

Trimble MATCH-T DSM

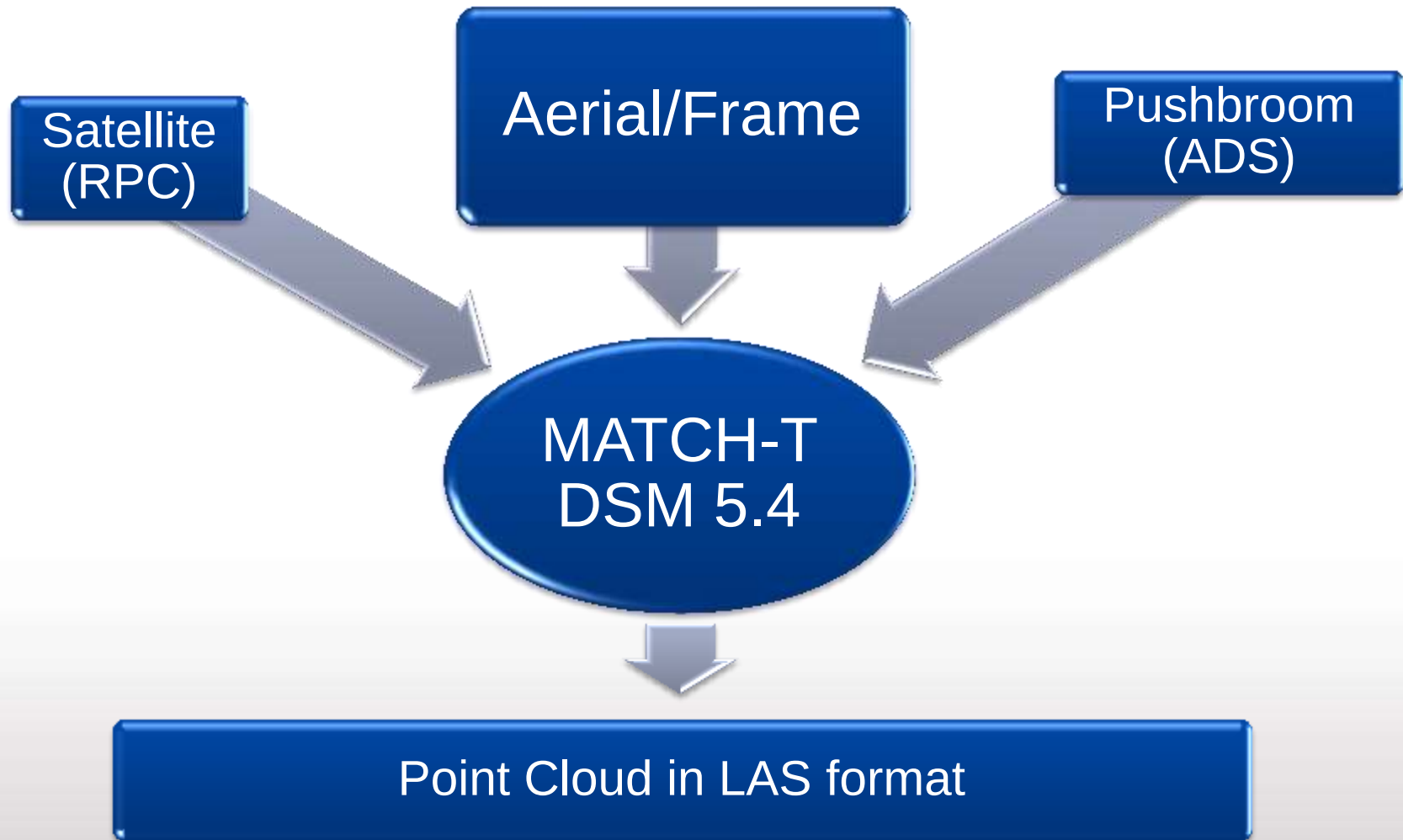
Vienna, February 17th 2012
Tobias Heuchel, Trimble GeoSpatial Stuttgart

MATCH-T DSM

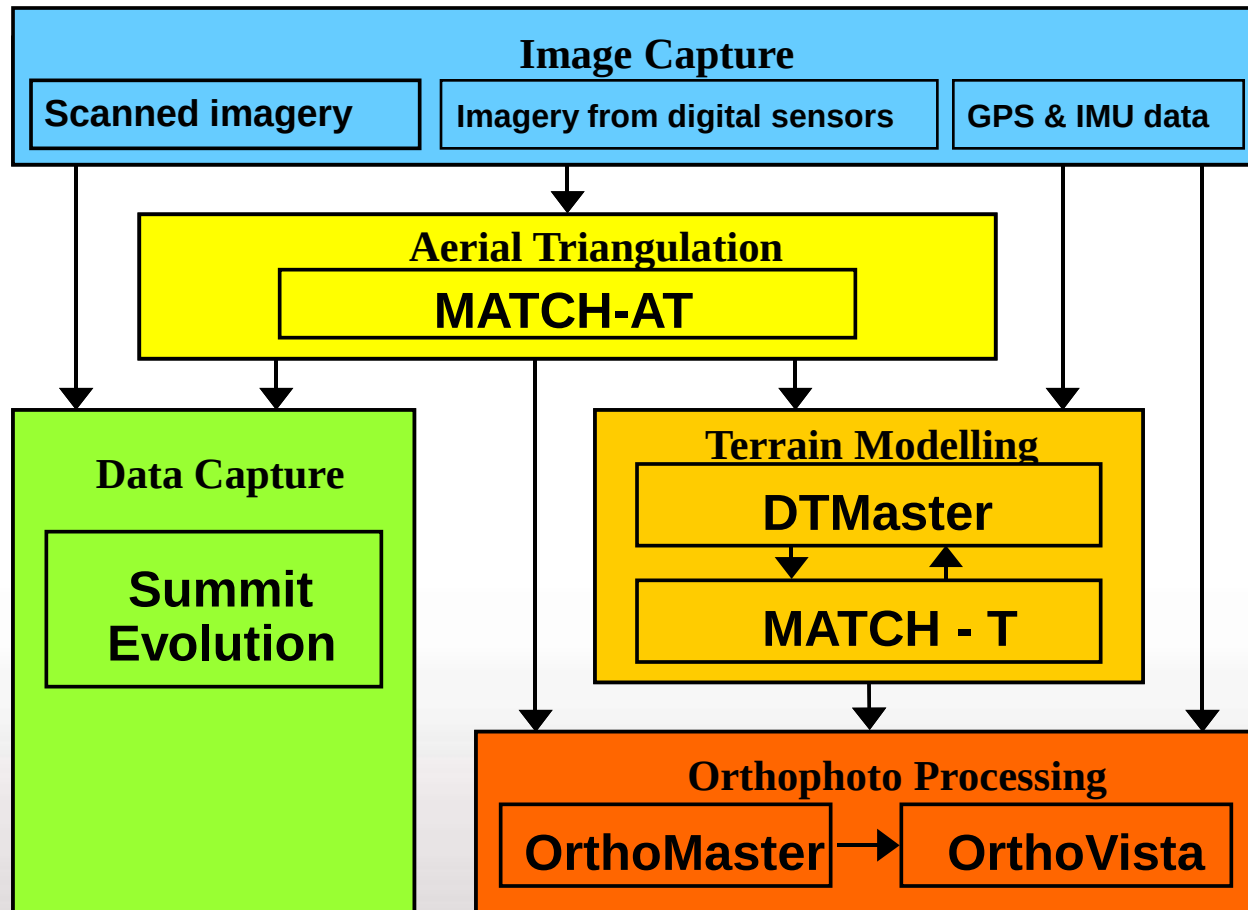
- **Trimble GeoSpatial SW package for:**

