



National Astronomical Institute of Thailand
(Public Organisation)
Ministry of Science and Technology

Prospects and Progress of RANGD Project

Phrudth Jaroenjittichai

Project Manager

IVTW, Krabi

11/11/18

Pre-RANGD Era

	Training	Telescope	Site
...-2013		<ul style="list-style-type: none"> • 3m SRT • 4.5m SRT 	<ul style="list-style-type: none"> • RFI U. of Malaya
2014	<ul style="list-style-type: none"> • NARIT-KASI winter school 	<ul style="list-style-type: none"> • Flashed the idea to MOST Minister 	<ul style="list-style-type: none"> • RFI 100-3300 MHz x 6 locations in Chiang Mai
2015	<ul style="list-style-type: none"> • Radio Astronomy Workshop (P. Thommasson) • 2week NARIT engineers training@KASI • Radio Astronomy & Geodesy Workshop (H. Schuh) 	<ul style="list-style-type: none"> • visited NAOJ-Mitaka-KASI • EAVN workshop 2015 (Hokkaido) • AOV meeting @Hobart 	<ul style="list-style-type: none"> • RFI-PTEC 20 MHz - 26.5 GHz @AstoP. @Jomthong • Meeting with Chancellor of Mae Fah Luang University, Chiang Rai
2016	<ul style="list-style-type: none"> • NARIT-KaVA winter school • Training on Radio Telescope Principles (P. Thommasson) 	<ul style="list-style-type: none"> • Proposal Submitted • Visit Tianma@SHAO • Project Roadmap to ISAC • KaVA meeting @Krabi • CMU-eng, NECTEC, KMUTT, ... • visit Yebes • Project Approval • TVN Collaborative Workshop 	<ul style="list-style-type: none"> • RFI 20 MHz - 6 GHz @alternative sites, Phrae, Maejo, Doisaket • Site Permission Process • move to current site
2017	<ul style="list-style-type: none"> • NF seminar series • NF summer school • NF staff exchange • NARIT- 	<ul style="list-style-type: none"> • N. Kawaguchi Visit • S.T. Han, D.-Y. Byun Visit • H. Schuh Visit 	<ul style="list-style-type: none"> • RFI 20 MHz - 6 GHz @HHK • Site concluded @ HHK
2018	SOKENDAI Winter School 2018 February 2018	more visitors...	Site construction started...

Radio Astronomy Network and Geodesy for Development (RANGD)

2017-2021

“Capacity Building Through Radio Astronomy”

- Thai National Radio Observatory (**TNRO**)
 - 40m Thai Radio Telescope (**TNRT**)
 - 13m VGOS Telescope
 - Visitor Centre
- Receiver and Electronics Laboratories

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Human Expertise

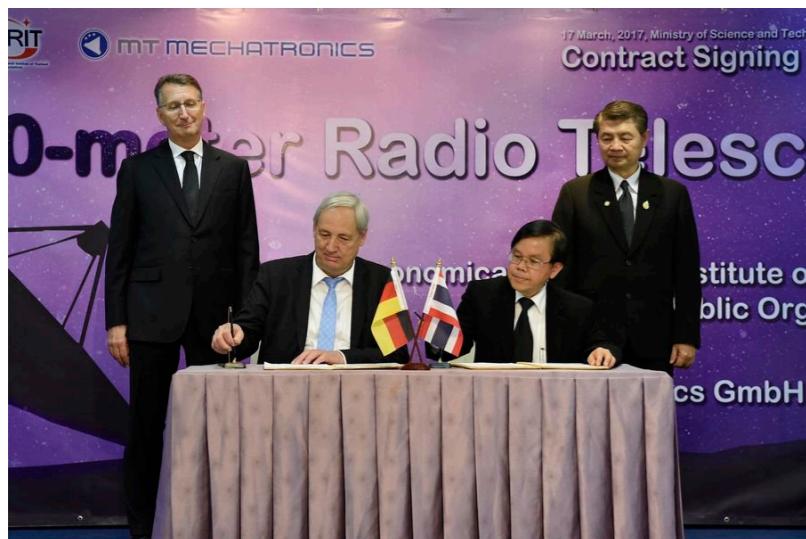
- Workshops & Seminars
- Trainings & Staff exchange

Background of TNRT

- Multipurpose ~40m RT — with flexibility
- (preferably) Existing Design — limited experience
- Frequency ~ UHF - ~100 GHz — determined by Science area,
Radio Frequency Interference,
Weather conditions
- Ideal latitude location : +18 N (Chiangmai)
- Single Dish Applications focus on Time Domain astronomy, such as pulsars and radio transients and variability of masers and AGNs.

The 40m Thai National Radio Telescope

- ‘Updated’ version of IGN’s 40m Yebes Radio Telescope
- 40m Paraboloid Antenna, Cassegrain-Nasmyth optics
- 150 um (rms) total surface accuracy (@52EL)
- 300 MHz - 115 GHz
- Slew: Az 3 deg/s, EL 1 deg/s
- Pointing: 2” (no wind), 6” (5 m/s wind)
- Tetrapod Head Unit (THU)

