



Look ma, no hands!

Advanced operational concepts for (maritime) microsatellites

Norwegian Maritime Microsatellites, NTNU, 2017

Briefly about Statsat AS



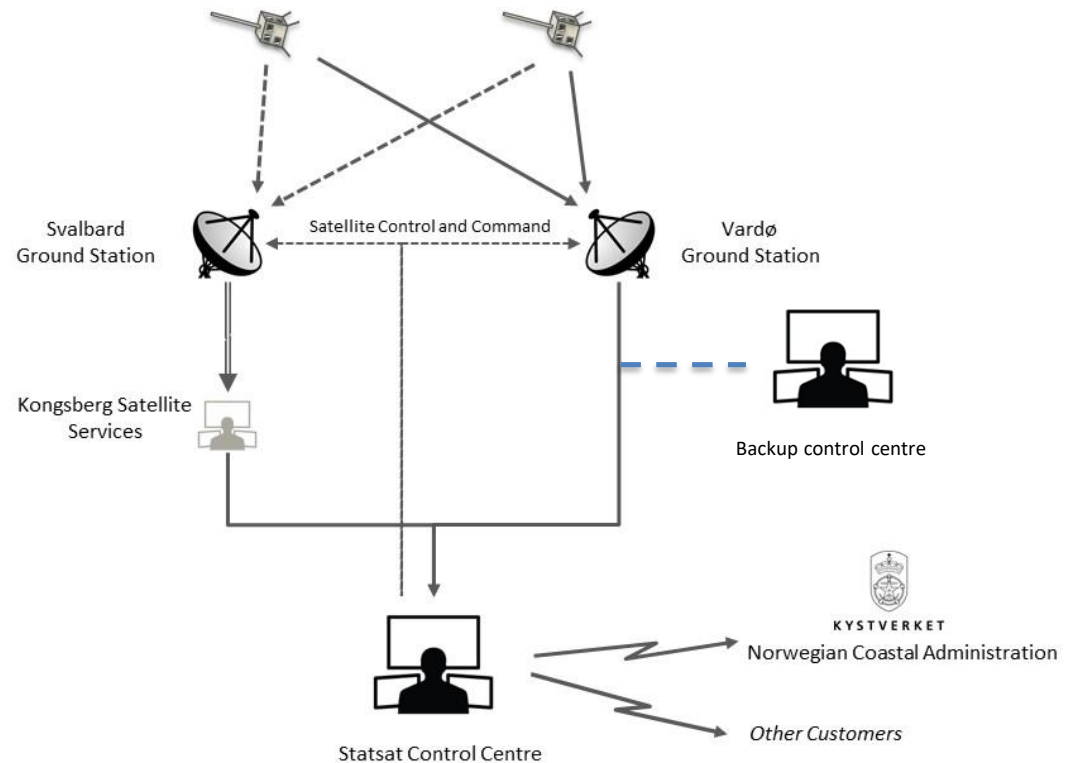
- Government owned through Space Norway
- Established 2013
- Located in Oslo, Norway
- Goal: efficient, low-cost, and not-for-profit
- Small, highly educated and skilled staff with broad background

Statsat's purpose:

To define, develop, source and operate space infrastructure for public purpose and use

Statsat operating environment

- Statsat operates 2 polar orbit AIS satellites for Norwegian Coastal Administration
- 2 additional satellites to be launched in July
- One more by the end of 2017
- Additional projects under development