DTM and DSM generation from aerial images (frame and pushbroom sensors), and from various types of satellite imagery (Ikonos, Quickbird, WorldView, Spot, Landsat, IRS C/D, Aster, CartoSAT and ALOS)

MATCH-T DSM



Photogrammetric Workflow







Content

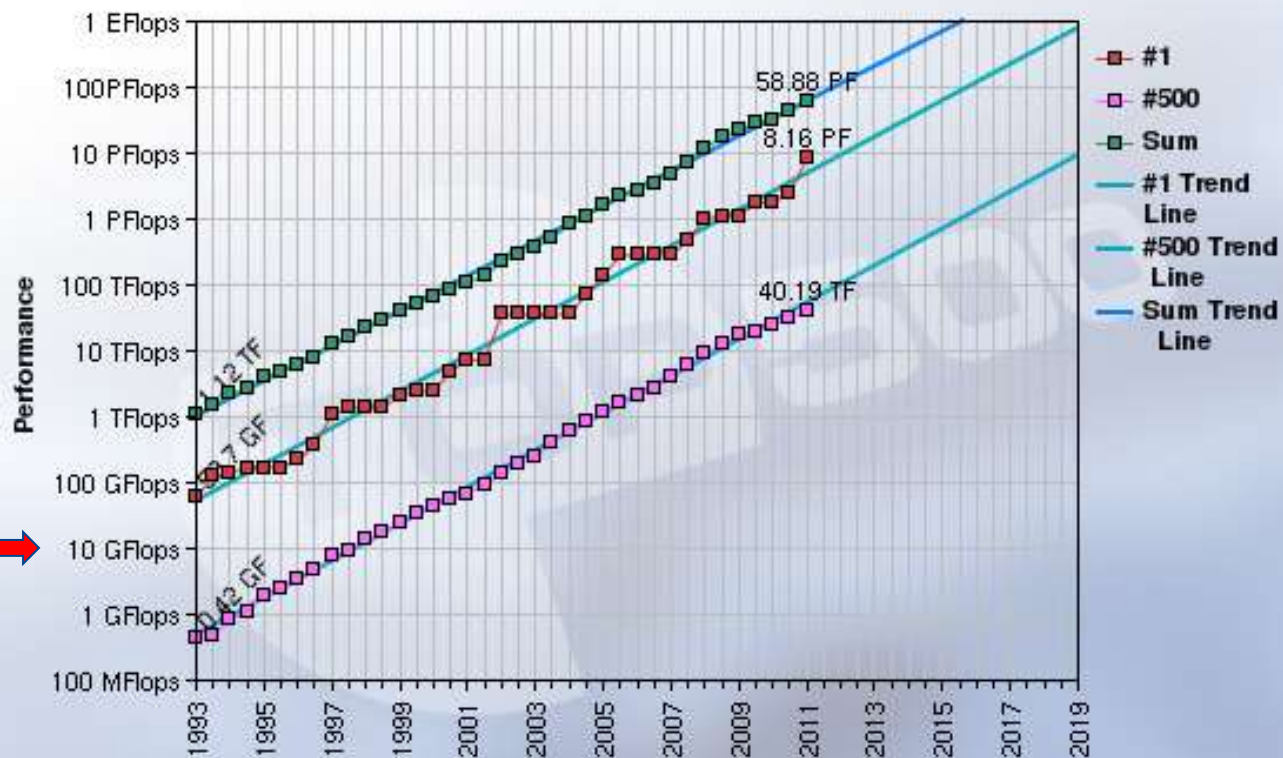
- Dense matching - why not until now?
- Performance test for dense matching
- Handling large data sets
- Characteristics of point cloud
- Use of dense point clouds for automatic feature extraction in Trimble eCognition

Dense Matching why not until now?

- Digital camera development
- New customer demands for orthophoto processing
- New stereo matching algorithms
- Point cloud processing tools available today to handle large data, ready for millions of points
- Progress in standard HW and SW:



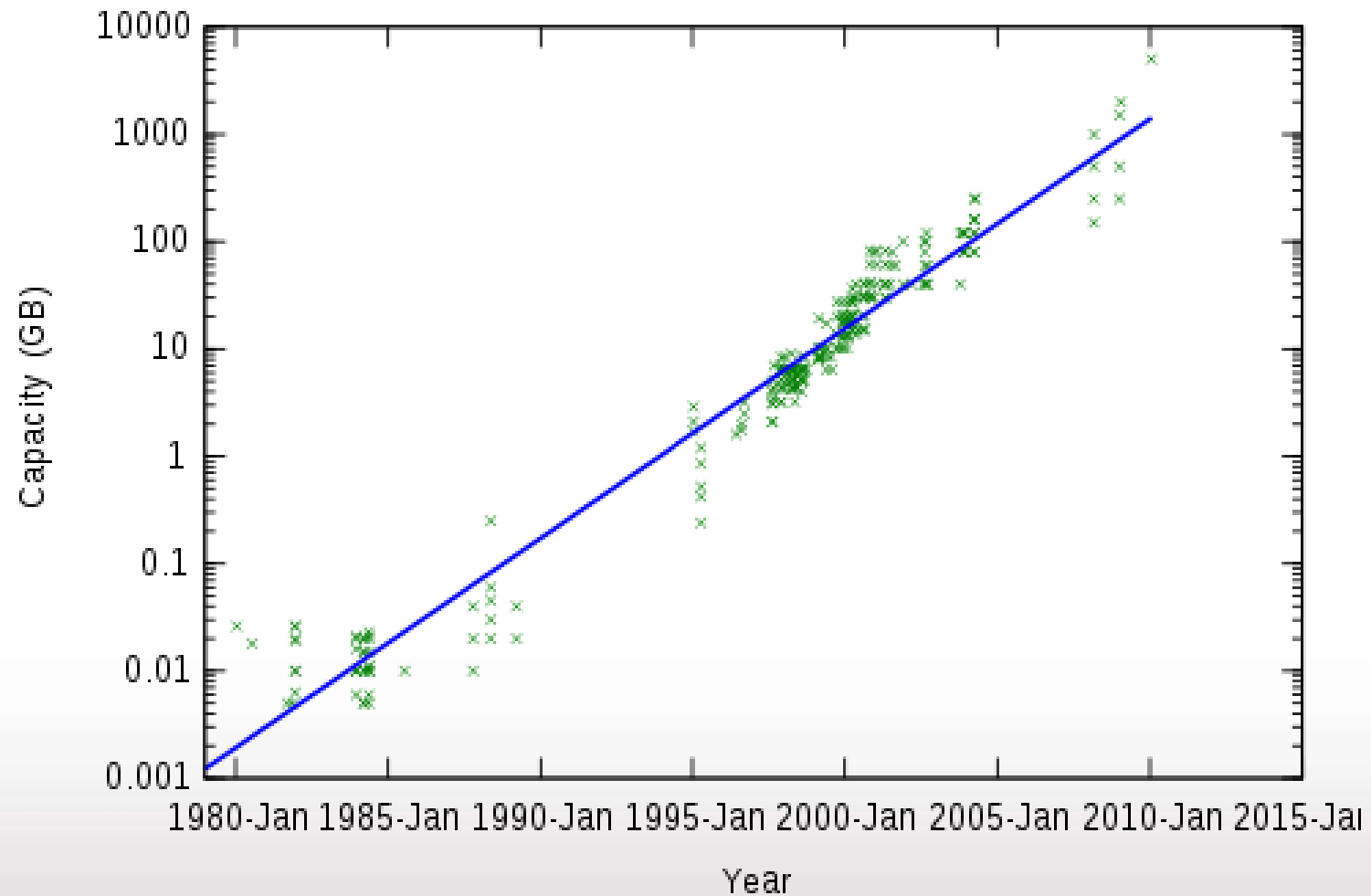
Projected Performance Development



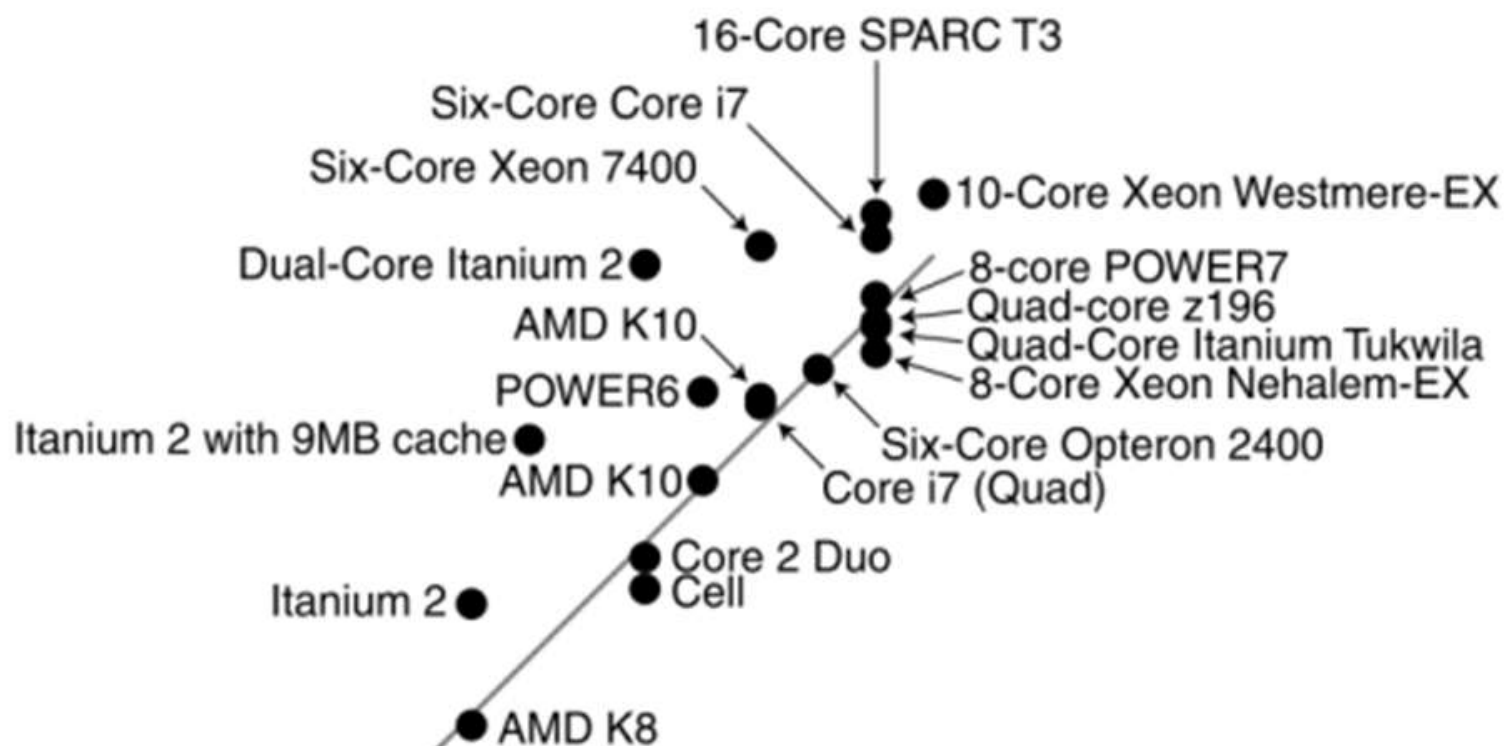
PC

16/06/2011

<http://www.top500.org/>



Source: wikipedia.org 08/2011





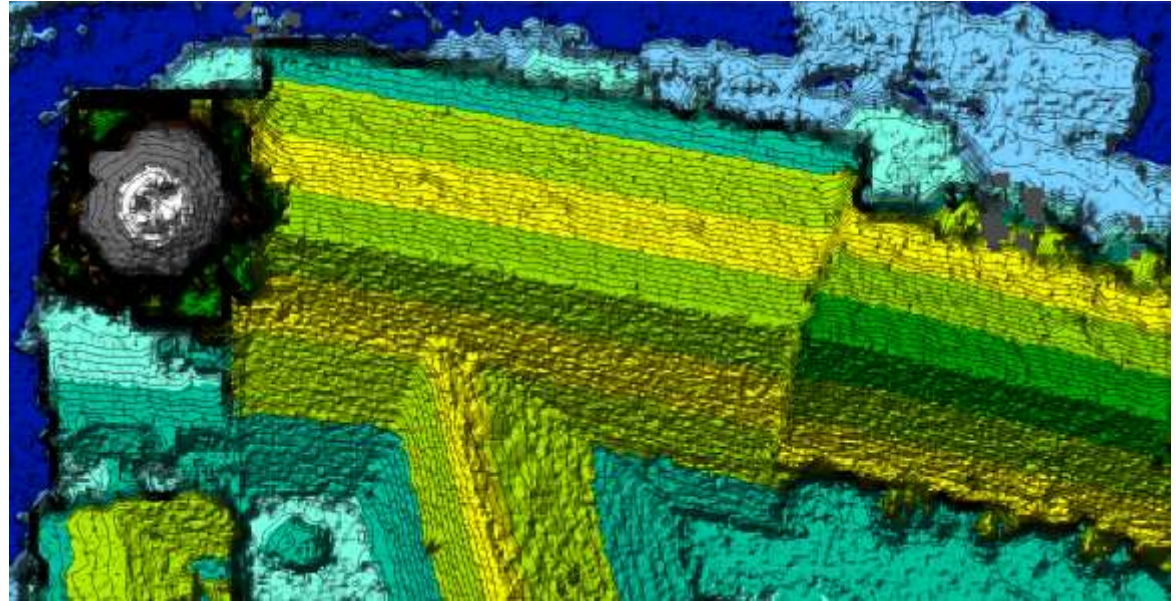


Features MATCH-T DSM 5.4

