



SUNET · CAMPUSNÄT / CNAAS

Where are we going with CNaaS in Sweden?

A look back at how the service was built — and where it's headed next

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And let's not talk about the
ice hockey



Mikael Ottosson

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20 years in network engineering

A bit about me

Outside the network operations center



Golf

Working on my handicap, one round at a time.



Ice hockey

Rarely miss a game — as a fan on the couch or in the stands.



Family

Spending time with my wife and our two kids tops the list.



What this talk covers

From the first campus install to a fully virtualized, automated service

01

The building blocks

What a working campus network actually needs — the checklist we started from.

02

The journey

Six stages of installs, from hand-built to fully templated and automated.

03

The architecture

How the backend evolved — from physical servers on-site to Sunet's virtual datacenter.

04

What's next

RADIUS/NAC 2.0, the DDI project, and full migration to virtual infrastructure.

The building blocks

What do we need in order to build a working campus network?



Network & access

- Switches
- WiFi
- Firewall



Identity & security

- RADIUS / NAC
- Active Directory
- Out-of-band (4G)



Management & inventory

- NMS
- Network inventory
- IPAM



Operations

- Monitoring
- DHCP
- DNS
- Log



The journey

Six stages, from a hand-built first install to a fully automated service



01

STAGE

The first real installation

Everything built from scratch, together with the customer

- Lots and lots of man-hours
- Making some things up as we went along
- Continuous problem-solving
- Many long discussions with the customer during the build
- Configuration was not smooth or streamlined
- Lots of testing before go-live



Component set at this stage: Switches, WiFi, Firewall, RADIUS/NAC, NMS, Inventory (NI), IPAM (Wiki), Monitoring, AD, OOB, DHCP, DNS, Log — largely undefined, decided per customer.

02

STAGE

The consecutive installations

Patterns from the first build start turning into templates

- Again, lots and lots of man-hours
- Most things invented in the first install were now templates — a lot smoother
- Some things still had to be improvised during installation



Templating begins: the first install's ad-hoc solutions become reusable building blocks for the next two customers.

02,5

STAGE

Discussions with customers

What do they want?

- “The black box”
 - DNS
 - DHCP
 - IPAM
 - RADIUS/NAC



The black box

03

STAGE

The following installations

Standardization takes hold, and the stack grows

- Fewer man-hours — people were becoming more specialized
- Most parts of the configuration were now standardized
- Firewall introduced as an optional component



Component change: Firewall added to the standard build

04

STAGE

Later installations

Specialization deepens and the tooling consolidates

- Even fewer man-hours — people were now highly specialized
- Almost all parts of the configuration were standardized
- RADIUS/NAC removed for new customers
- NI and Wiki replaced by Netbox



Component change: Inventory & IPAM consolidate onto Netbox, replacing NI and the wiki.

05

STAGE

Recent installations

One engineer, heavy automation

- One person configuring the system together with the customer
- A lot of automation between NMS, Netbox and NAV
- Geteduroam introduced for all CNaaS customers



Automation now links NMS, Netbox and NAV directly, cutting manual configuration steps.

06

STAGE

The newest installation

No more hardware on-site — everything runs centrally

- One person configuring the system together with the customer
- Automation between NMS, Netbox and NAV keeps increasing
- No more physical servers at the customer site
- All systems moved to Sunet's virtual datacenter
- Management of customer equipment via VRFs in the Sunet core

