Vienna Correlation Activities

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TECHNISCHE UNIVERSITÄT WIEN

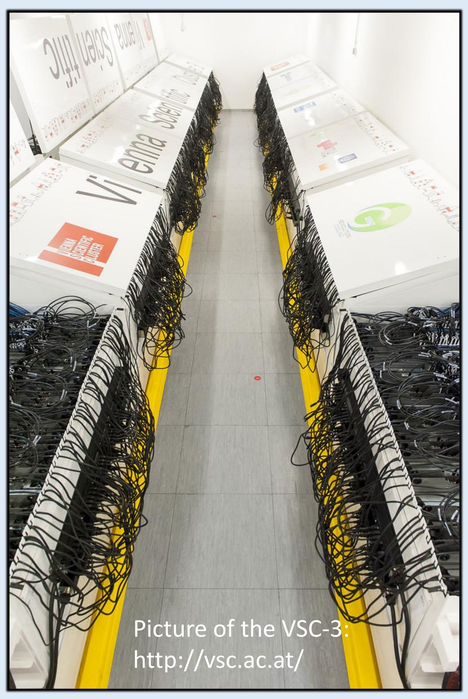
Introduction

At TU Wien, we are correlating VLBI sessions on the Vienna Scientific Cluster (VSC-3) which is a collaboration of several Austrian universities that provides supercomputer resources and corresponding services to their users. For our purpose, we installed the Distributed FX (DiFX) software correlator and the Haystack Observatory Postprocessing System (HOPS) on the VSC-3 in June 2016. One of our main interests is the optimization of correlation and fringe-fitting procedures on the VSC-3. We will show new tools which support the operational correlation and decrease the manual interaction to carry out correlation and fringe-fitting tasks. Furthermore, we will give an overview of correlated sessions and we will present an outlook of the new correlation infrastructure on the VSC-4 with its capacities and technical details.

Correlation activities and milestones

2014	Installation of the **VSC-3**
2016	Jun: Installation of DiFX and HOPS on the VSC-3 (J.McCallum)
	Jun: Correlation of first session AUG032
	Sep: Correlation of first **satellite observation** APOD2
	Nov: Correlation of McWz
2017	May: Correlation of ds317
	Sep: Correlation of first official IVS session **AUA025**
	Dec: Correlation of AUA026
2018	April: Correlation of **European Intensive Session**
	Correlation of CRDS94, verified by WACO
	Correlation of AUA028, AUA032, ...
	Jun: Correlation of **SBL500**
	Aug: CRDS94, verified by WACO to become an **IVS correlation center**
2019	Start of **K-band** sessions
	AUA048, AUA049, AUA50, AUA51, … AUA059
	Installation of the VSC-4

VSC-3 Correlation Capacities



Picture of the VSC-3: http://vsc.ac.at/

VIENNA SCIENTIFIC CLUSTER

Disk Storage (230 TB)

Number of cores (160) shared

Technical specifications

- Liquid-cooled
- 2 x Intel Xeon E5-2650v2 8 x 2,6 GHz
- BeeGFS parallel filesystem
- Intel QDR-80 dual-link high-speed
- InfiniBand fabric

Upgrade within 2019

VSC-4 Correlation Capacities

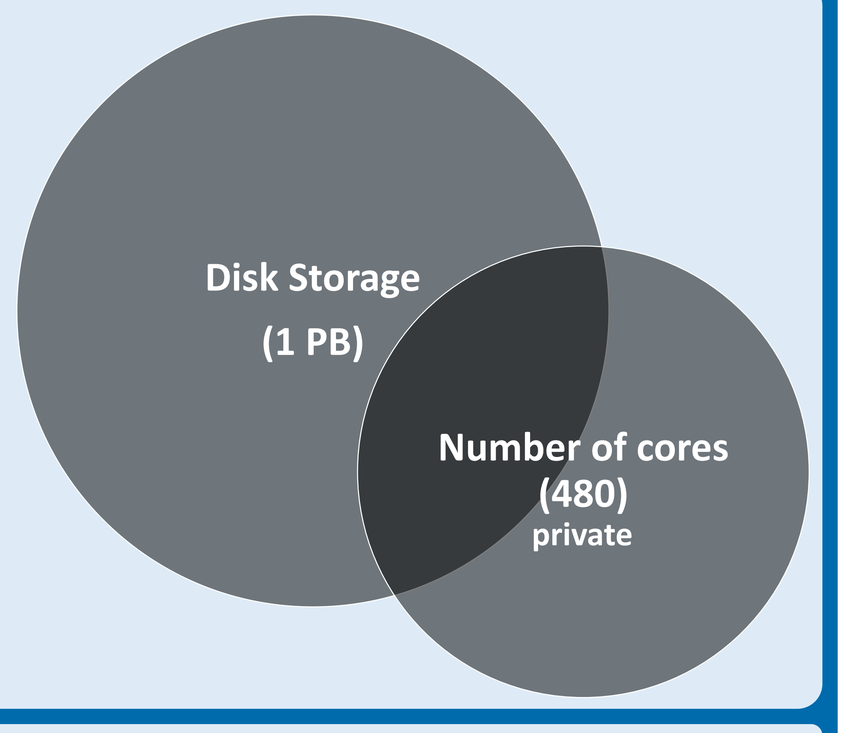
New correlation infrastructure from 2019 on

