 23	Virtualisation	26
2014	SANOG 23	Security	38
2014	btNOG 1	Virtualisation & Cloud (NSRC track)	30
2015	DrukREN	Campus Network Design (T1)	35
2015	DrukREN	Linux System Administration (T2)	36
2016	btNOG 3	Routing	30
2017	btNOG 4	Network Design	23
2018	btNOG 5	Network Design	36
2018	btNOG 5	Wireless Design	20
2019	SANOG 33	Campus Network Design	37
2019	SANOG 33	System Administration	36
2019	btNOG 6	Network Management & Monitoring	37
2019	btNOG 6	Routing & Switching	36
2024	btNOG 11	Campus Network Design & Operations	35
2025	btNOG 12	BGP Deployment & Operations	27
2025	btNOG 12	Campus Network Design & Operations	37
2025	btNOG 12	Virtualisation	30
2026	btNOG 13	Practical Cybersecurity	26
2026	btNOG 13	SysAdmin & Infrastructure Ops	29
Total — 23 workshops			712



Bhutan - NSRC Relationship

NSRC, globally	
Operating since	1992
Countries	130+
Engineers trained	60,000+
IXPs helped deploy	dozens, all regions
ccTLD registries advised	dozens

Bhutan: Around 712 people trained in a country of about 800,000 —or roughly 1 in every 1,100 Bhutanese, and a much higher proportion of the working ICT sector.

Over time: Bhutan is one of the highest engagement locations globally for NSRC.

22 in-country engagements over 21 years with 700+ routers, switches and access points donated is a continuous activity that is higher than most places we have worked.

It has been an honor and a privilege



Moving Forward - Training the Trainers



**More
Local
Trainers**



**More
Local
Expertise**

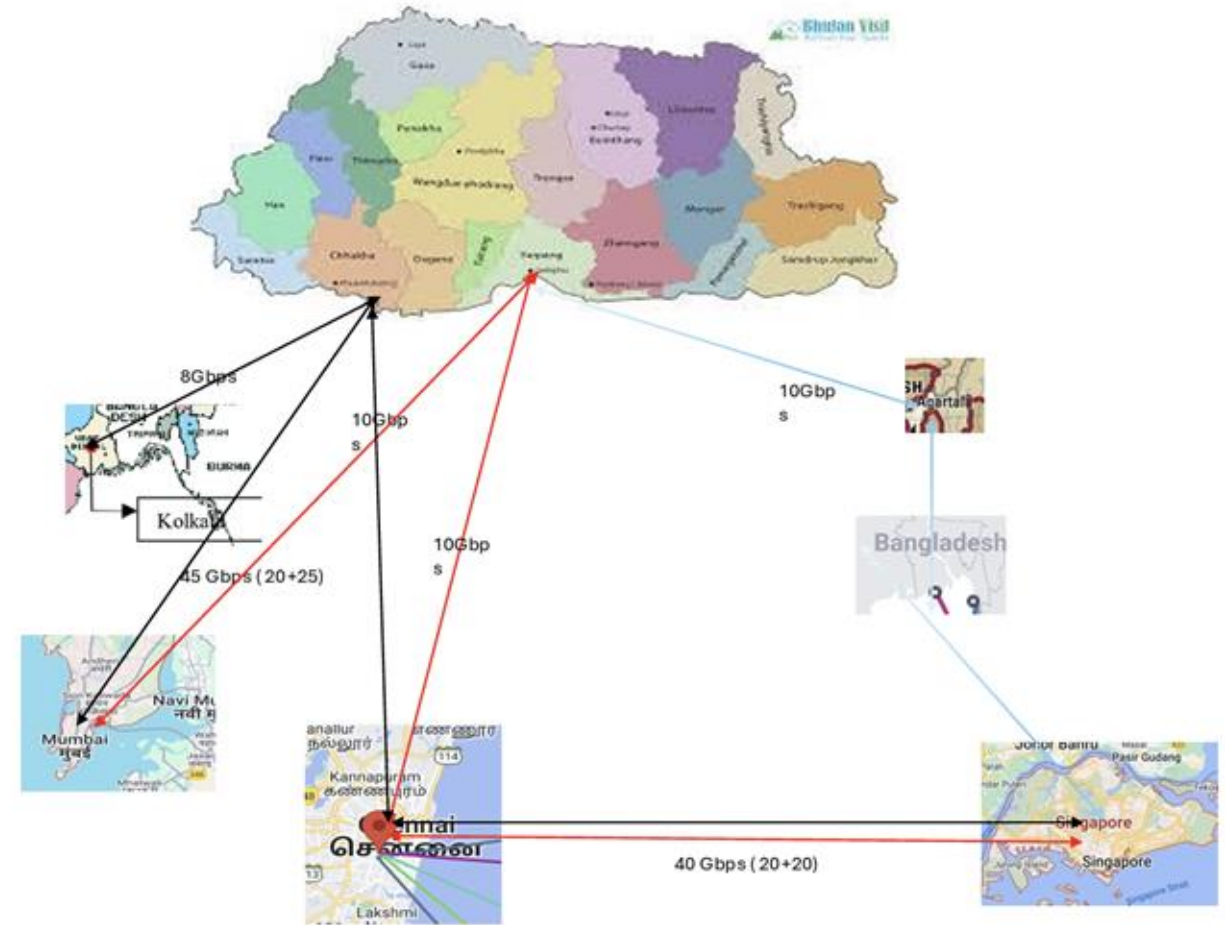


Bhutan connectivity today...

2026: Twenty seven years since 256 kbps satellite to the UK (British Telecom) as part of inauguration of DrukNet.

In 2025*: Jichen Thinley told us all that there are 24 ISPs in Bhutan and 105 Gbps of IP Backbone available (SANOG 43 Keynote).

256Kbps to 105 Gbps IP Backbone ++



*Since then, significant increase

https://www.sanog.org/resources/sanog43/SANOG43_Conference-Key_Note-Jichen.pdf

Why do we do this

Why we do what we do...

...Our approach is in our mission statement

The NSRC cultivates collaboration among a community of peers to build and improve a global Internet that benefits all parties. We facilitate the growth of sustainable Internet infrastructure via technical training and engineering assistance to enrich the network of networks.

Our goal is to connect people.