Advanced == simple



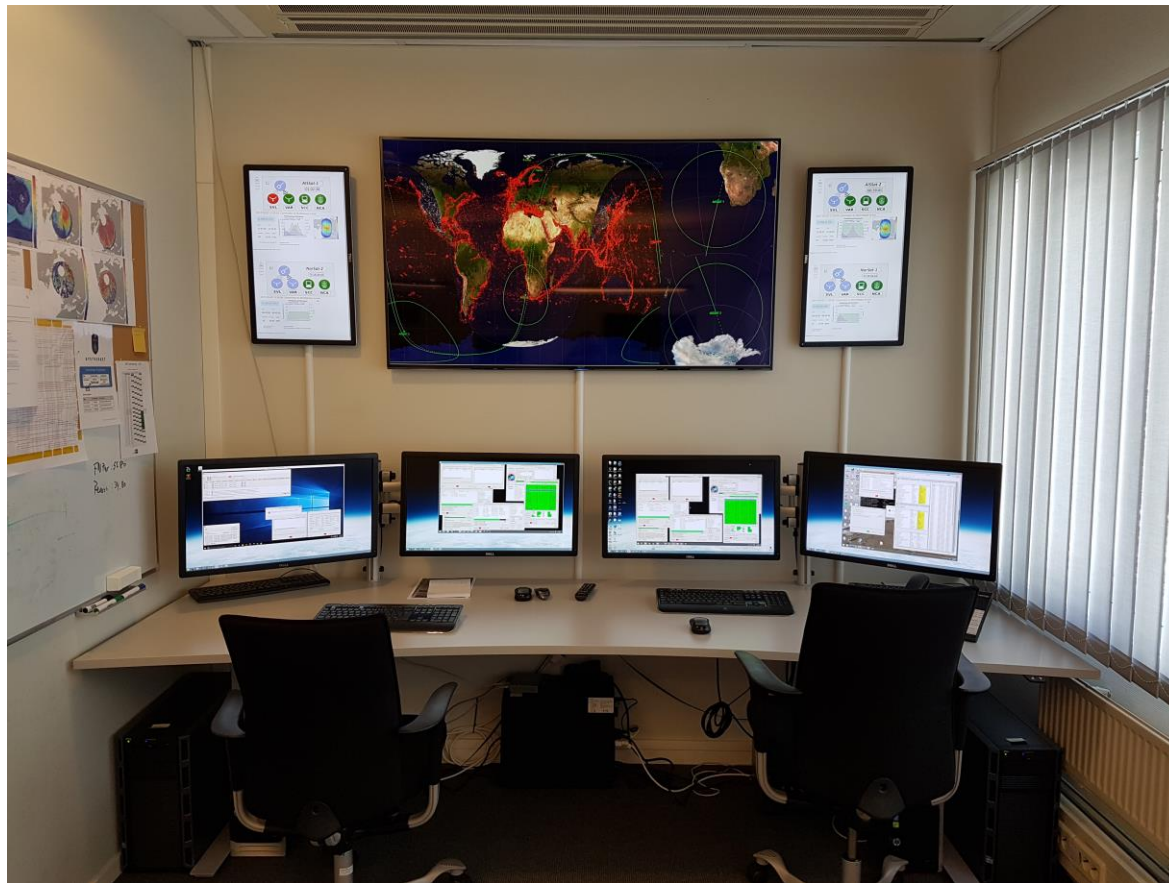
ESA



Statsat

Information, automation, and analysis
(and some hands-on)

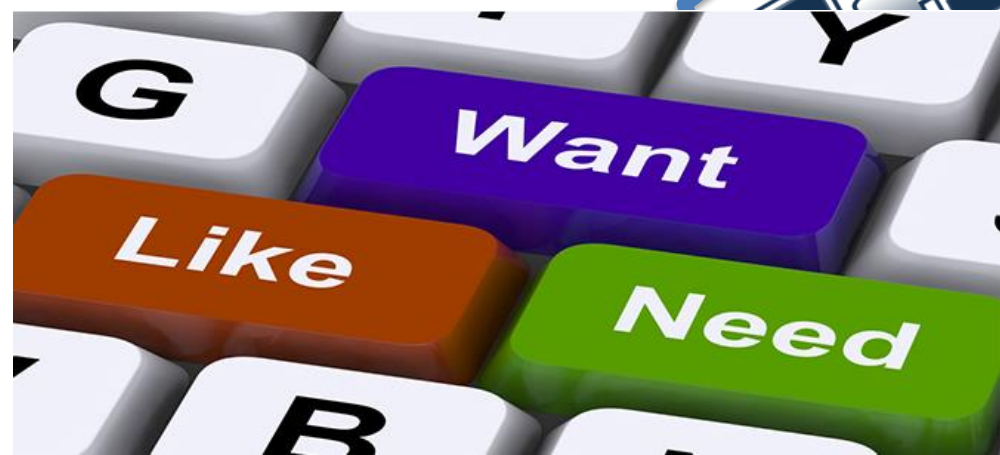
Statsat Control Centre – when someone visits