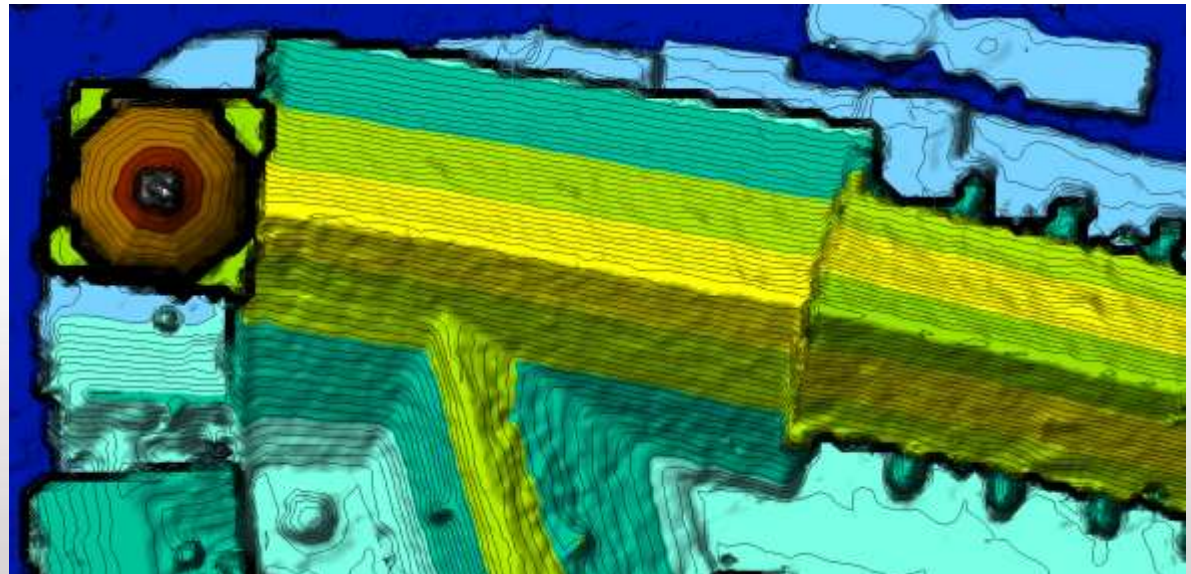
- **Resulting DSM needs less manual editing**
- **Significant reduction of noise in final point cloud**
- **More points in less processing time**
- **Improved results In poorly textured areas**
- **Better modeling of small details**