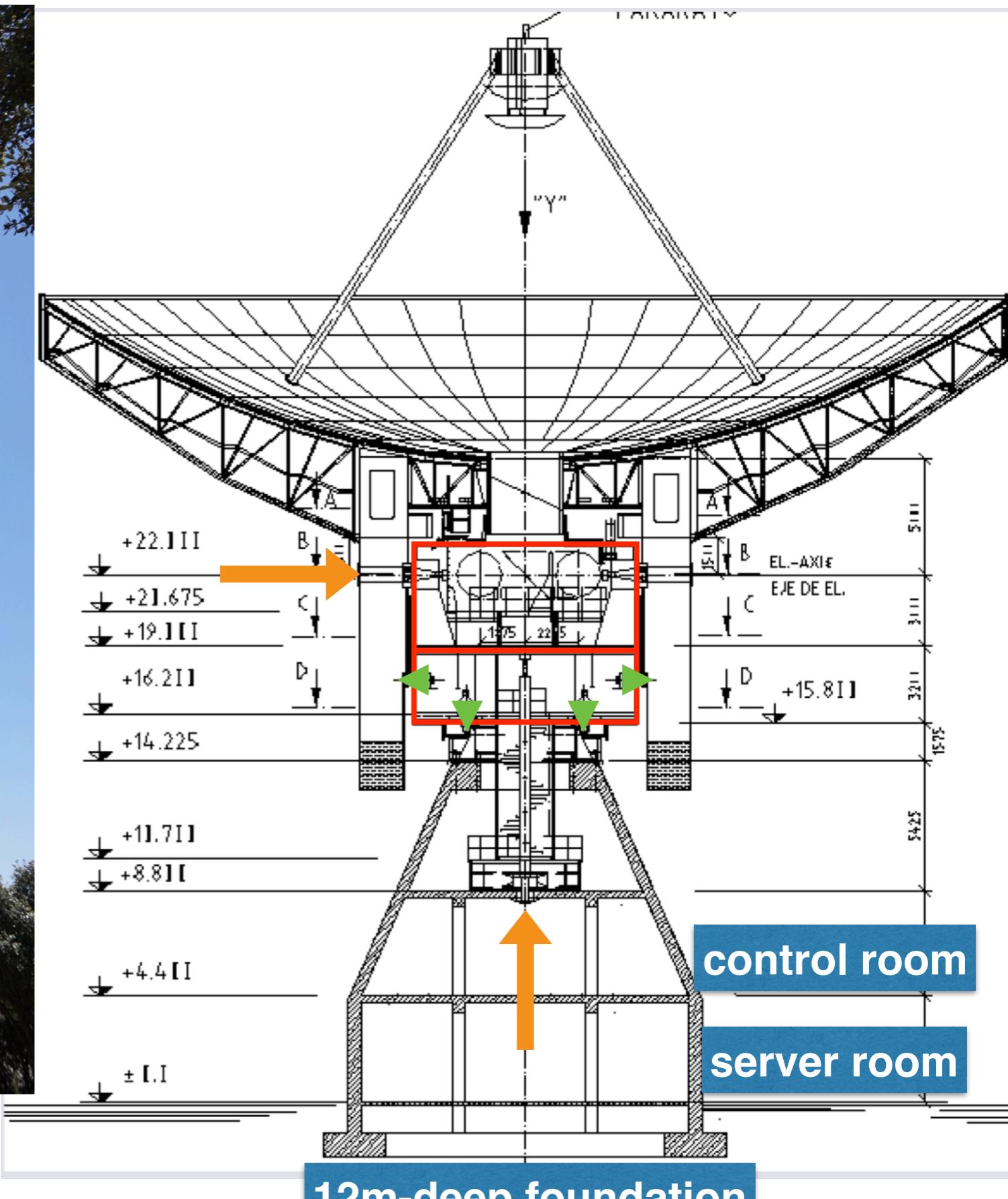


40m RT Contract Signing March '17



40m Yebes, Spain

The 40m Thai National Radio Telescope