Information



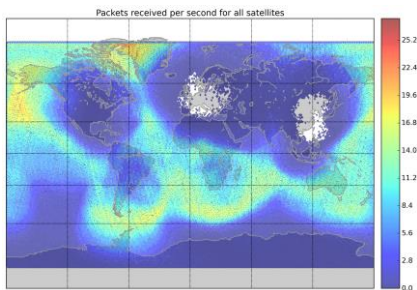
User requirements



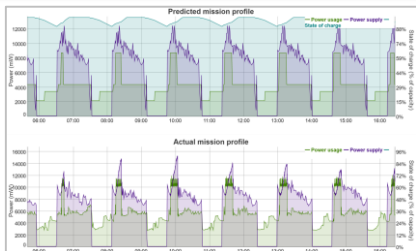
Satellite operation constraints

Performance data

SATELLITE AIS RECEPTION



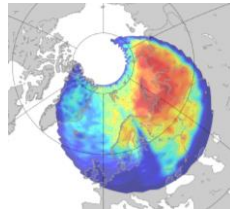
SATELLITE POWER PROFILE



COMMUNICATION QUALITY

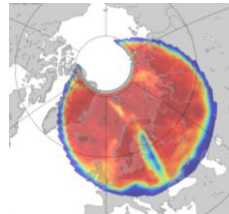
AISSat-1

From Vardø

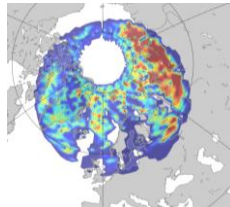


AISSat- 2

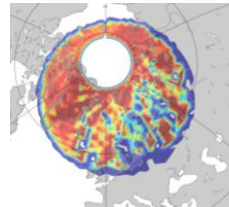
From Vardø



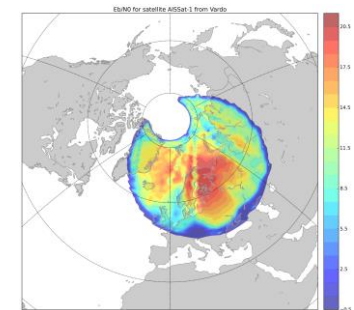
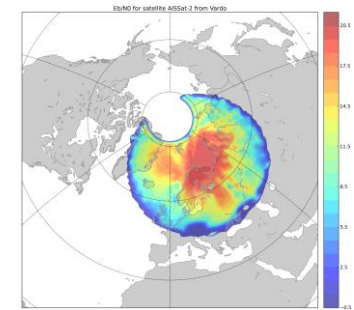
From Svalbard