Quality

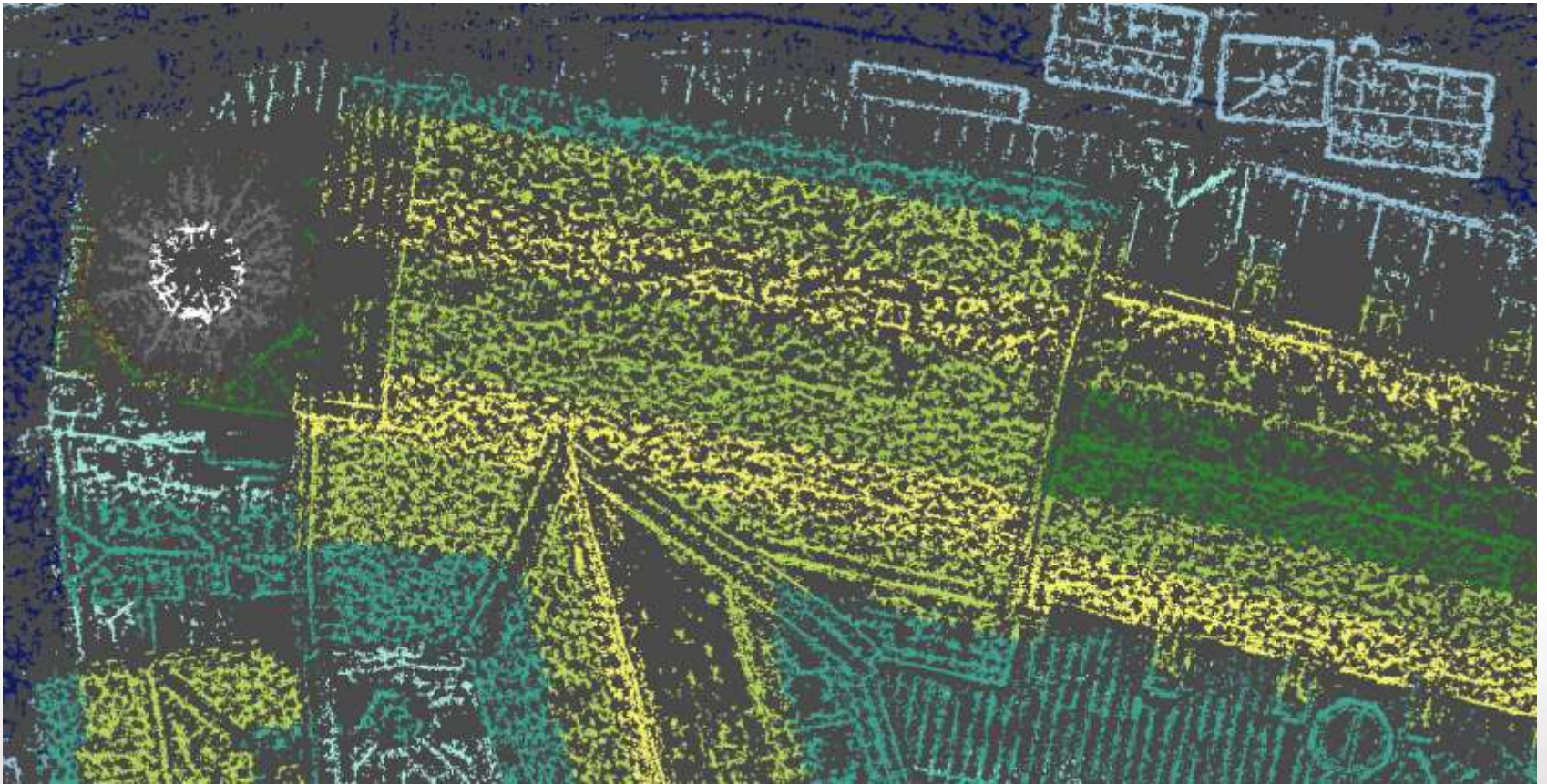
MATCH-T DSM 5.3



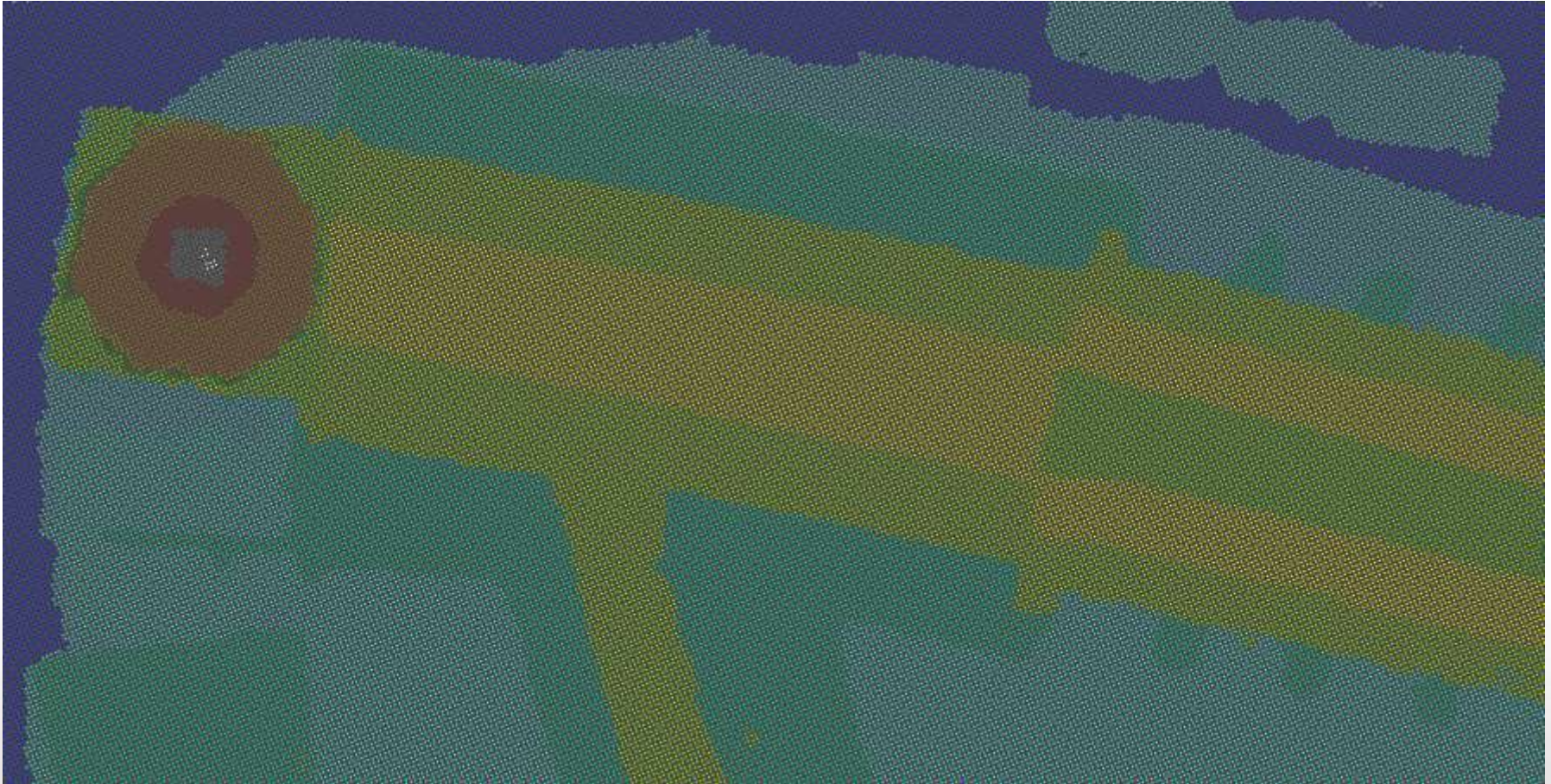
New:
MATCH-T DSM 5.4



Data coverage MATCH-T DSM 5.3



Data Coverage New: MATCH-T DSM 5.4



MATCH-T DSM Performance test

- Test of MATCH-T DSM 5.4 version on dedicated HW platform and Windows Server 2008 R2 HPC
- Data set of the city area of Montpellier provided by company InterAtlas France
 - 1562 UltraCam images (total 1.14 TB)
 - 9 cm GSD, 80 / 80 overlap