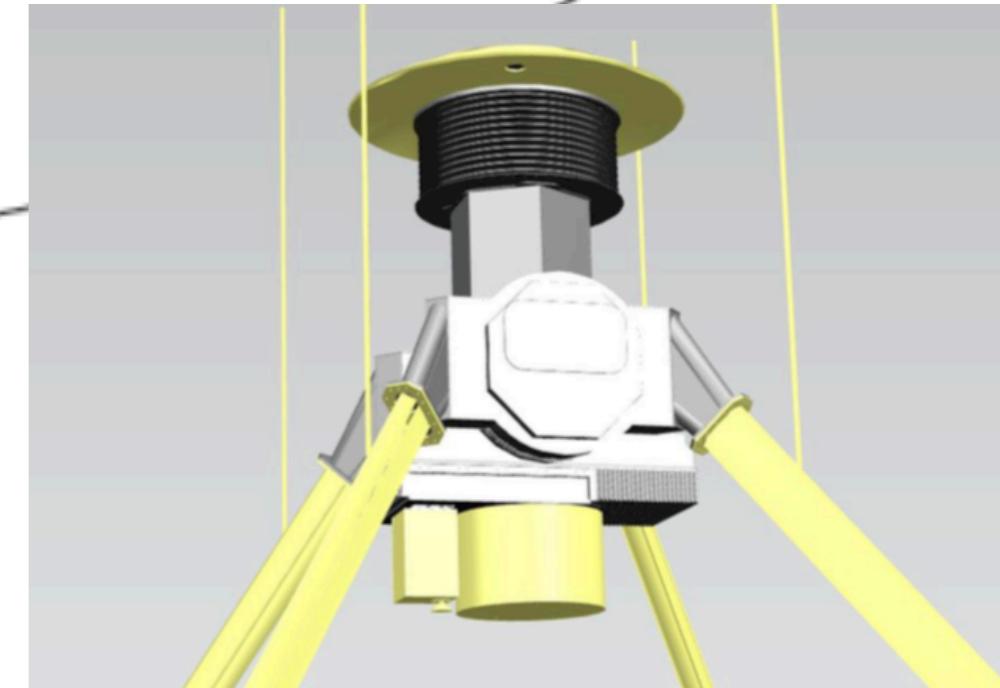
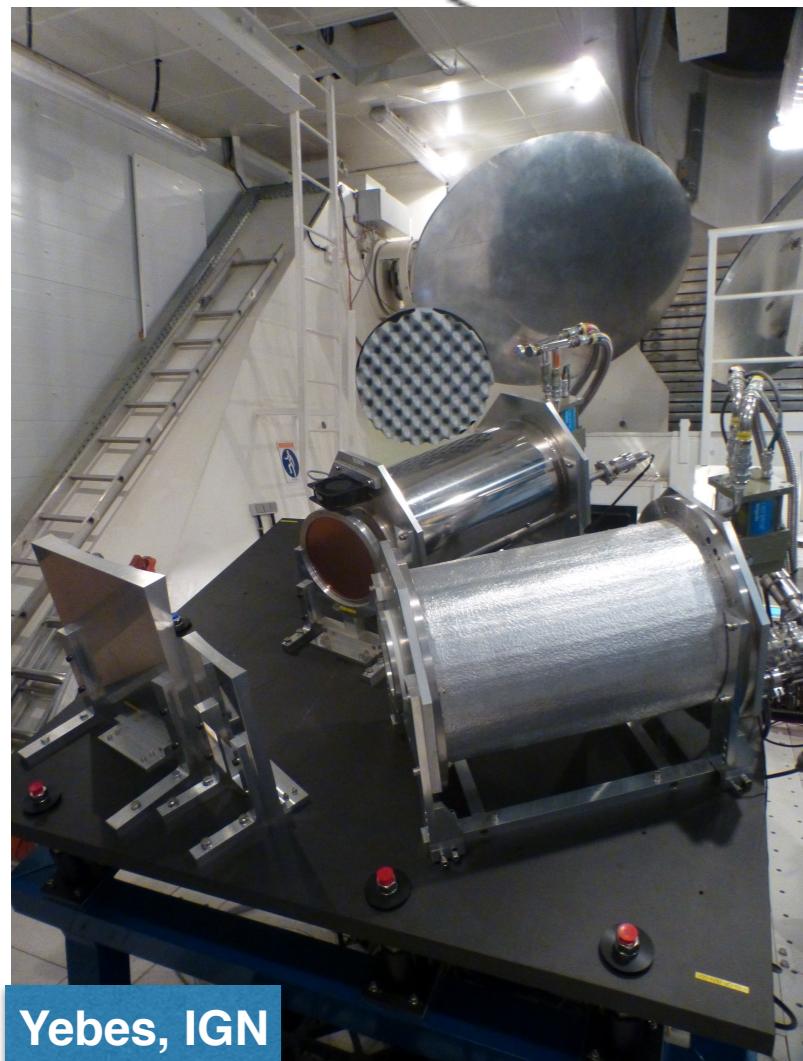
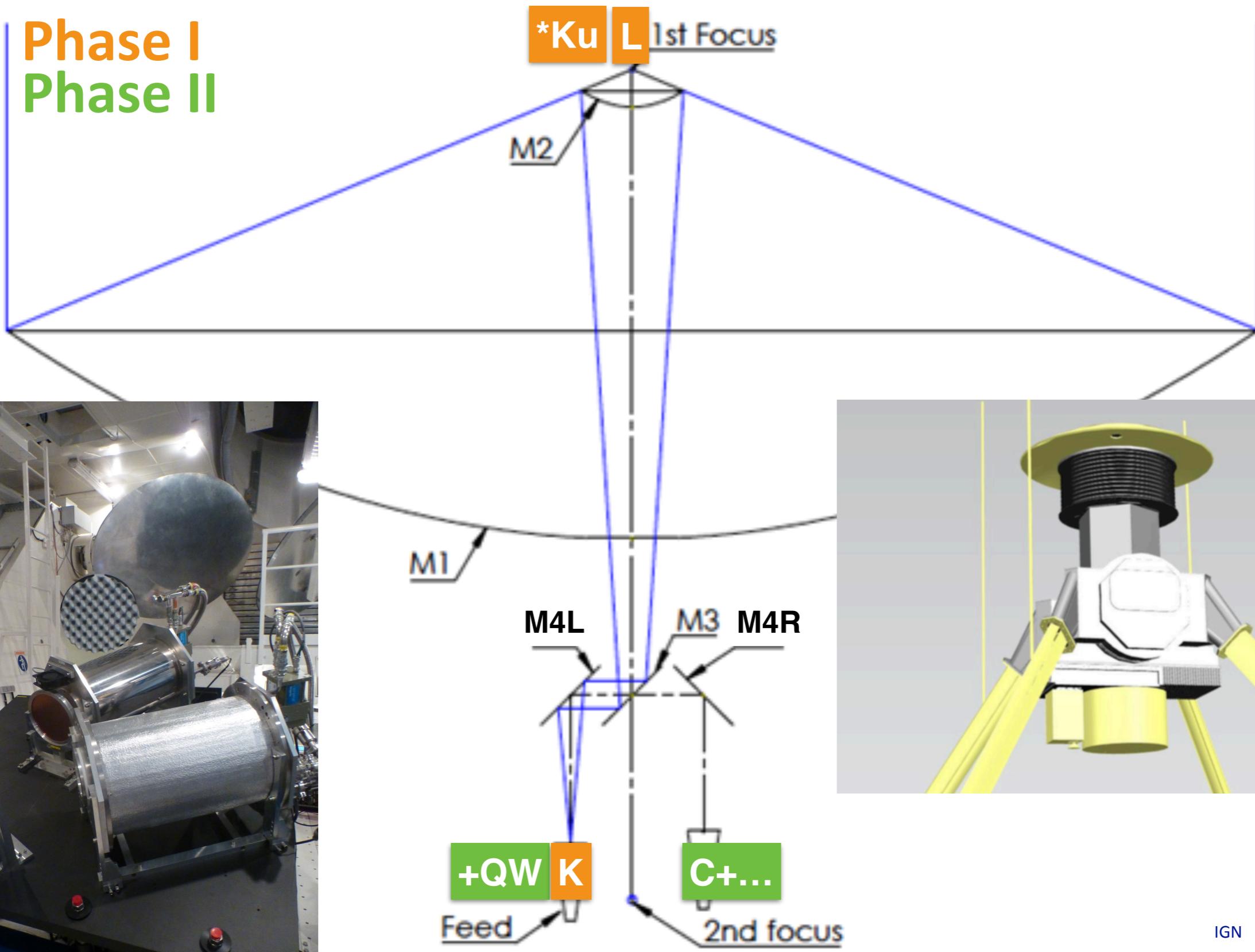
Main Reflector Trail Assembly (October)