Currently under development

480 private cores

Functions:

- Take part in VGOS correlation
- Development of procedures for correlation performance optimization
- Analysis and simulations to improve correlation algorithms



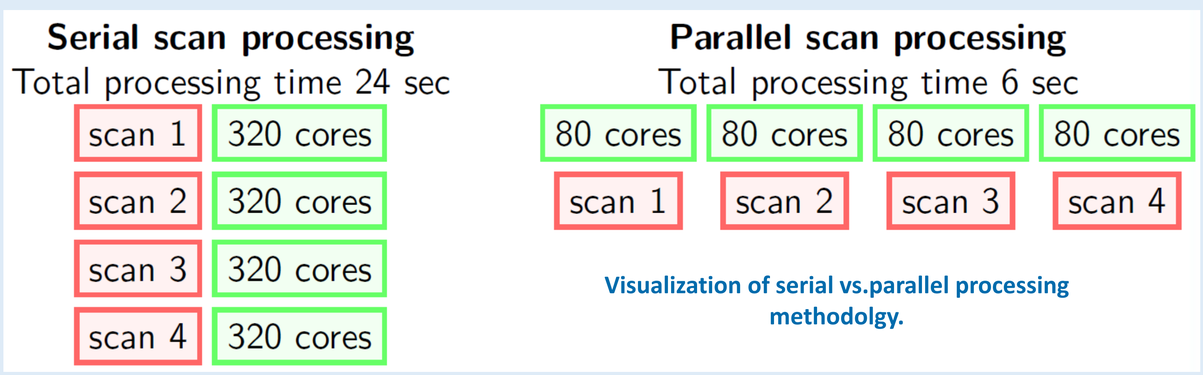
Technical specifications

- Liquid-cooled
- Per node:
  - 2 x Intel Xeon Platinum 8174 (Skylake) 24 x 3,1 GHz (turbo 3,9 GHz)
  - 12 x 8 GB DDR4 RDIMM 2666 MHz
  - 1 x Intel SSD 480 GB (used for fast local disk storage)
  - 1 x OPA100 Omnipath Adapter (100 Gbit/s) high-speed link & 1 x 1 Gbit Ethernet
- Disk based on Spectrum Scale (formerly GPFS)

Performance Tests

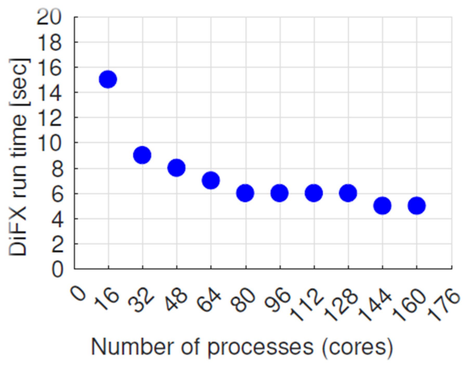
Performance tests are carried out to evaluate the most efficient processing strategy on the VSC-3. Two different methods are applied:

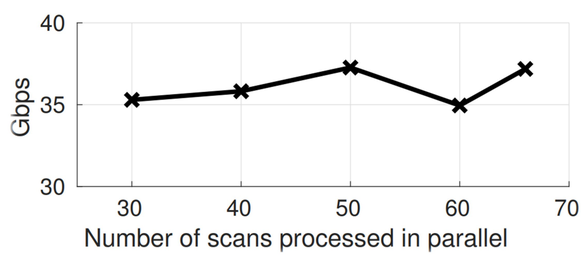
- Serial scan processing
- Parallel scan processing (realized with SLURM job array)



Visualization of serial vs.parallel processing methodolgy.

- DiFX scales up to approximately six nodes at the VSC-3 for an AUSTRAL session → usually six nodes are requested
- The maximum possible data throughput on the VSC-3 is around 35 Gbps. E.g. the EINT session (v12) consists of 89 GB baseband data. Using the parallel scan strategy a total processing time for the whole session of 22 sec can be achieved.





Left: processing time improvement with respect to number of cores Up: maximum data throuput with respect to number of scans processed in parallel

Software

Main software programs:

- jive5ab for data transmission
- Distributed FX (DiFX) software correlator
- Haystack Observatory Postprocessing System (HOPS) with the program fourfit for fringe-fitting
- nuSolve is used for post-correlation processing and for geodetic parameter estimation to verify the correlation results
- SLURM for cluster management and job scheduling

In-house correlation support tools:

- **pcorr.sh**: A bash script to setup and prepare relevant correlation files. Automatic generation of .v2d, $CLOCK and $EOP block in vex file and SLURM files. Makes use of geteop.pl to download EOP parameters and routines provided by Ed Himwich to consider peculiar offsets.
- **antennahealth.py**: A python program which parses the station field system log files and reports about antenna performance (e.g. missed scans, system temperature)

Post-Correlation Processing

To close the gap between the correlation/fringe-fitting output and VieVS

- vgosDbMake.m: stand alone Matlab tool to convert the fringe-fitting output to vgosDb. Currently HOPS fourfit output files (type 1-4) and PIMA ASCII output is supported.
- Ionospheric correction and ambiguity correction under development within VieVS

TU WIEN VieVS Vienna VLBI and Satellite Software