Distributed computing MATCH-T

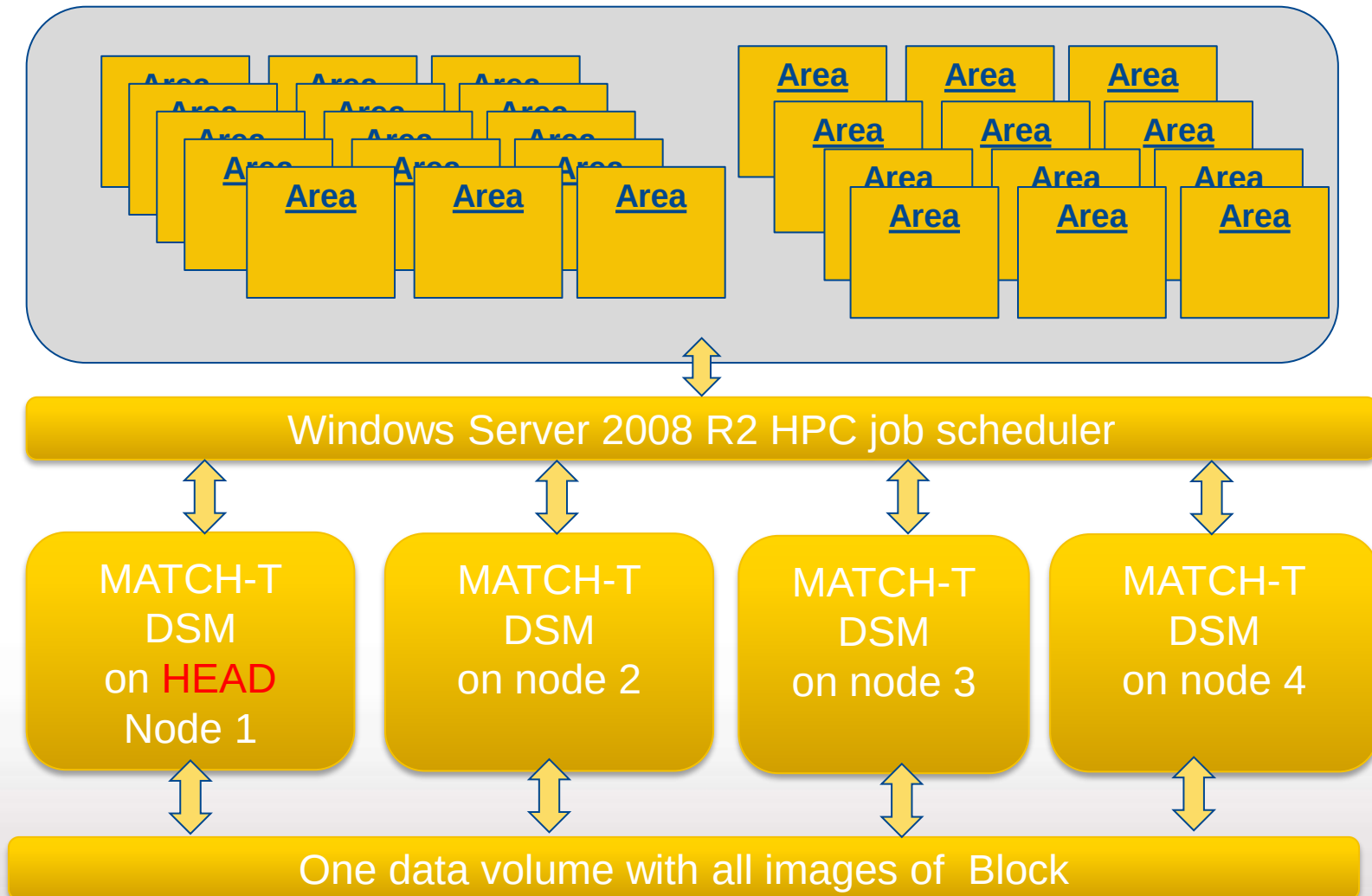
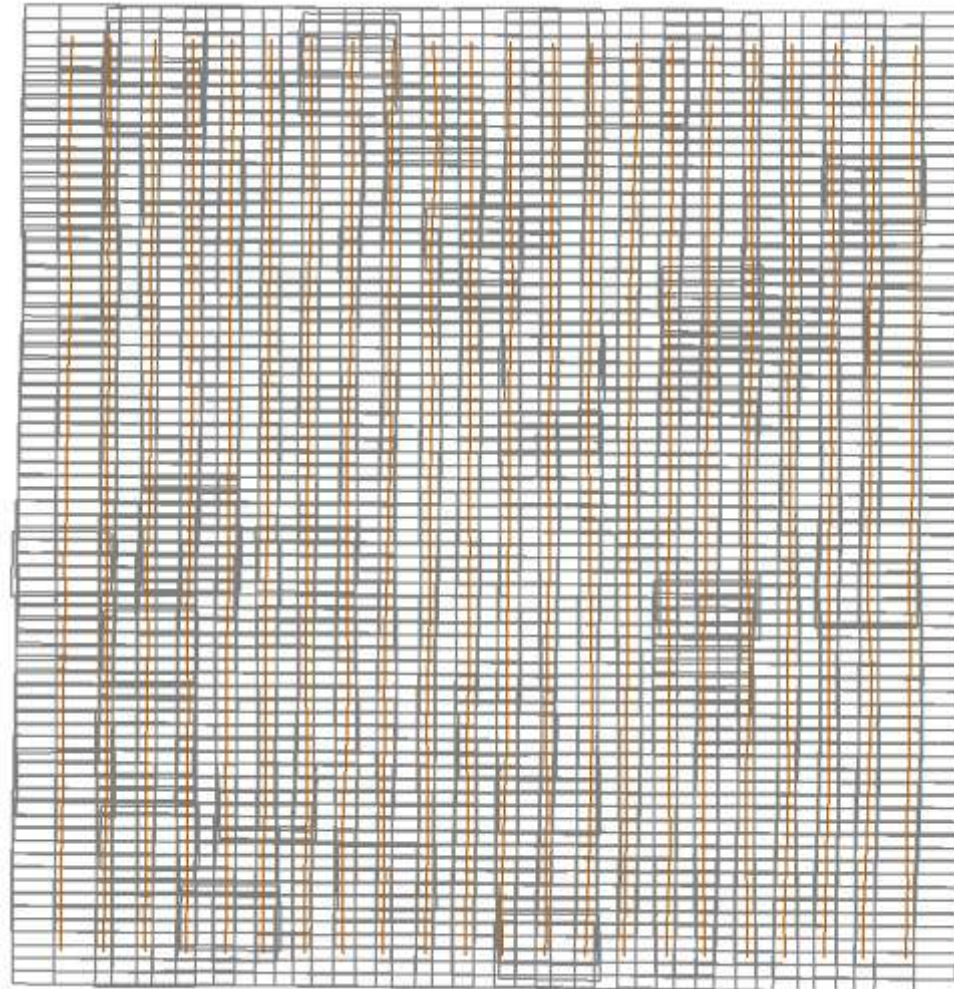


Image Footprints



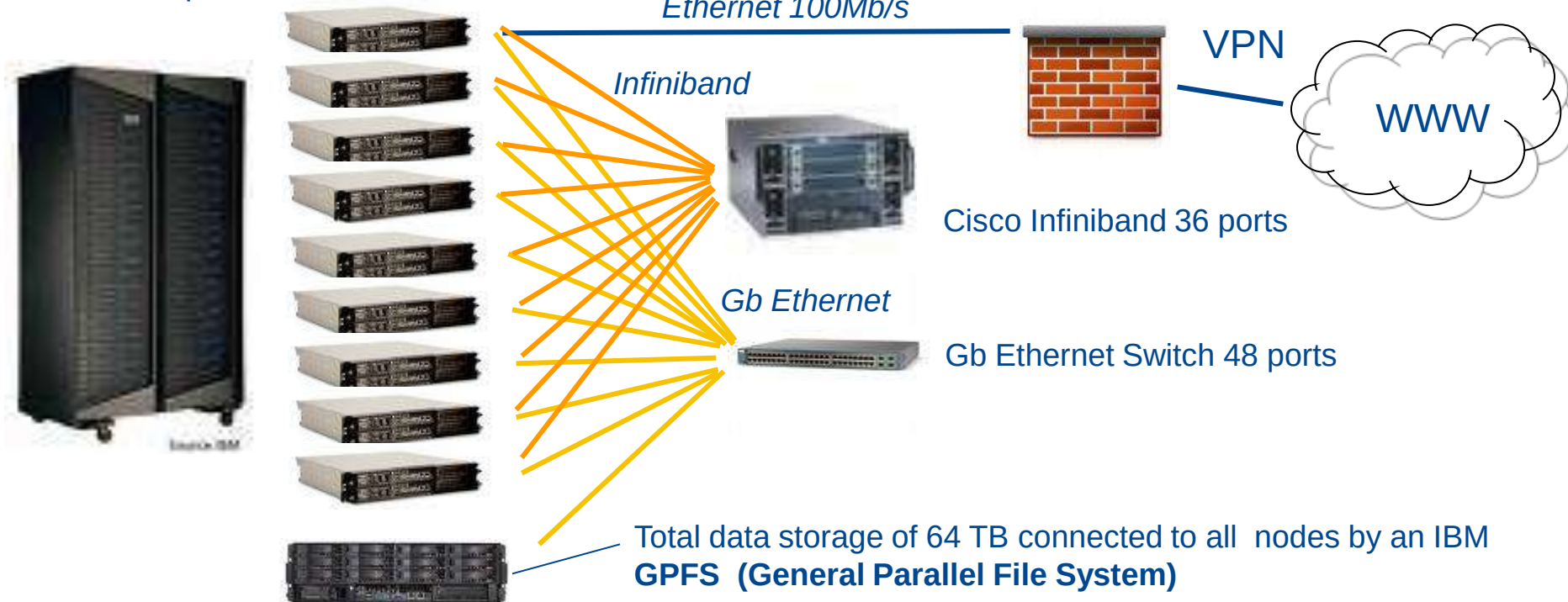
- 1562 images
- 22 N-S lines
- 8.6 x 9 km
- 1.44 TB
- 80 / 80 overlap