- Steel structure is fabricated in Thailand



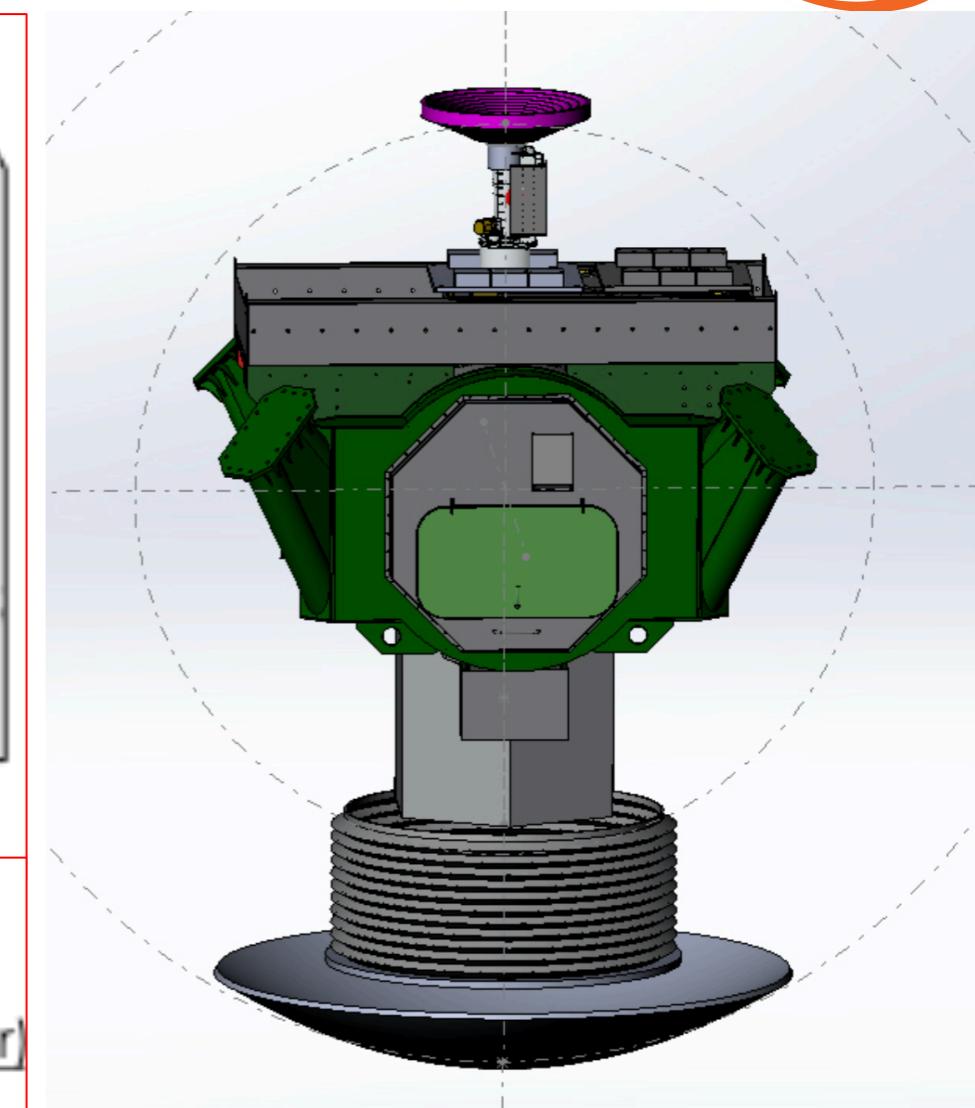
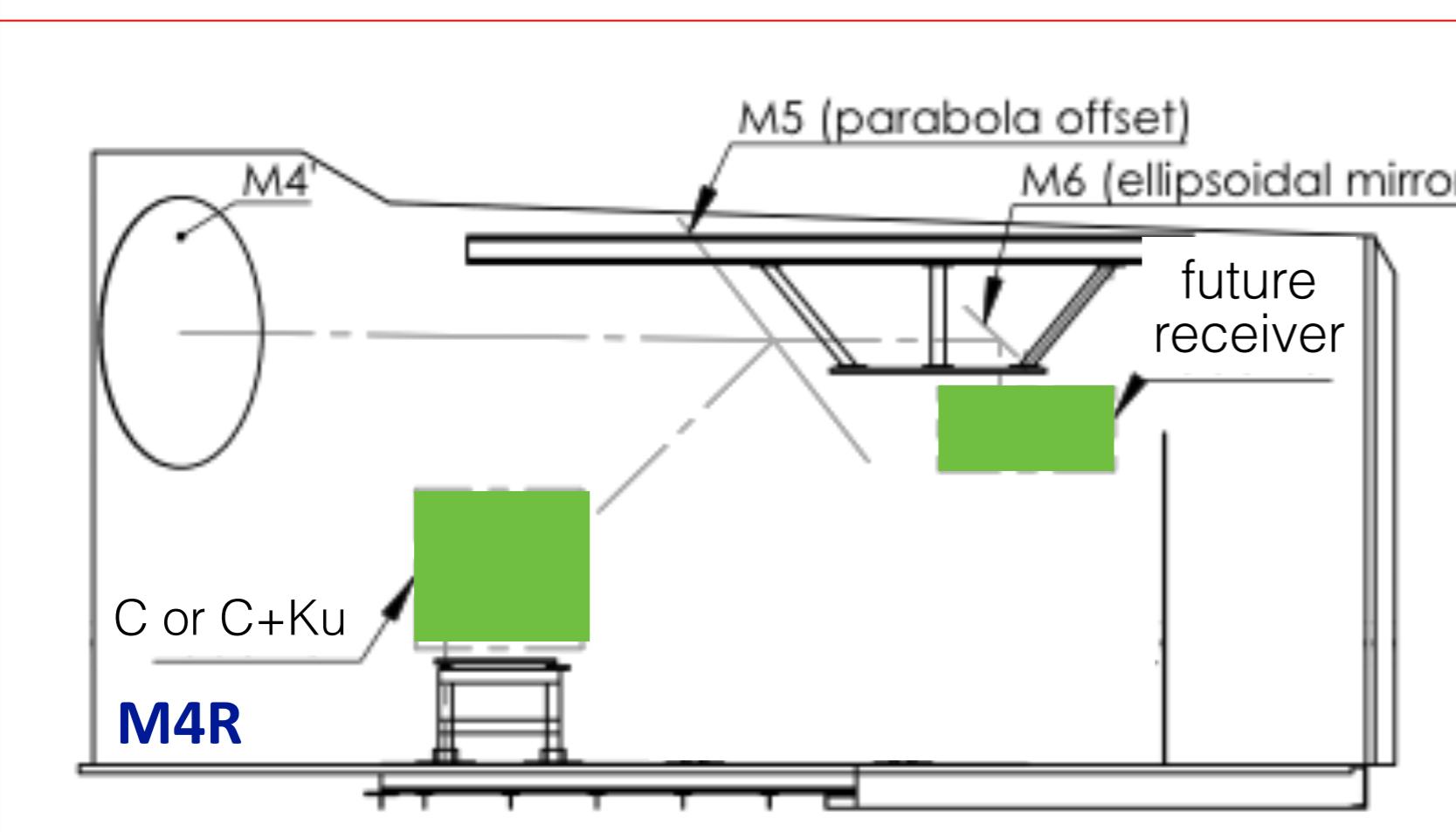
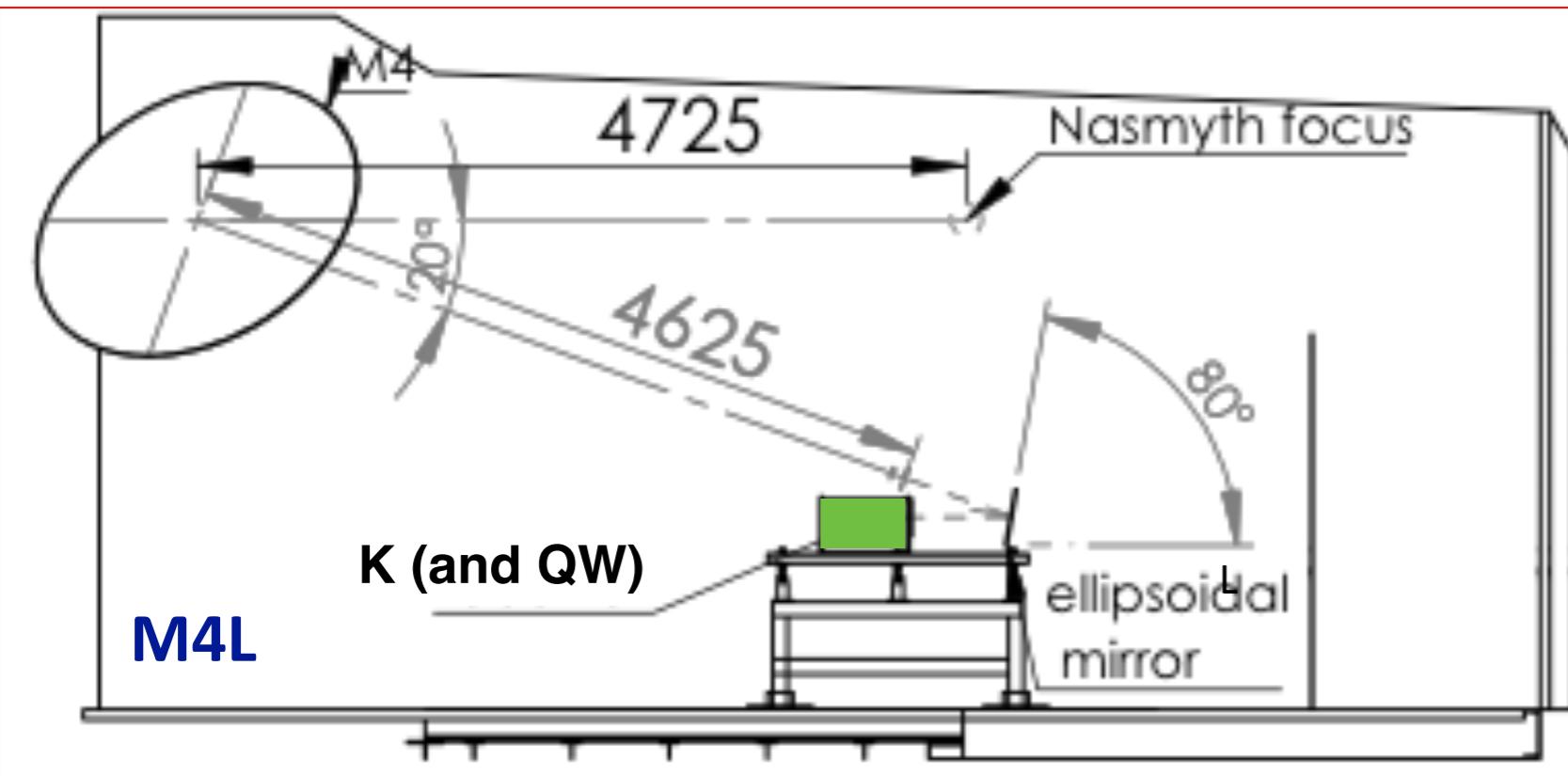
Optics

