Recent Status of KJCC for KaVA and EAVN

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2019 VERA UM @ MIZ, Dec. 13~14, 2019

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❖ **KJCC Development status**

Korea-Japan Correlation Center(KJCC)

Executive Board

Daejeon HW Correlator

DiFX SW Correlator on HPC

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Korea Astronomy & Space Science Institute

Correlation Mode

Corr. mode	Band width [MHz]	Output streams	#bits	Output data rate [Mbps]	Clock rate [MHz]
[a]C1	256	1	2	1024	32
C2	128	2	2	1024	32
C3	64	4	2	1024	32
C4	32	8	2	1024	32
C5	16	16	2	1024	32
[b]W1	512 x 4band	4	2	8192	64
W2	512 x 4band	1IF[c]x2P[d] 2IFx1P	2	8192	64
W3	512 x 4band	2IFx2P	2	8192	64

a, Narrow band, b. Wideband, c. IF, d. Polarization

Correlation Status

http://radio.kasi.re.kr
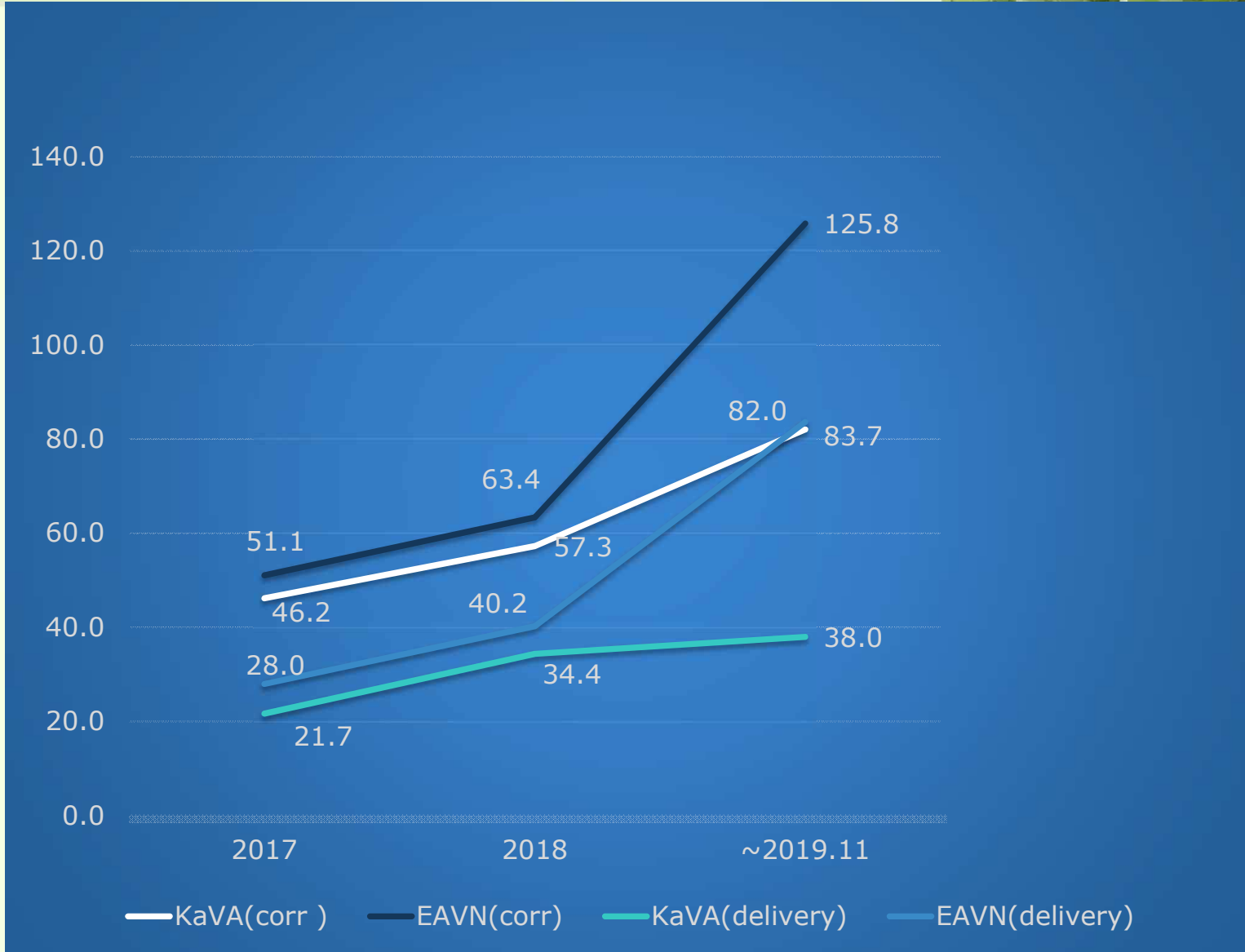
Number of correlations

KaVA Hybrid : VERA 2 Beam + KVN Multi Band or KVN Dual Pol. Observation

Correlation Processing Time after Obs.