Configuration for HPC Cluster

Each compute node running Windows2008R2 HPC, with :

- * 2 quad-core Intel Nehalem X5570@2.93Ghz CPUs
- * 24GB DDR2 RAM
- * 250 GB internal drive

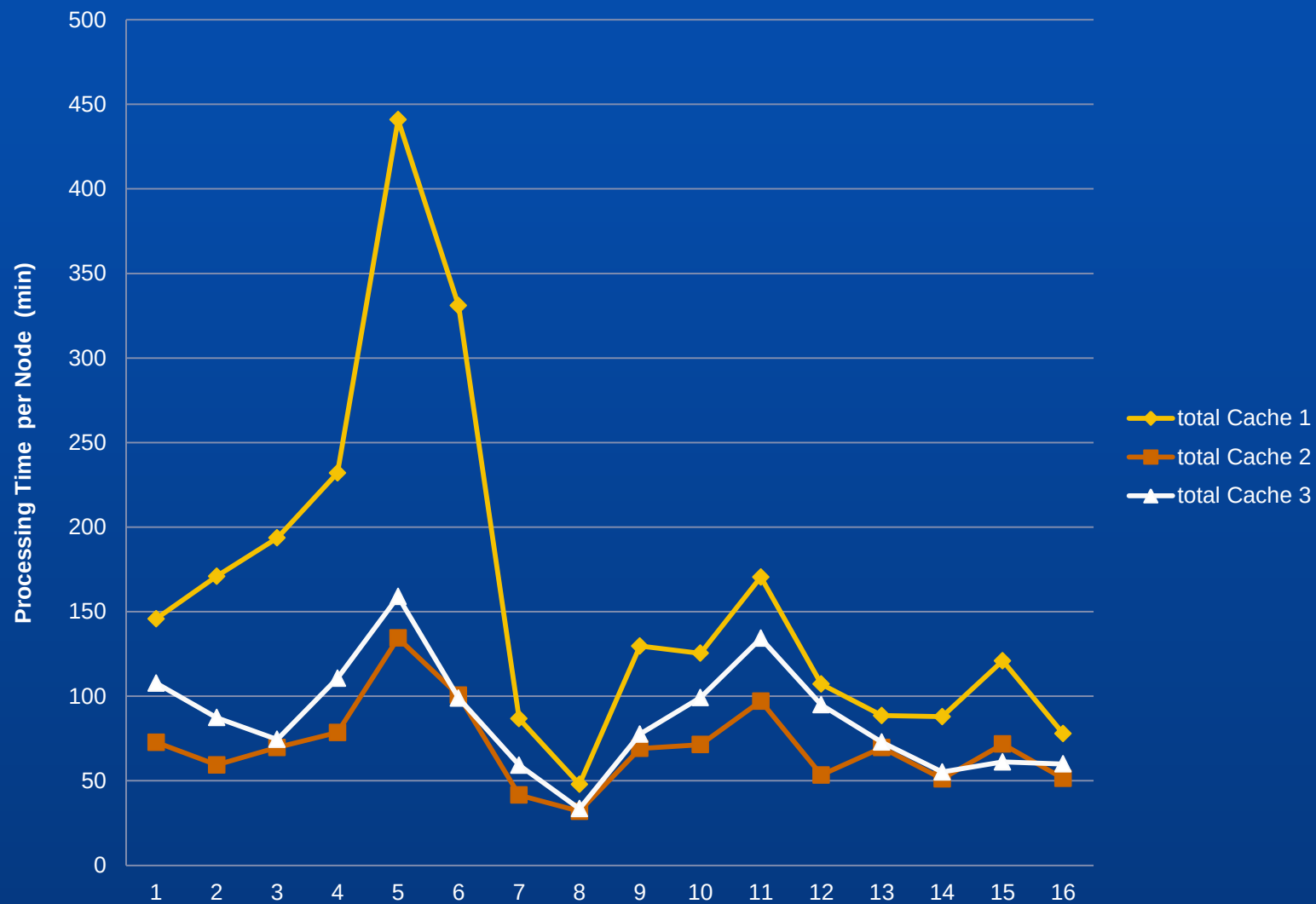
16 x Compute Nodes dx360m2



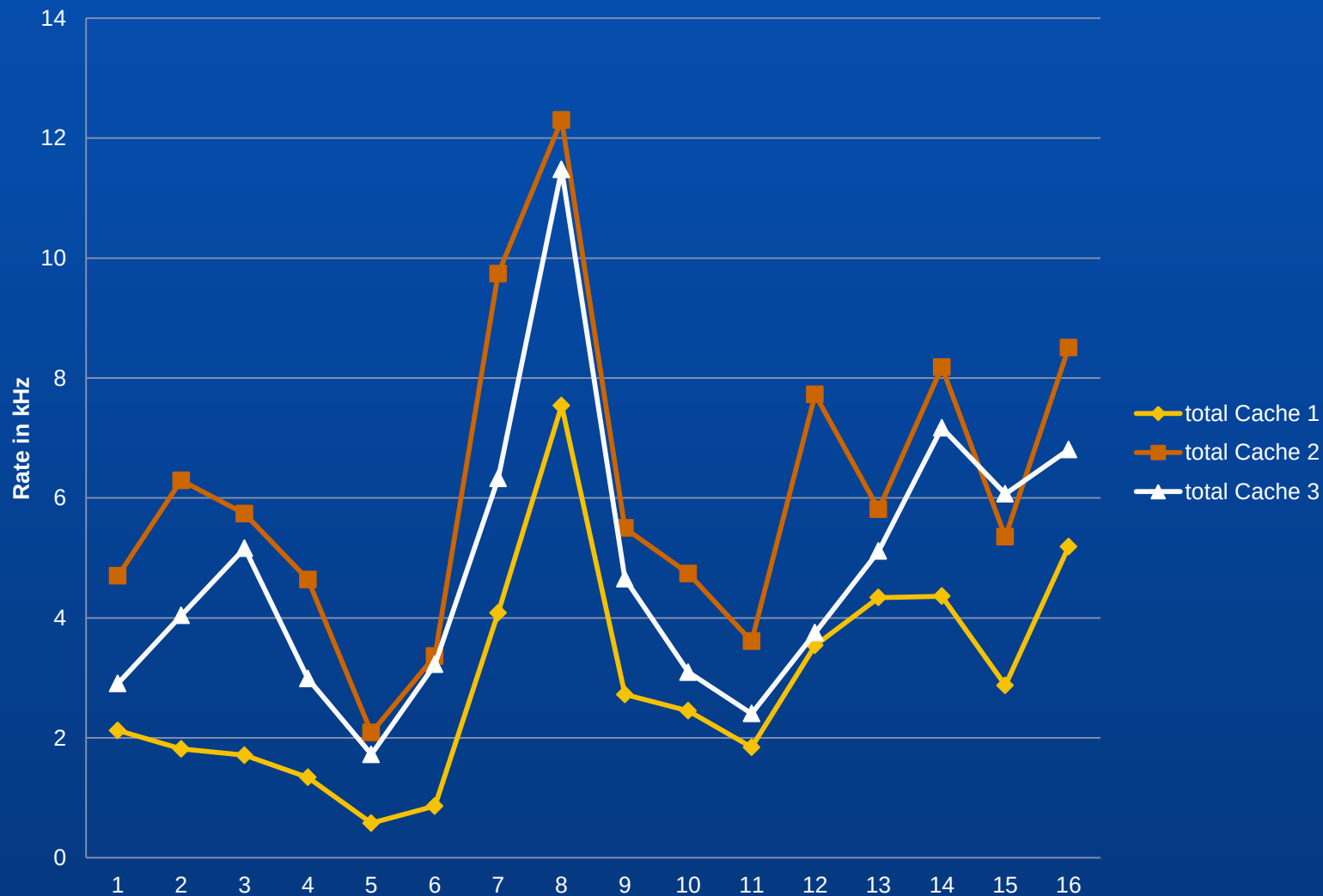
Data processing benchmark

- Point cloud 997 Million in LAS file(s)