From Svalbard

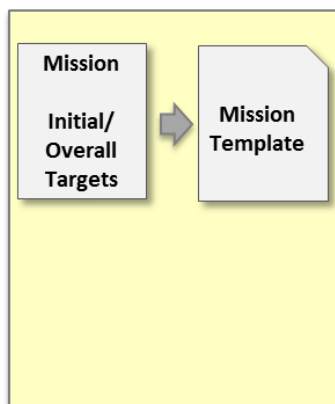


EXPECTED SIGNAL STRENGTH

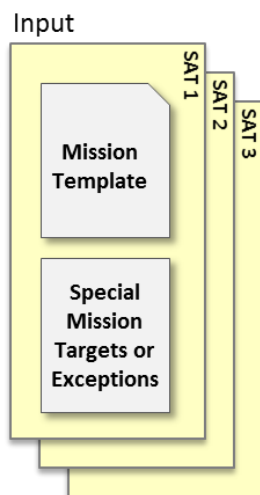


Requirements and constraints - Mission planning and Schedule optimisation

Overall Mission Planning



Weekly mission



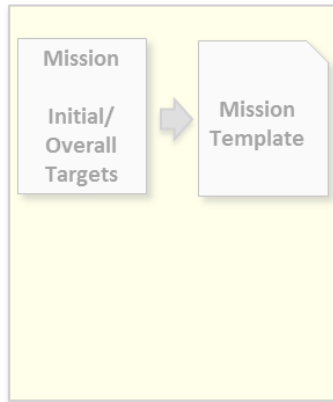
Seq.	Event	Parameter	Offset	Repeats	Commands
1	Mission start		0.000	1	AISSat-1,AISSat-2: Observation start nextpoweroff(32000ms)
2	Acquisition of signal		-2.000	*	AISSat-1,AISSat-2: Downlink start(2000ms)
3	Loss of signal		0.000	*	AISSat-1,AISSat-2: Downlink end(2000ms)
4	Passing SVL		-300.000	*	AISSat-1,AISSat-2: Switch inactive table(2000ms)
5	Mission end		0.000	1	AISSat-1,AISSat-2: Observation end(6000ms)
10	Acquisition of signal		-4.000	*	AISSat-1,AISSat-2: Switch inactive table(2000ms)
11	Start of eclipse		0.000	*	AISSat-1,AISSat-2: Payload OFF(4000ms)
12	Acquisition of signal		0.000	*	AISSat-1,AISSat-2: Enable feedthrough(2000ms)
13	AOS SG stations (downlink)		-60.000	*	AISSat-1,AISSat-2: Point Z- (SBand) towards SG(2000ms)
14	AOS VG stations (downlink)		-60.000	*	AISSat-1,AISSat-2: Point Z- (SBand) towards VG(2000ms)
18	Start of eclipse		900.000	*	AISSat-1,AISSat-2: Payload ON_copy(325000ms)
20	End of eclipse		200.000	*	AISSat-1,AISSat-2: GPS ON(7000ms)
21	Start of eclipse		-4.000	*	AISSat-1,AISSat-2: GPS OFF(4000ms)
22	End of eclipse		800.000	*	AISSat-1,AISSat-2: Sync GPS time(2000ms)

Automation

- Planning activities
 - Fleet scheduling
 - Satellite mission planning
- Operational activities
 - Data delivery
 - System health monitoring
 - Satellite operations/maintenance
 - Event handling (e.g. failures)
- System monitoring

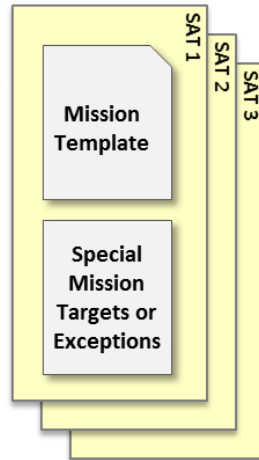
Automatic planning activities

Overall Mission Planning

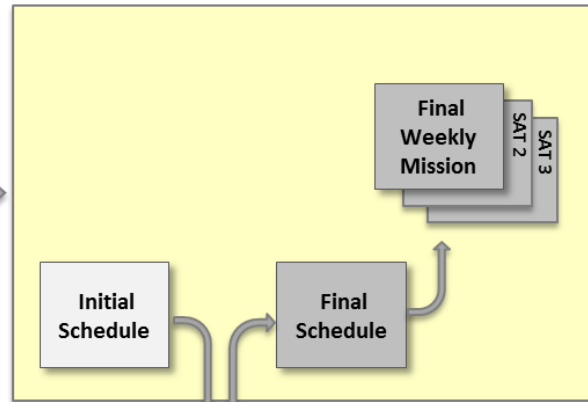


Weekly mission

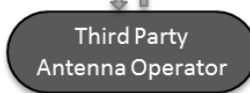
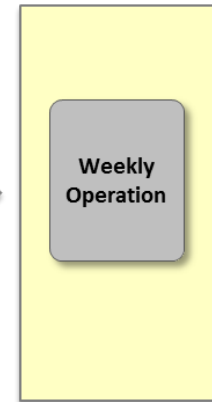
Input