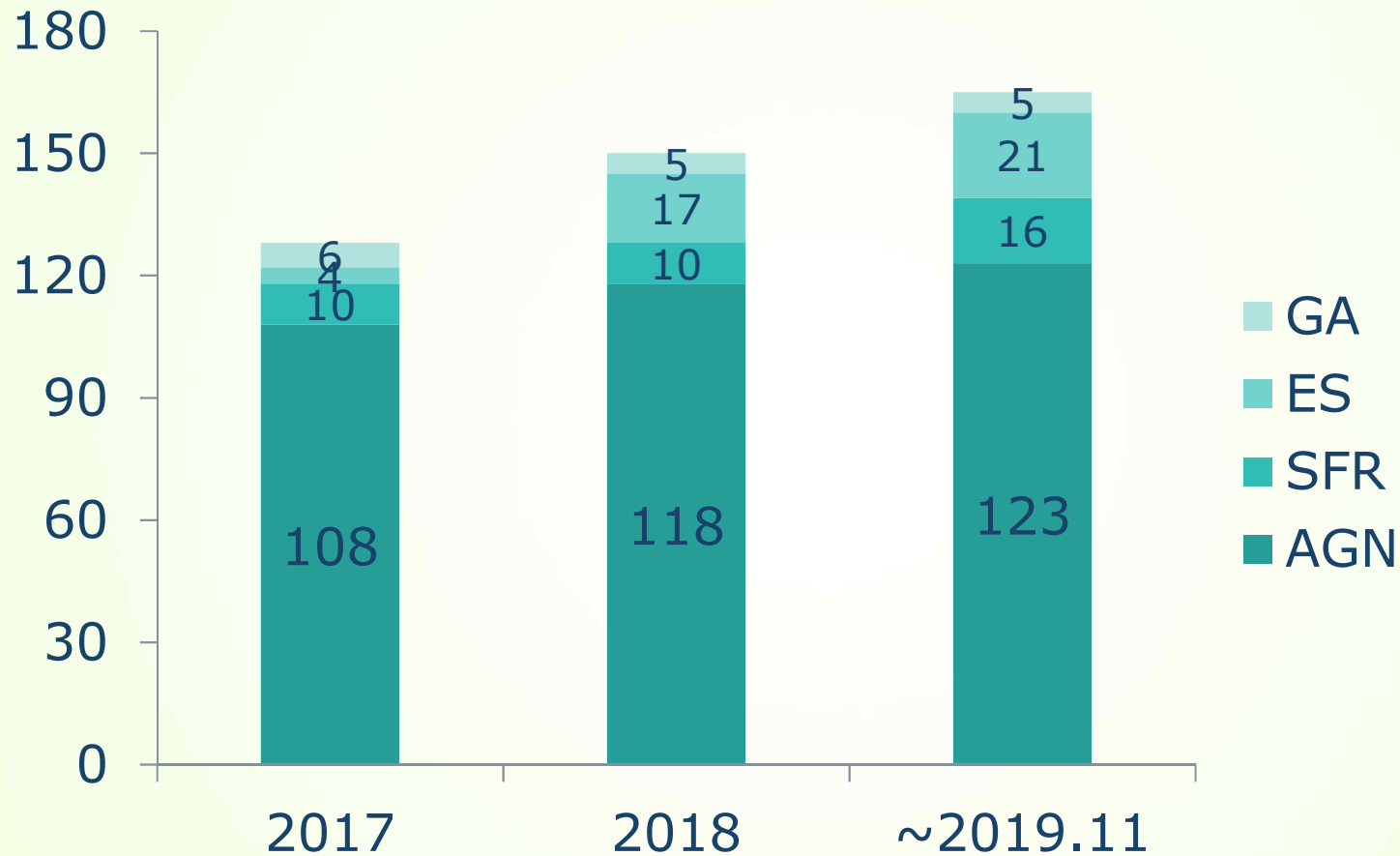KaVA Hybrid : VERA 2 Beam + KVN Multi Band or KVN Dual Pol. Observation