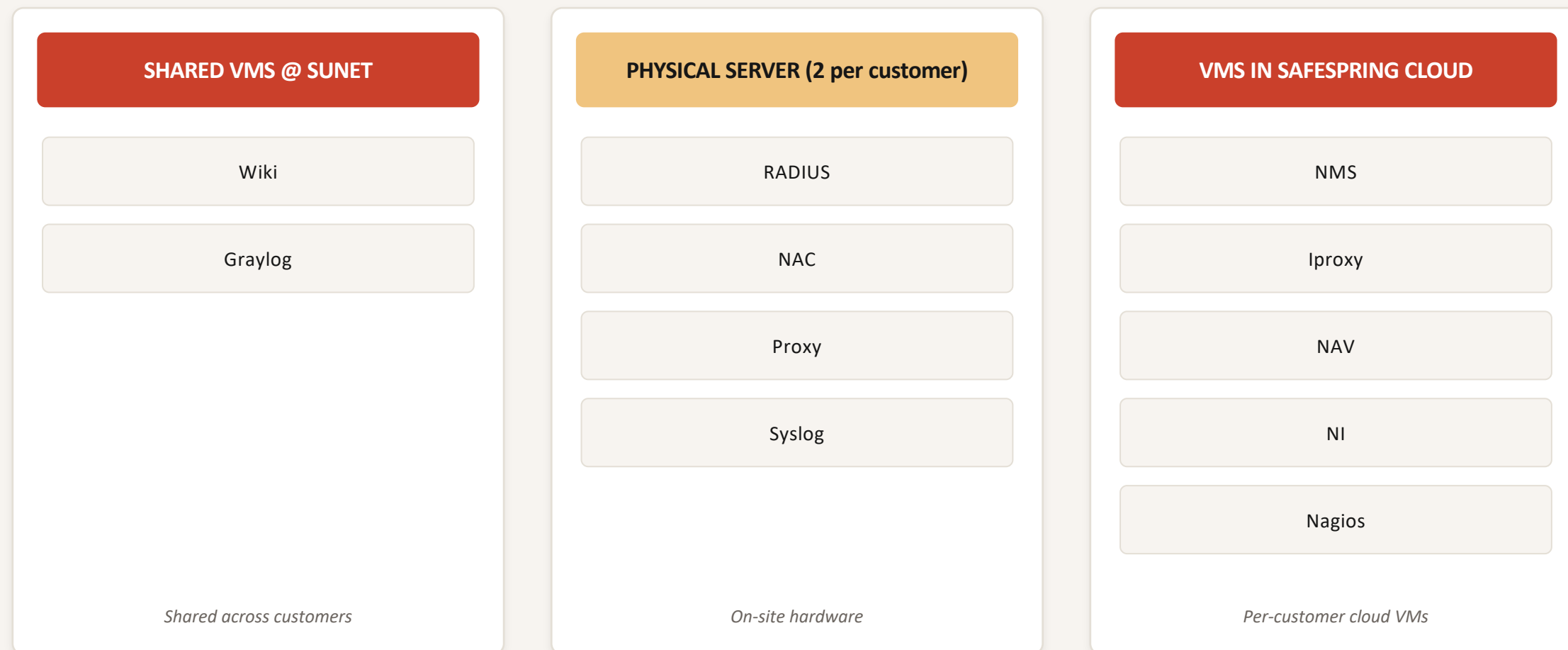


Component change: physical per-customer servers retired entirely; management now via Sunet-core VRFs.



Architecture — Day 1

Per-customer physical servers, minimal shared infrastructure



Every customer required its own physical server on site — heavy on hardware, light on shared tooling.



Architecture — Now

Shared tooling grows, cloud VMs remain per customer

SHARED VMS @ SUNET

Wiki

Nagios and Argus

Netbox

Graylog

platform

Shared across customers

VMS IN SUNET VDC CLOUD

NMS

Iproxy

NAV

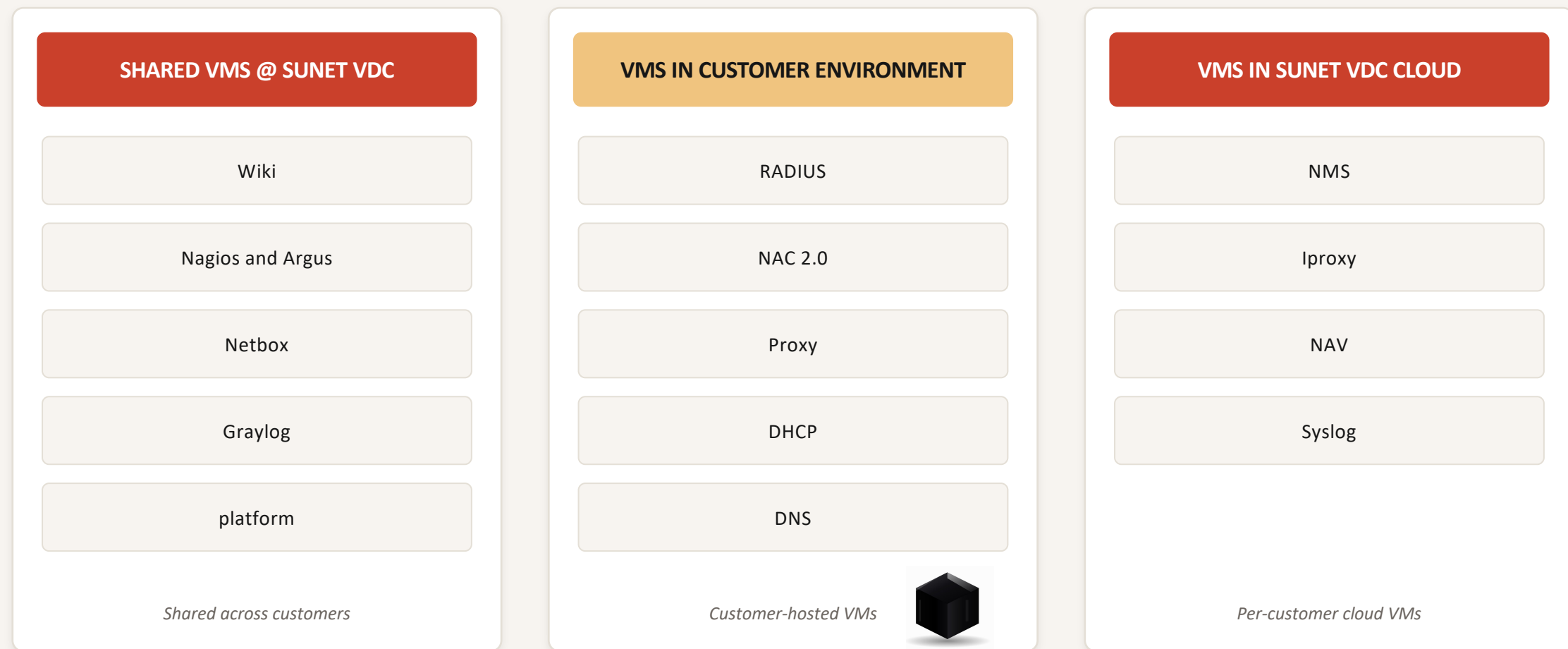
Syslog

Per-customer cloud VMs

Physical servers are gone. Most tooling — inventory, logging, monitoring — is now shared rather than duplicated per customer.