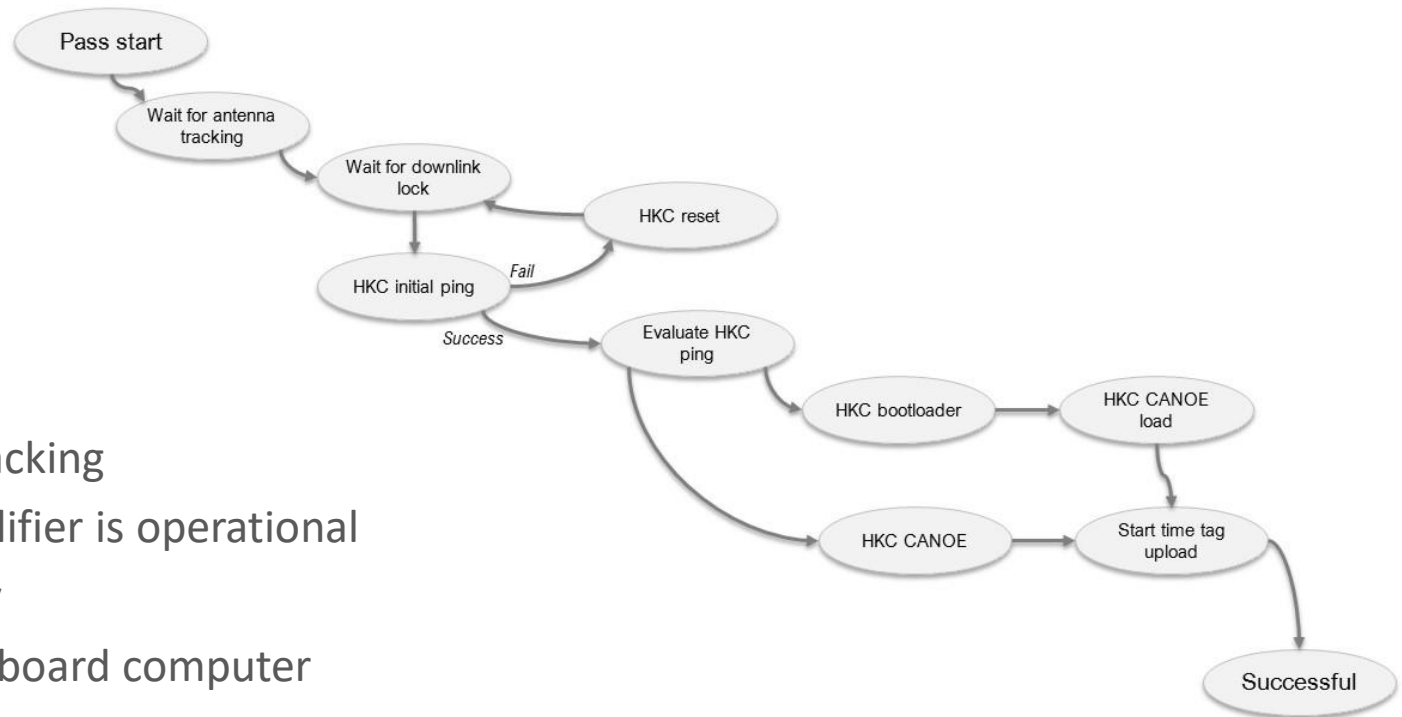
Operational planning



Operation



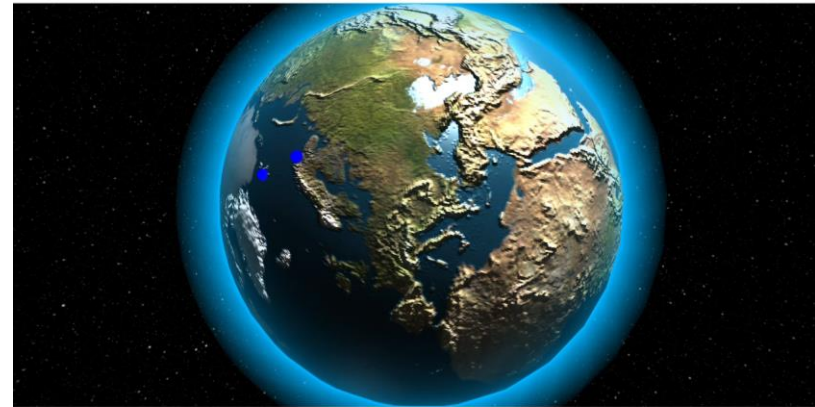