Phase I
Phase II



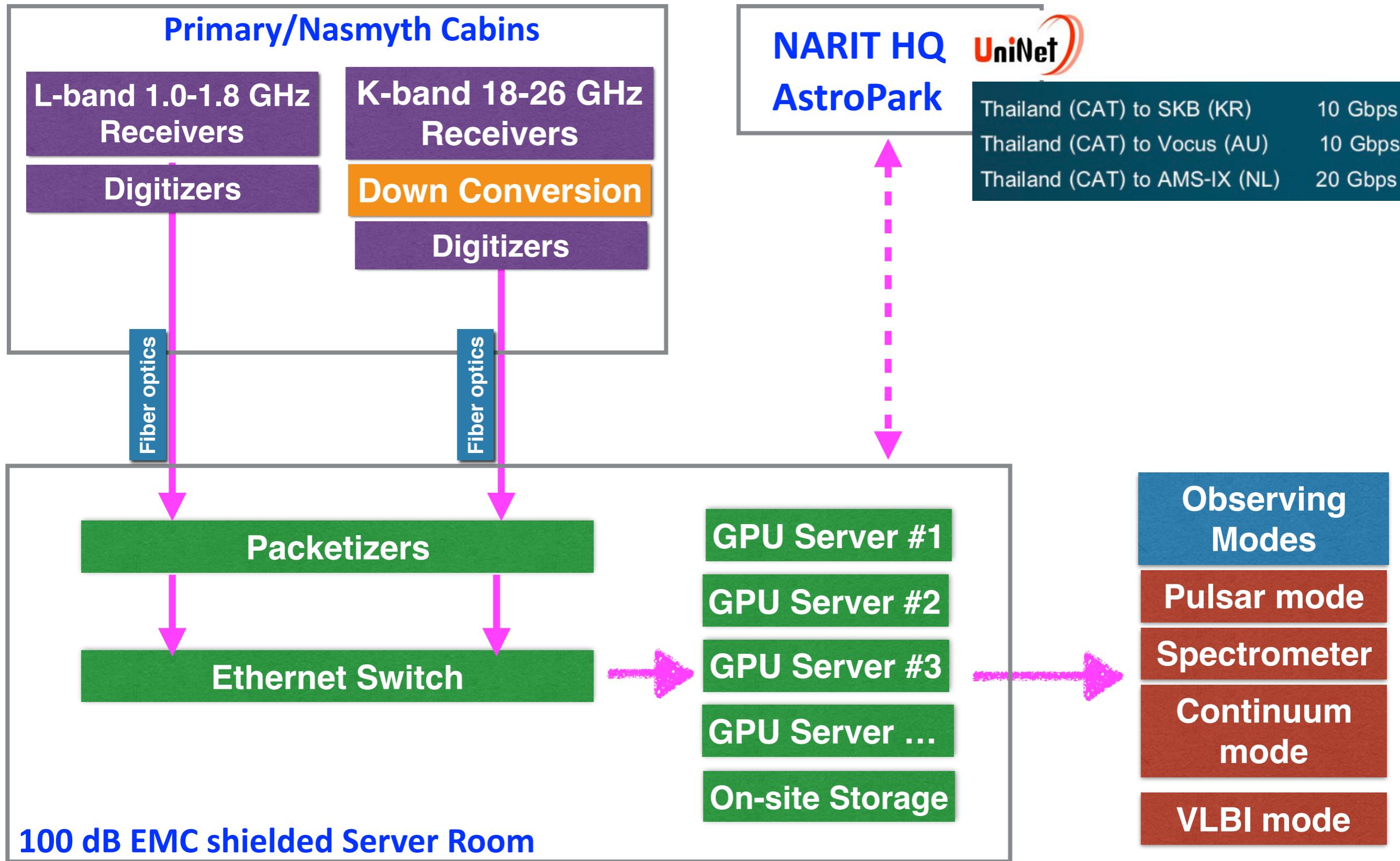
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Optics