Architecture — The future

Moving customer-specific services into the customer's own environment



Direction under discussion: reintroduce RADIUS/NAC 2.0 and DDI services inside each customer's own environment.



What's next

The near-term roadmap for CNaaS

IDENTITY

Reintroduce RADIUS with a new NAC 2.0

DDI

DDI project — DNS, DHCP and IPAM

INFRASTRUCTURE

Move all customers to Sunet's virtual datacenter

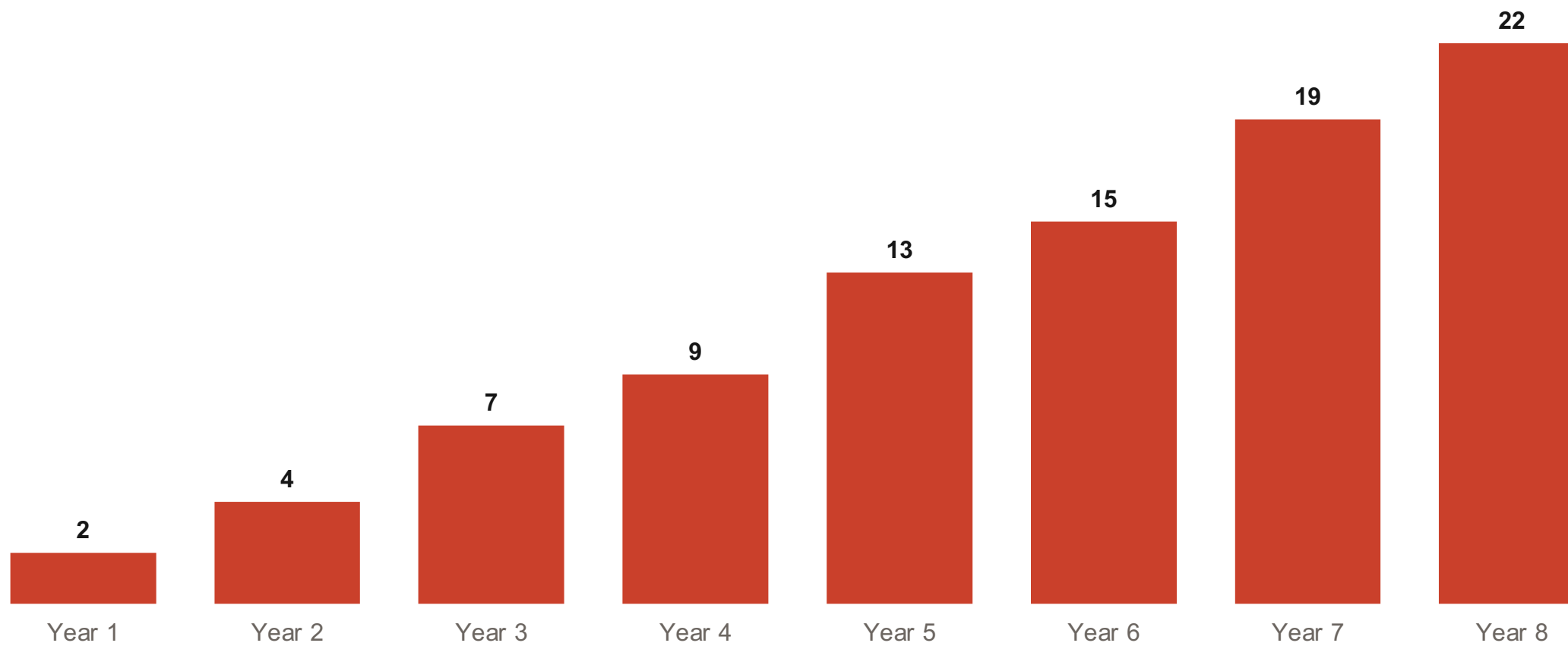
TEMPLATES

Redesign templates and remove logic from them



Growth in customers

Number of customers on CNaaS, by year since launch





Number of end-users right now

Number of end-users in total

- **Students @universities:** $\approx 254,000$ (registered headcount)
- **Employees @universities:** $\approx 26,100$
- **Employees @other organisations:** ≈ 865



How did we get here?

Some personal thoughts

- **Give the networking people a tool and a reference architecture that is good enough**
- **Let them be a part of the future**
- **Have Sunet do the boring stuff so the engineers can focus on building networks**
- **Have an easy-to-understand price model**
- **Have a great team of people on your team**

Thank you

Questions and discussion welcome

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