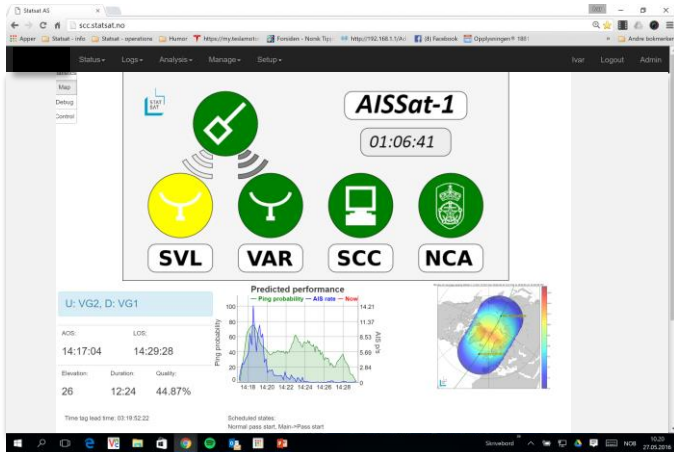
Operational automation



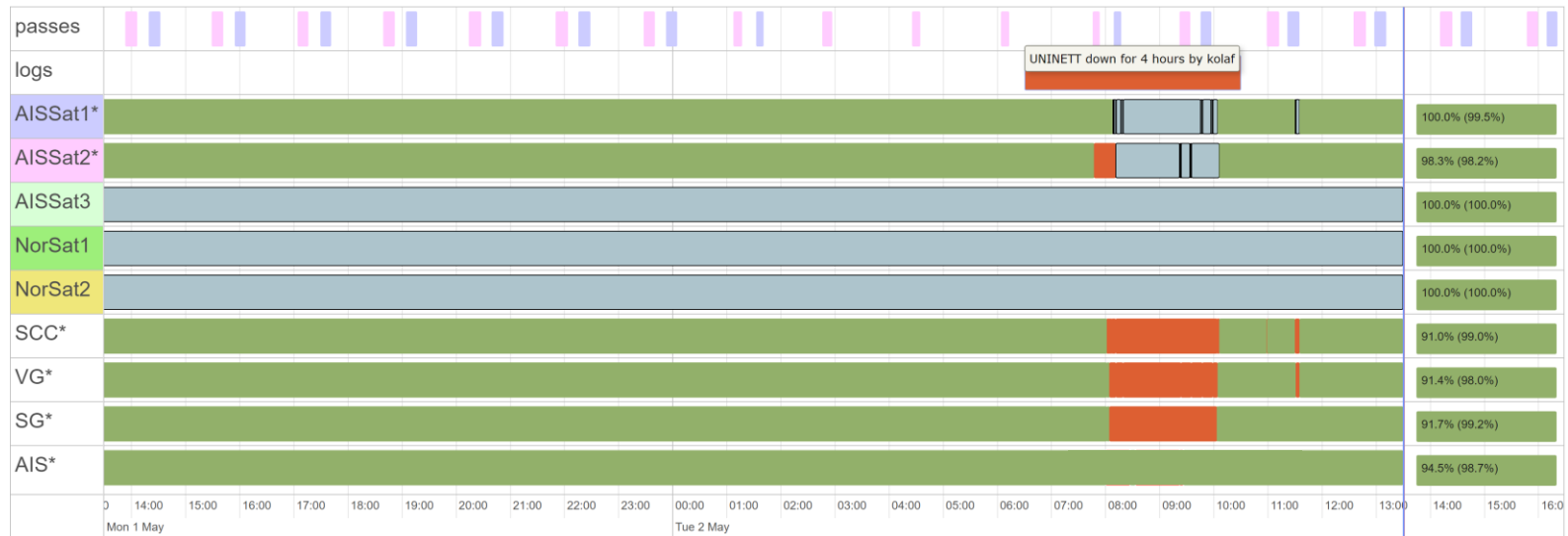
Checks:

- Antenna tracking
- Uplink amplifier is operational
- Link Quality
- State of on board computer
- State of payloads

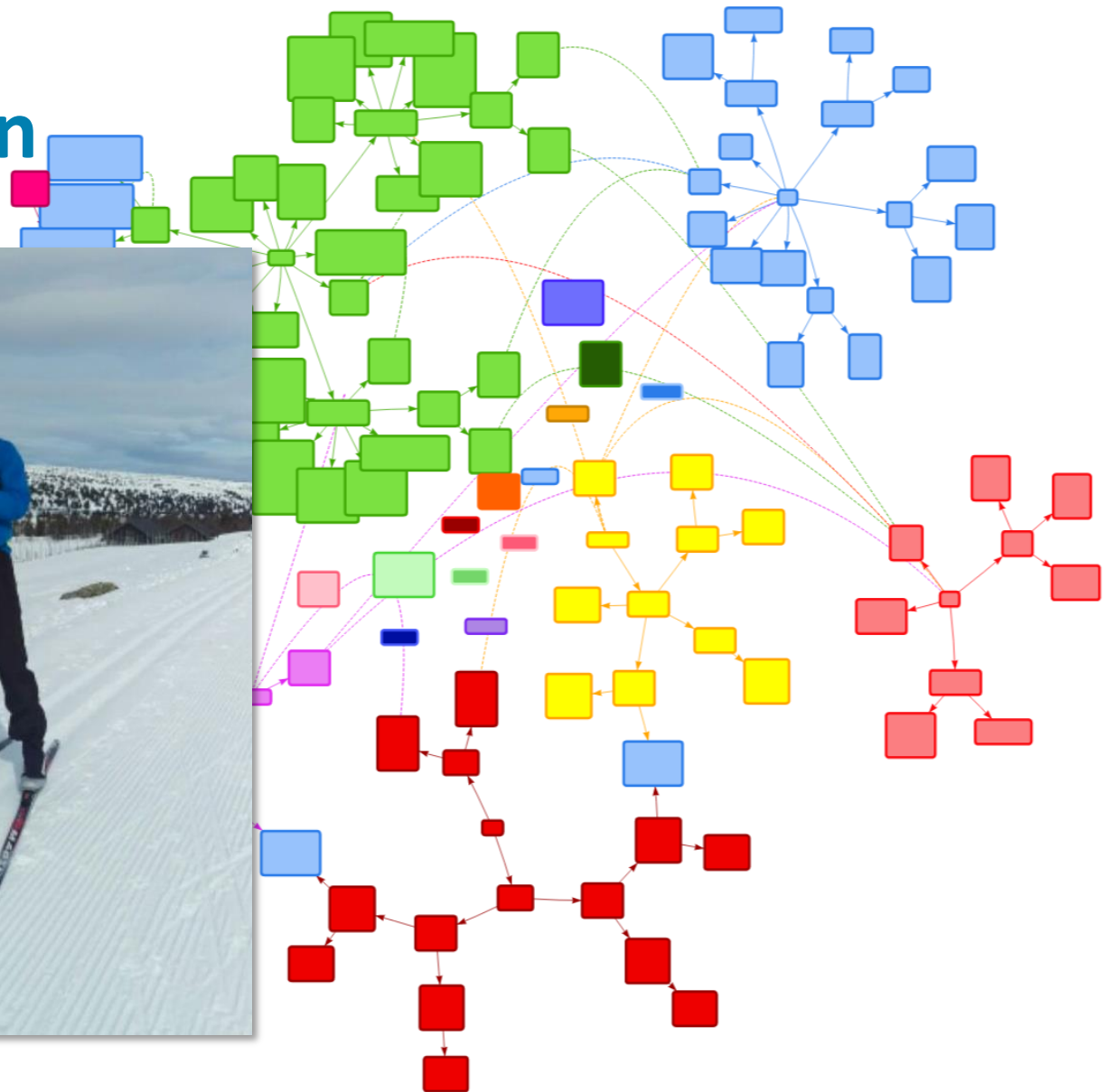
Monitoring and analysis



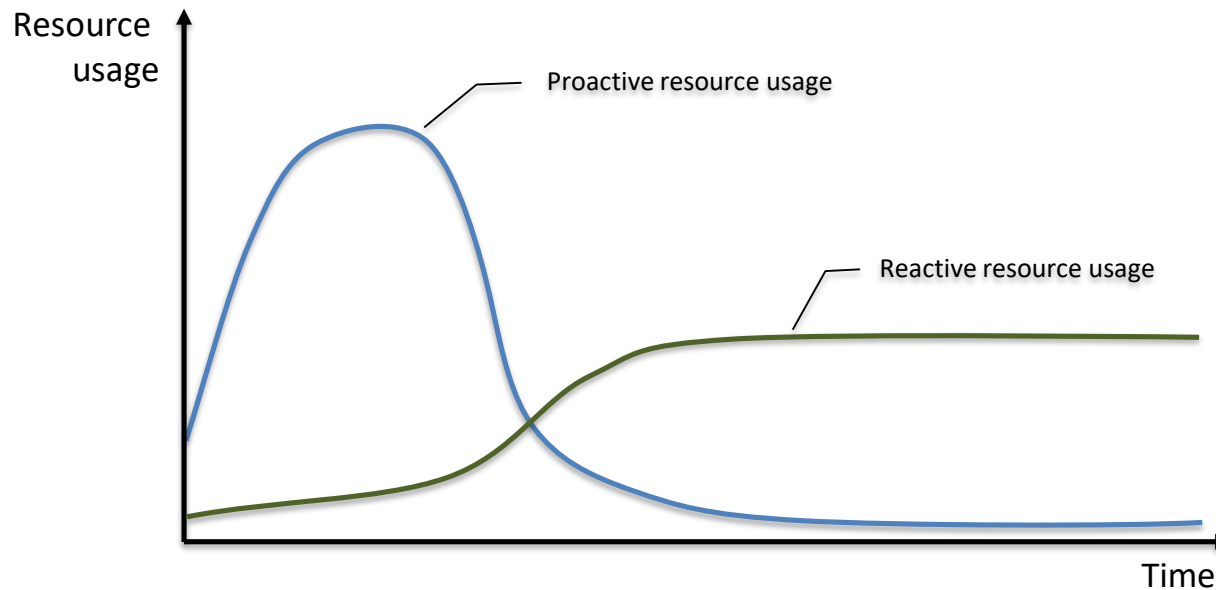
Payloads:



Hands-on



The project manager's chartls



75% cost saving achieved through
upfront resource usage

The interesting part – Quality

- Operational quality
 - Increased up-time
 - *Quicker abnormality detection*
 - *Quicker exception handling*
 - Increased consistency in exception handling
 - *Same exception pattern always leads to same action*

“No hands” – That’s a good thing