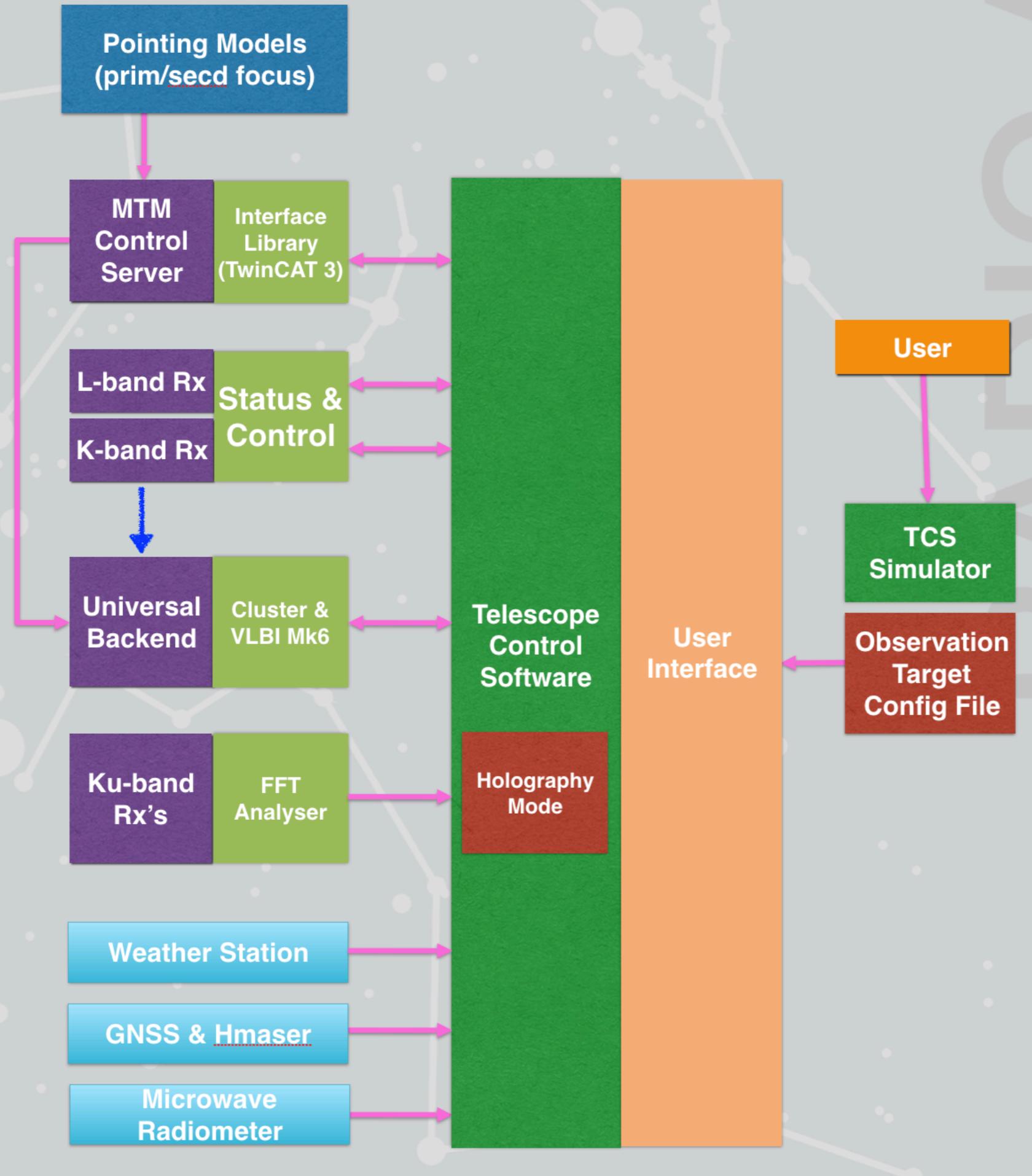


	L-band	K-band
Location	Primary Focus	Nasmyth Focus
Frequency range (GHz)	1.0-1.8	18.0-26.5
Centre wavelength (cm)	21.4	1.36
Beam width (arcmin)	22	1.4
Polarisation	Linear	Circular
Cross polarisation	-25 dB	-25 dB
RF BW	800 MHz	8 GHz
sampler	3 Gps	>4 Gps
Packetizer BW	1.5 GHz	>2 GHz
digitisation bits	< 12 bit	< 12 bit
Digitizer Output	2 x 40 Gbps	2 x 40 Gbps
Total efficiency	0.7	0.5
Gain (K/Jy)	0.32	0.23
Trx	13	20
Tsky (K)	12	50
Tsys (K)	25	70
SEFD (Jy)	78	304

Signal diagram



Control diagram



- TCS is based on Alma Common Software (ACS) and Yebes' TCS
- Significant work to integrate L-/K-band, Backend, etc
- Calibration modes
- Scientific modes
 - pulsar, spectral-line, continuum, VLBI

MOU signing with Yebes Observatory (March '17)



Collaboration on:

- Development of Telescope Control Software
- Development of Microwave Holography System
- Training on operations and observations
- etc...