Average Corr. and Media Delivery Period

	2017	2018	~2019.11
KaVA(corr)	46.2	57.3	82.0
EAVN(corr)	51.1	63.4	125.8
KaVA(delivery)	21.7	34.4	38.0
EAVN(delivery)	28.0	40.2	83.7

KaVA(corr)   EAVN(corr)   KaVA(delivery)   EAVN(delivery)

한국천문연구원
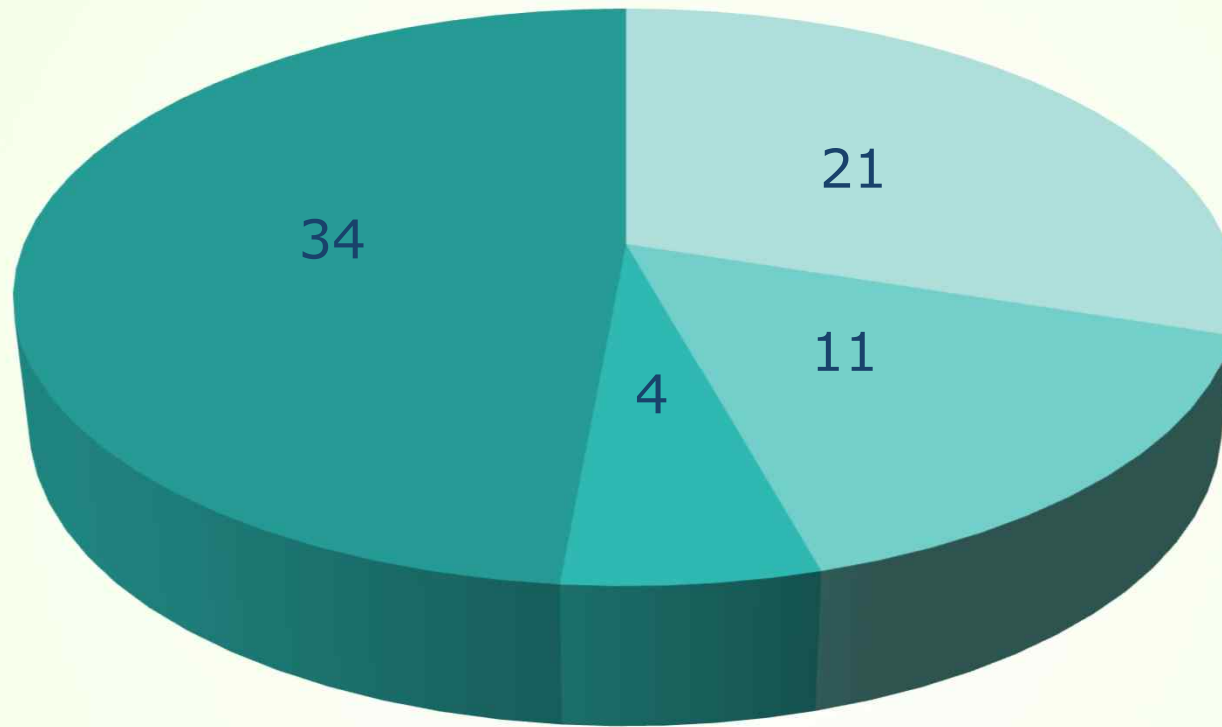Korea Astronomy & Space Science Institute

Number of Science Working Group

GA: Galactic Astrometry, ES: Evolve Star, SFR: Star Formation Region, AGN: Active Galactic Nuclei

of Fringe Detection Failures by Cause

FS: Field System, BS: Backend System, WC: Weather Condition
Unknown: miss operation? and/or unreported problems?