Annex Signing with Max Planck Institute for Radioastronomy (April '18)

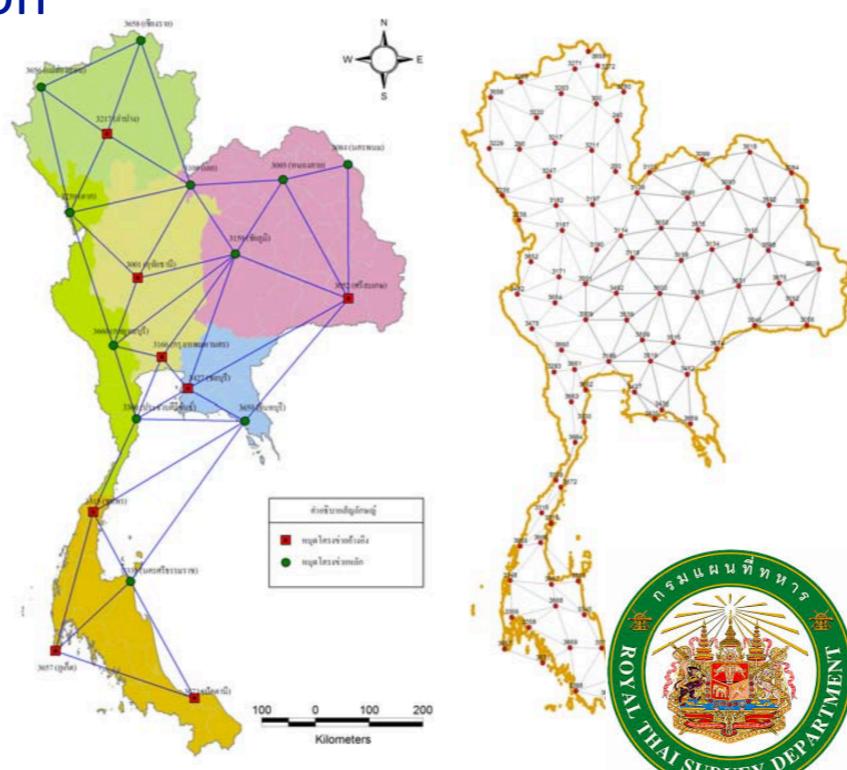


Collaboration on:

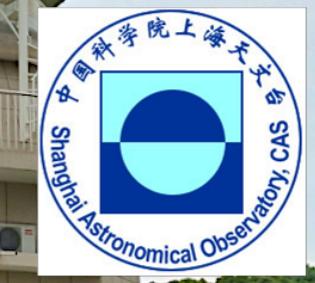
- L- and K-band Receiver Systems
- Universal Software Backend
- Training on operations and observations
- etc ...

VGOS station

- First geodetic VLBI station in SEA
- International VLBI Service for Astrometry & Geodesy (IVS) -> CRF, EOP, ITRF
- Tectonic motion/crustal motion
- Thai Continuously Operating Reference Stations (CORS) networks as national infrastructure
- National Institute of Metrology of Thailand (NIMT)
- Co-locating 40m & 13m Science Applications
- Local-tied survey and IRP determination
- **SHAO-NARIT Collaboration on VGOS antenna @TNRO**



สถาบันมาตรฐานแห่งชาติ
National Institute of Metrology (Thailand)





Huai Hongkhrai Royal
Development Study Center

เชียงใหม่

เทศบาลนคร
เชียงใหม่

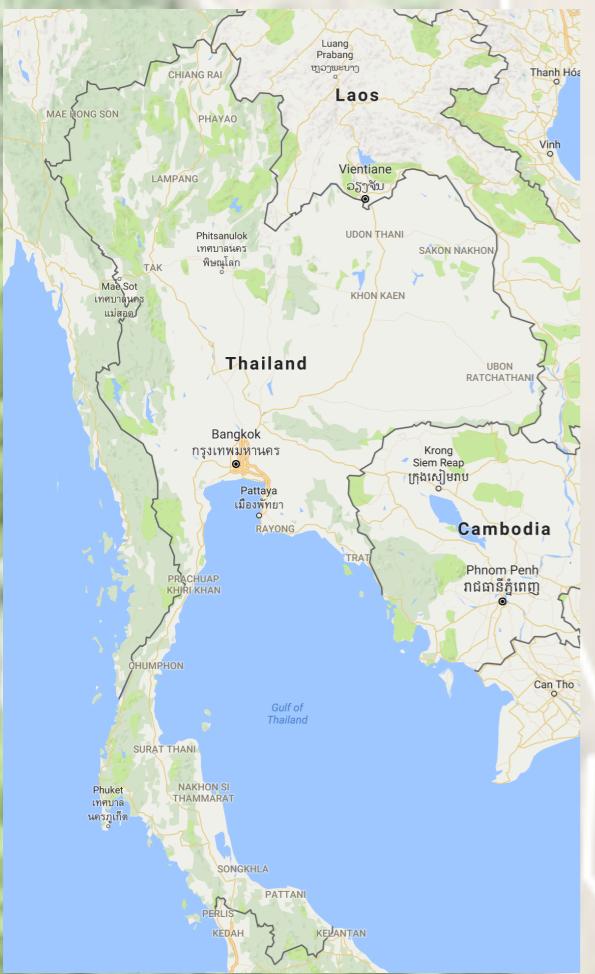
สำนักงานพัฒนาชุมชนท้องที่รับผิดชอบพื้นที่ชุมชนท้องที่

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Radio Quite Zone
National Broadcast and
Telecom Commission (NBTC)



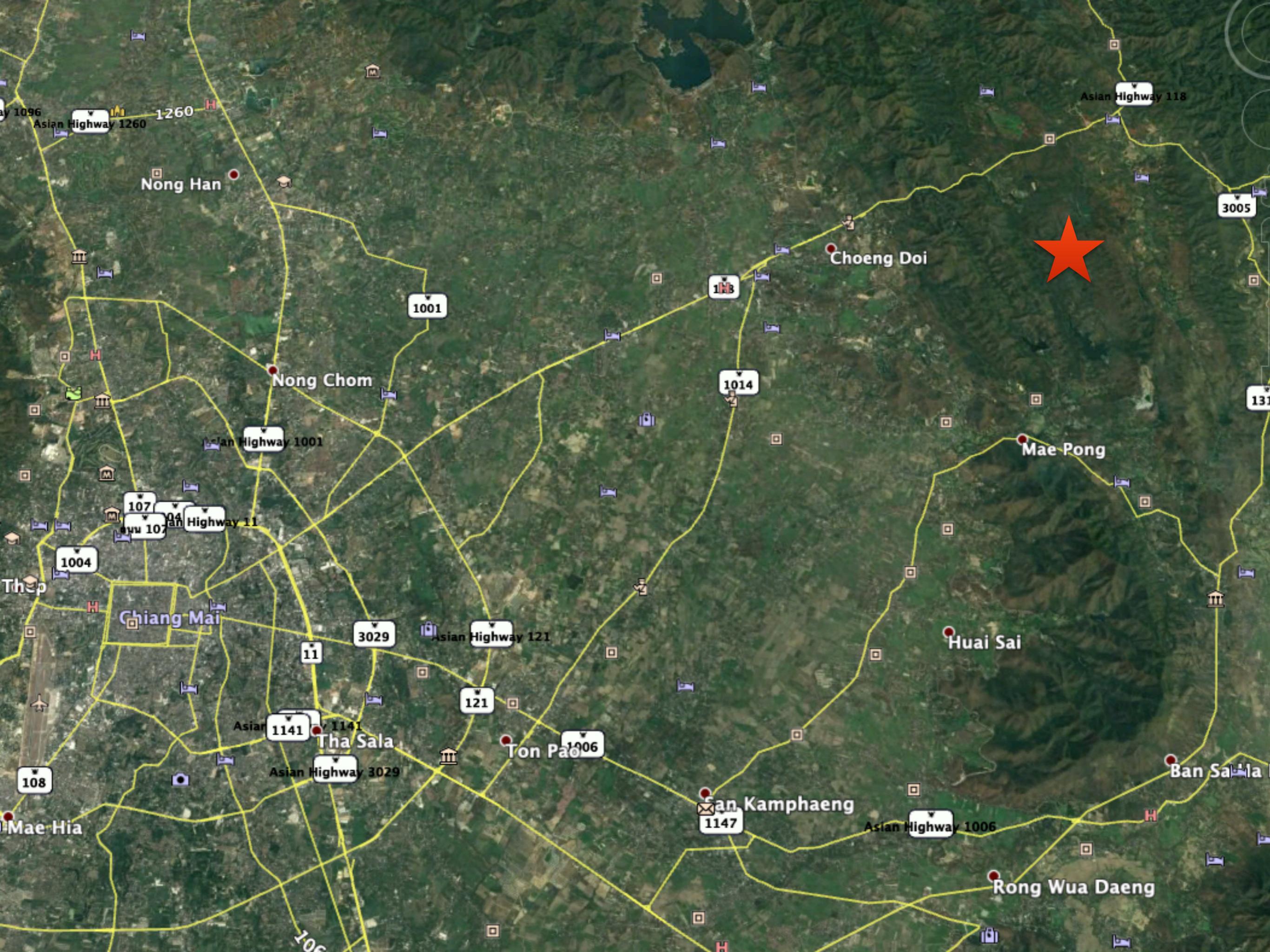
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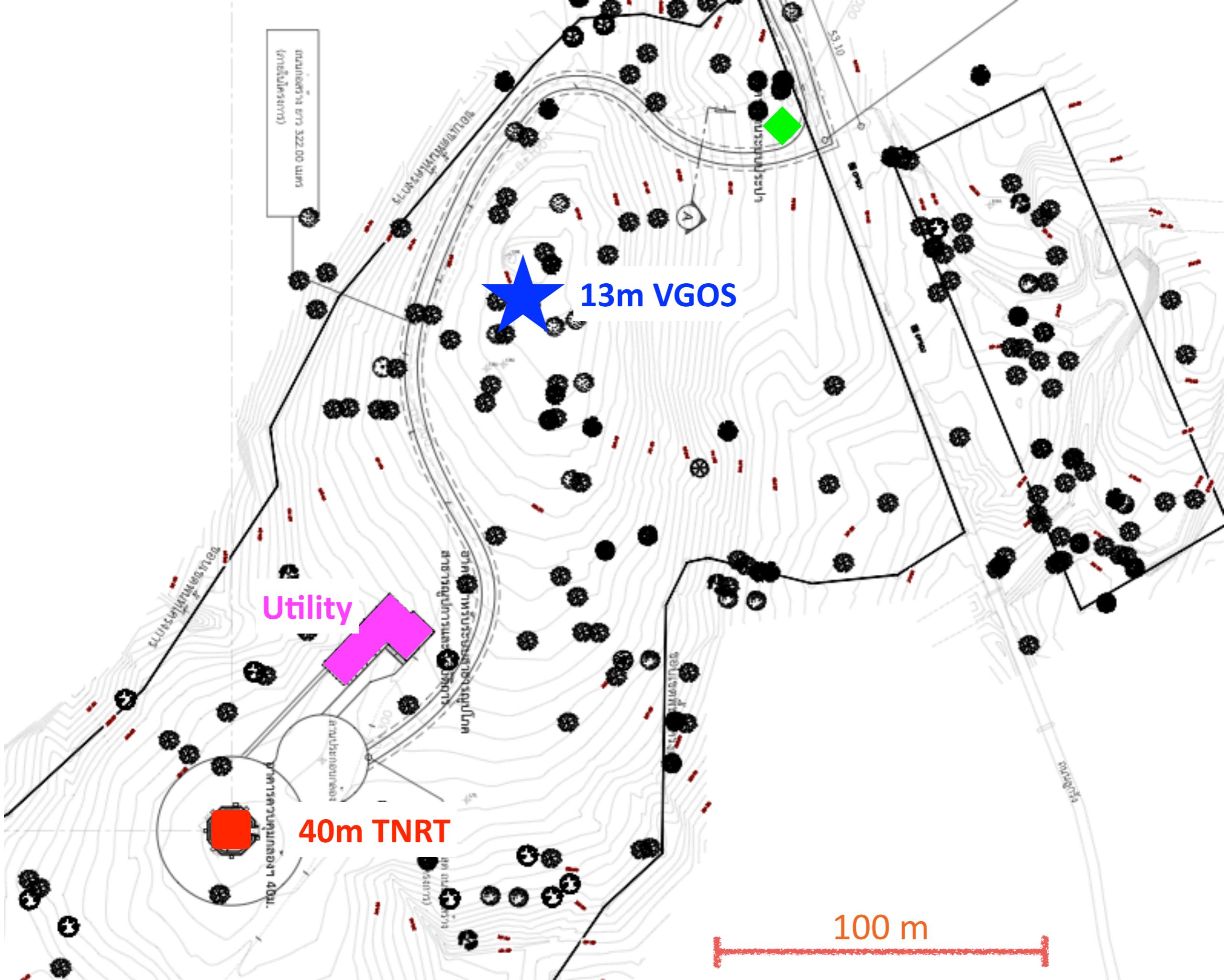
เชียงใหม่



เทศบาลนคร
เชียงใหม่

Radio Quite Zone
National Broadcast and
Telecom Commission (NBTC)





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October '18





Before (May '18)

Recent (Sept '18)

Timeline	collaborators /partners	2018	2019	2020	2021
Sitework 40m TNRT	NARIT				
40m TNRT Installation	MTM				
L-/K-band	MPIfR				
Backends	MPIfR/ Manchester				
Time&Frequency systems	NARIT				
SAT & Commissioning	...				
VGOS	SHAO			installation	Commissioning
C-band or C+	...			Feasibility Study	
Simultaneous (K) +QW	KASI + ...			TBD	