of Fringe Detection Failures by Station

Ky: Yonsei, Ku: Ulsan, Kt: Tamna, Vm: Mizusawa, Vr: Iriki, Vo: Ogasawara, Vs: Ishigakijima
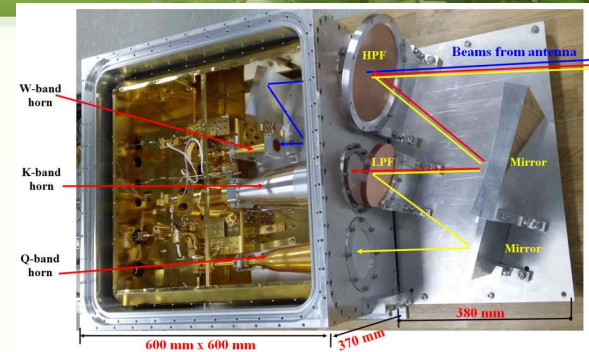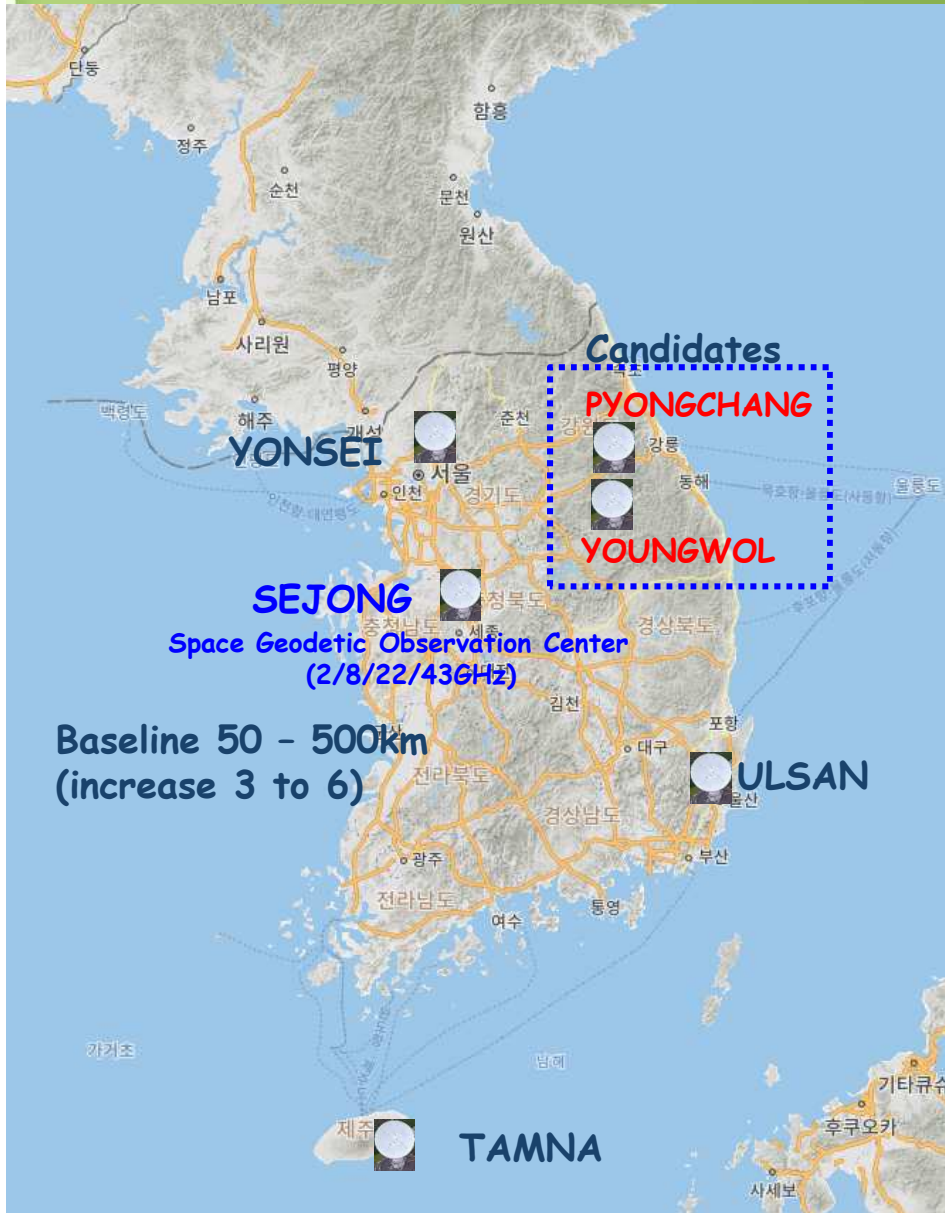Ny: Nobeyama, T6: Tianma, Ur: Urumqi

Problems during Corr.

1. Increased correlation period due to delayed data shipment
2. Difficulties in detecting fringes for unknown reasons
3. Setting mismatches(frequency, polarization, etc...)
4. Data storage
5. Log and antab files

What is Extended KVN?

YONSEI

Candidates
PYONGCHANG

YOUNGWOL

SEJONG
Space Geodetic Observation Center
(2/8/22/43GHz)

**Baseline 50 – 500km
(increase 3 to 6)**

ULSAN

TAMNA

S-T, Han

Compact Triple-band Receiver(CTR) 22/43/86 GHz
 + 150 GHz (D-band)
 + 230 GHz for EHT
 + 8 GHz (X-band, 7.8GHz)

KVN Receiver	Freq. (old)	Freq. (new)	Trx (new)	Installation
K-band	21.24 – 23.25	18 – 26	< 40	Completed in '18 (all KVN stations)
Q-band	42.11 – 44.11	35 - 50	< 50	KYS ('19 Sep) KUS ('20) KTN ('20 or '21)
W-band	85 – 95	84 – 116	< 80	KYS ('19 Sep) KUS (done, '18) KTN ('20)
D-band	125 - 142	125 - 174	< 60	~ '22 Sep

E-KVN DAS

KVN observe full polarization with 4 frequencies
22 R/L, 43 R/L, 86 R/L, 129 R/L

- Sampler & Digital Filter (DBBC)
  - OCTAD x 2Set
- Recorder (and playback, 64Gbps)
  - Mark6, FlexBuff, or Peta Data Recorder

OCTAD Specification
- 4 ADC (4 x 16Gsps)
- Input Freq. 8 – 16GHz
- Digital Down Converter
- Digital Filter
- 4 x 10GbE Output
- VDIF Format
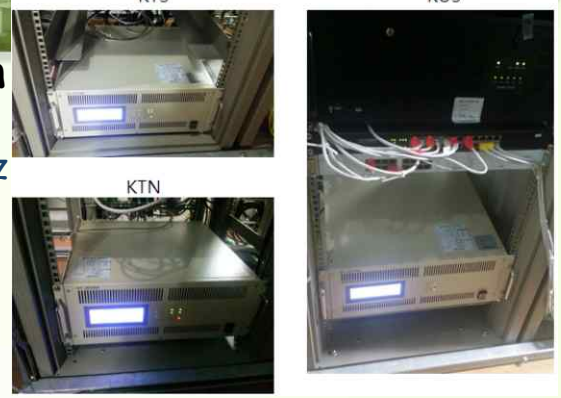
Bandwidth (MHz)	Max Num of Channels	Max Data Rate (Gbps)
8192	1	32
4096	2	32
2048	4	32
1024	8	32
512	16	32
256	16	16
128	16	8
64	16	4
32	16	2
16	16	1

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Correlator now in KASI

East Asian VLBI Network (EAVN)

Korea-Japan Joint VLBI Network (KaVA)

KVN

CVN

VERA / JVN

Image © 2005 EarthSat

Daejeon Correlator
- Hardware Correlator
- KaVA, EAVN
- 16 Stations, 8Gbps

DiFX Correlator
- Software Correlator
- KVN 3 Stations only
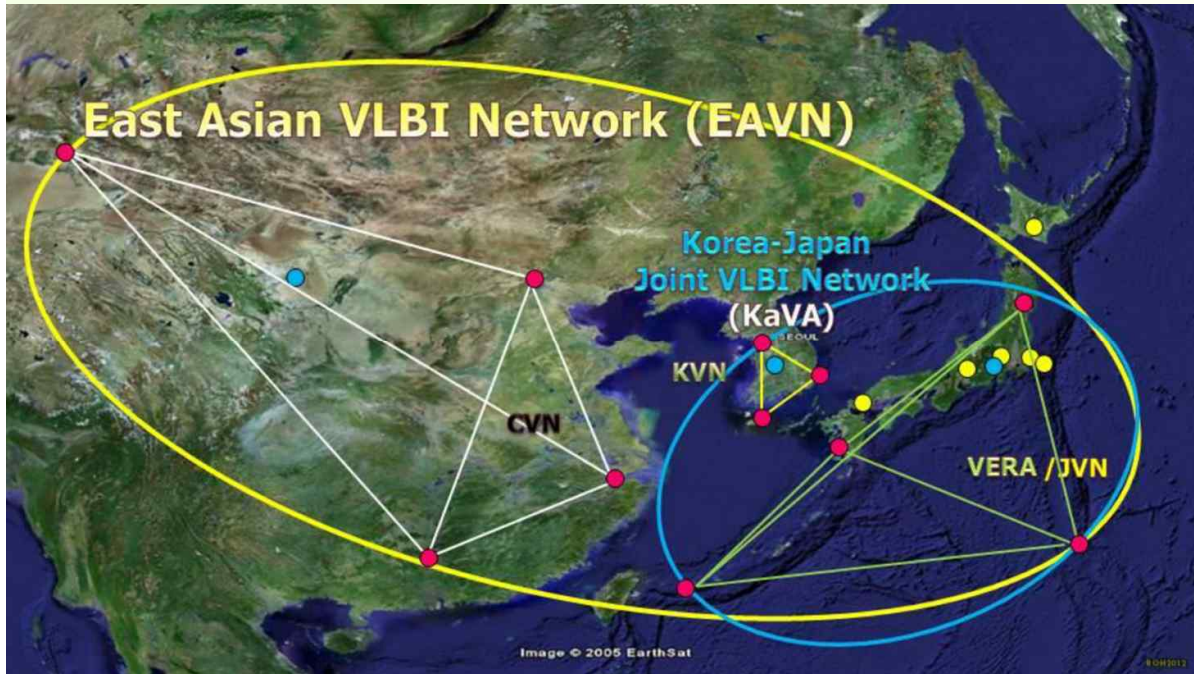
- Both correlators are not able to use in E-KVN
  - cannot process higher than 8Gbps data
- <u>Need a new correlator able to correlate 64Gbps data with full polarization</u>

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New Correlator's Goal

❖ **32Gbps R/L in real time mode**

❖ **64Gbps R/L in run time mode within 2 - 3 times for observation time**

❖ **Maximum 5 stations**

  (Yonsei, Ulsan, Tamna, Sejong, and another site)

❖ **GPU and network based, e-transfer using KREONET**

  (Korea Research Environment Open NETwork)

❖ **until 2024**

How transfer data to correlation center

KREONET
upgrade plan 2019 to 2024(?)
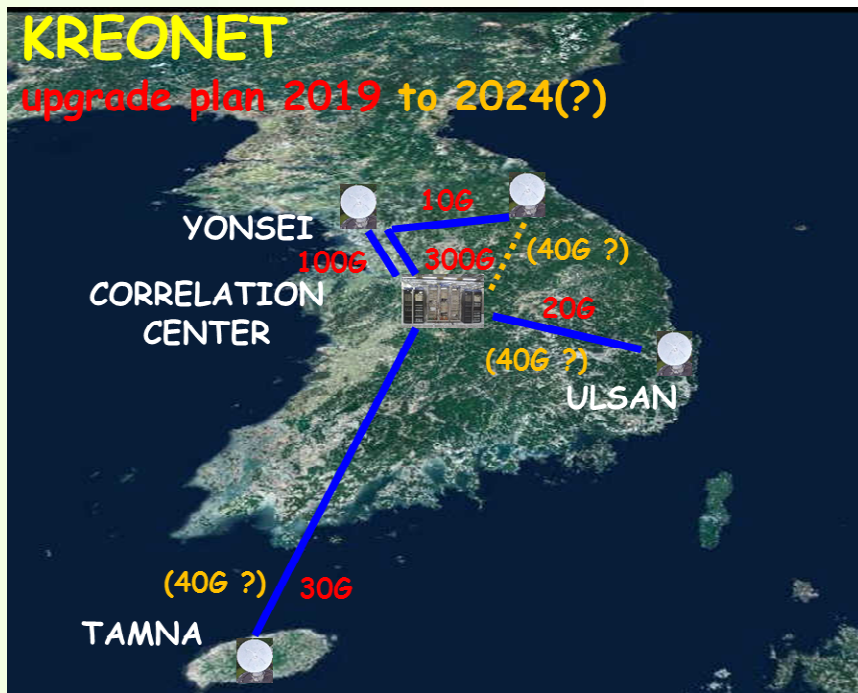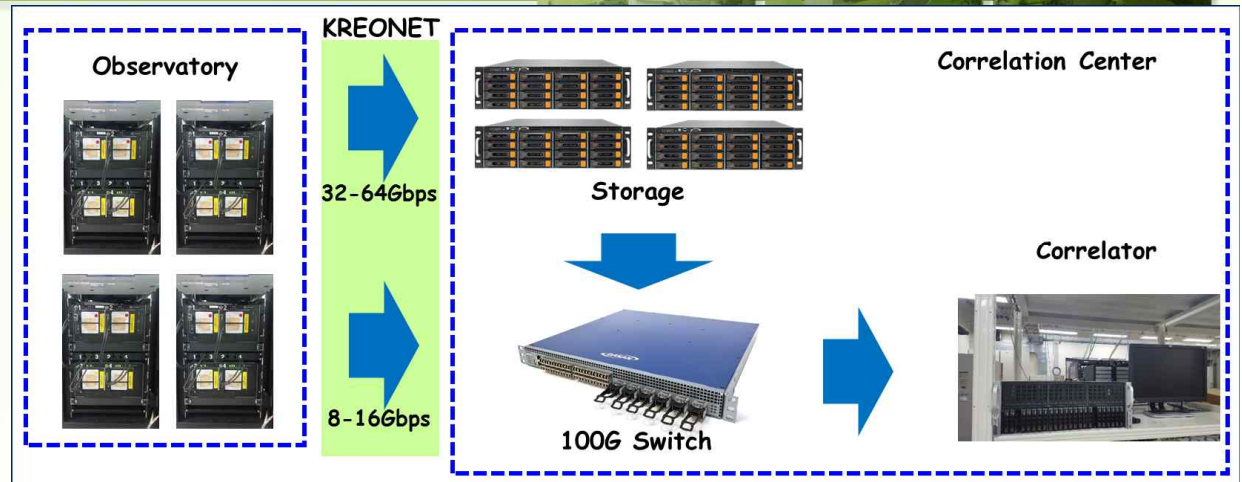
- Elementary concept is to use the KREONET
- Request 40Gbps speed rate until 2024
- Recorded data 8, 16Gbps, 32Gbps(?) correlate simultaneously with e-transfer (seems like e-VLBI)
- 32 , 64Gbps data, stored to local storage on correlation center, and then correlate

Lab Test

- **Supermicro 4029GP TRT**
  - · CPU Intel XEON Gold 6154 x 2ea
  - · RAM 384GByte DDR4
  - · SAS RAID Card x 2ea
  - · 10Gb Ethernet NIC SFP+ x 2ea
  - · 100GbE Mellanox NIC
  - · Nvidia Titan V GPU

- **Storage**
  - · Stardom RAID Box x 2ea
  - · 24TByte(3TB x 8), 64TByte(8TB x 8)
  - · Support SAS 12Gb

Correlation Control GUI(Graphical User Interface)

For this lab test

☐ Test data
- Experiment Code: k17kh03b (r17289c)
- Observation Date: 2017y290d02h43m25s
- Data Rate: 2.048Gbps (1.024Gsps), 2bit
- Site: KVN 3 stations (Yonsei, Ulsan, Tamna)
- 3 cross power + 3 auto power spectrum
- 4,096 FFT channels
- <u>Observation duration 103 seconds</u>
- <u>GPU correlation processing time 98 - 101 seconds (97%) using 1 Titan V GPU card only</u>
- Now, lab testing time split correlation using 2 GPU cards
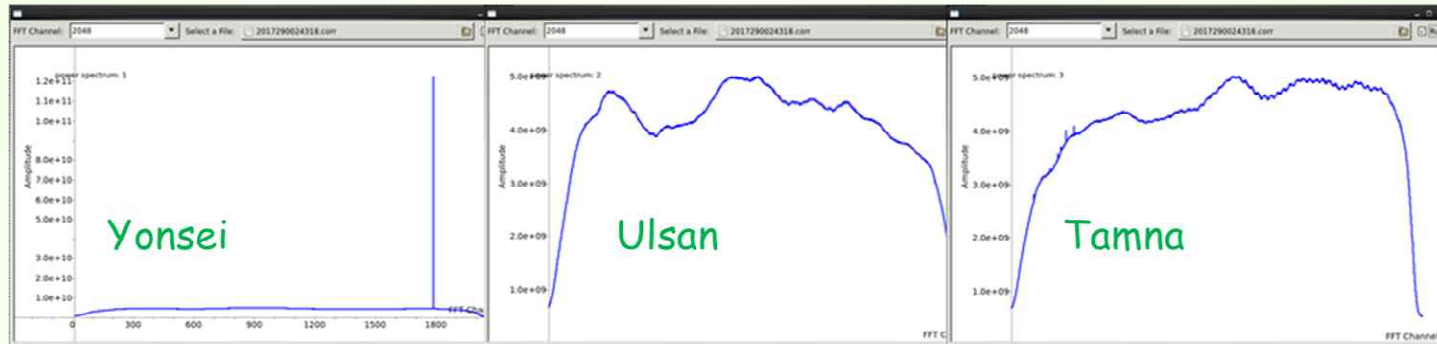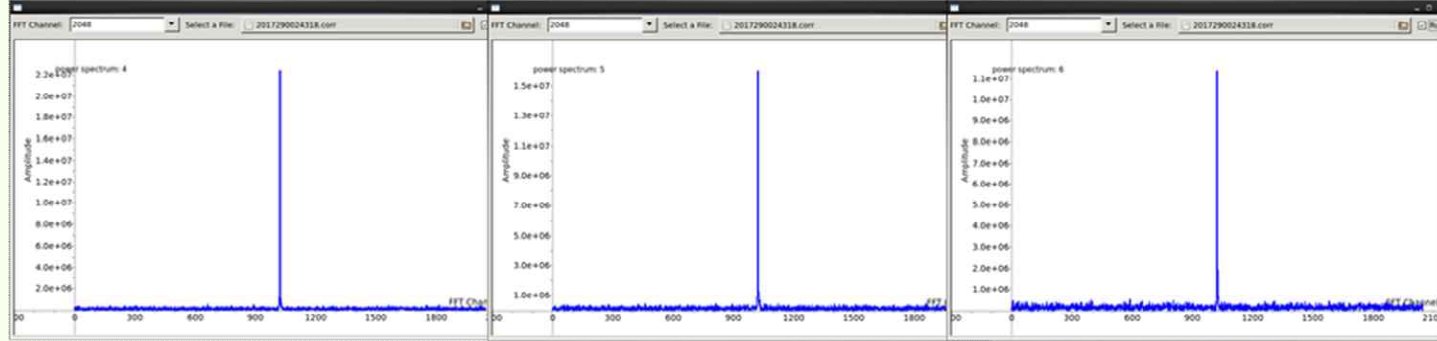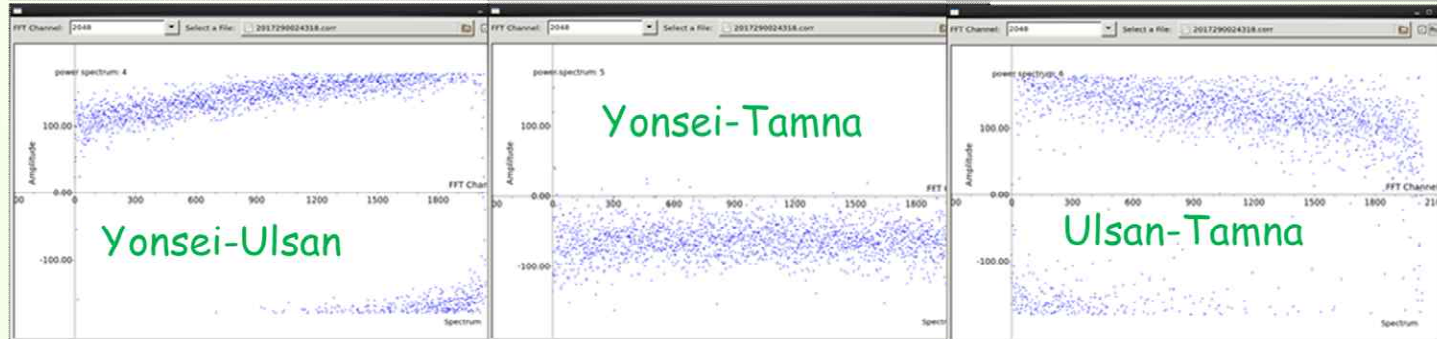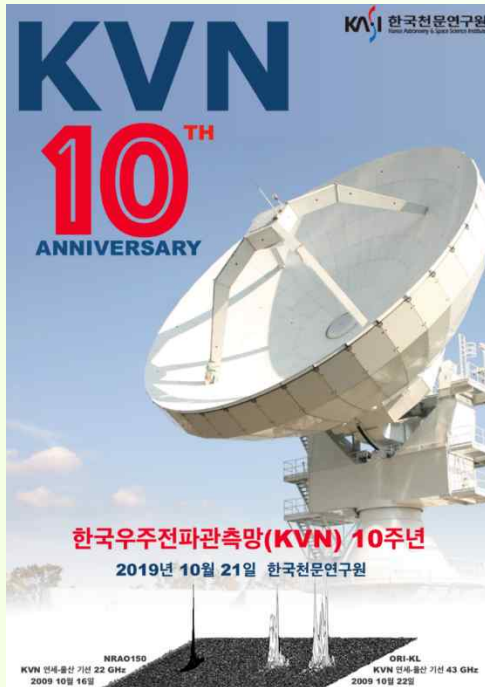- Complete in this year

Test Result

Plot

Auto-Power Spectrum

Fringe

Phase

Correlation Center Peoples

KVN 10TH ANNIVERSARY

한국우주전파관측망(KVN) 10주년
2019년 10월 21일 한국천문연구원

Leader
D- G, Roh

Correlator Manager
S- J, Oh

C- S, Oh   J- S, Kim

Data Quality Analyzer

DiFX Correlator
H- R, Kim

Daejeon Correlator
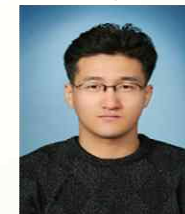
J- Y, Hwang   D- G, Jung

Correlator Operation

J- H, Yeom
Maintenance & Develop Engineer