(internally 14.3 Billion points)
- 1562 images
- Case A) Running block on 1 node
 - Time to finish: 40 hours 28 min (=> 93 sec / images)
- Case B) Running block on 16 nodes
 - Time to finish : 2 hours 32 min (=> 6 sec/ images)
- Factor: 15.9 (Case A / Case B)

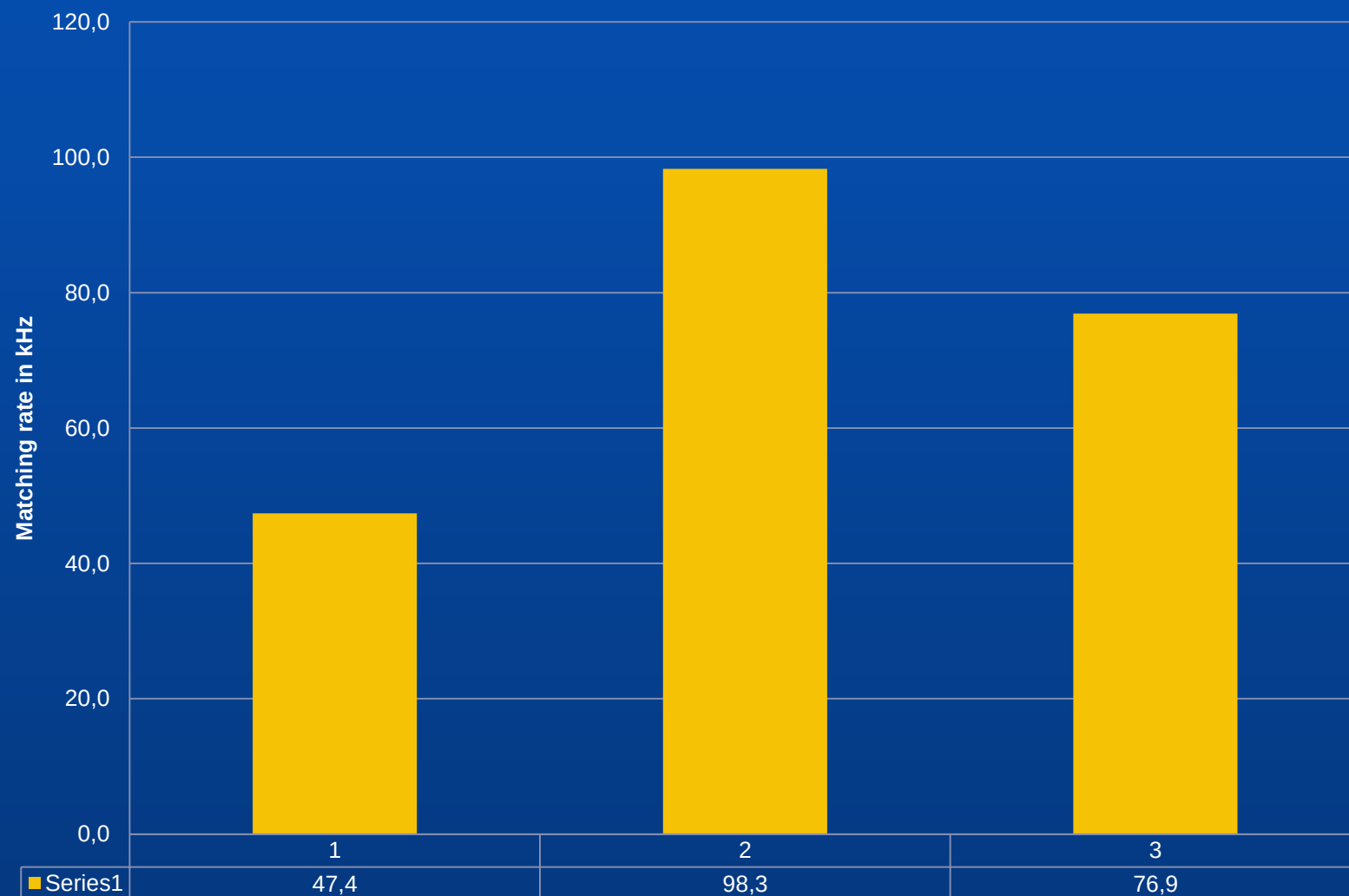
Total Time: Different Caching



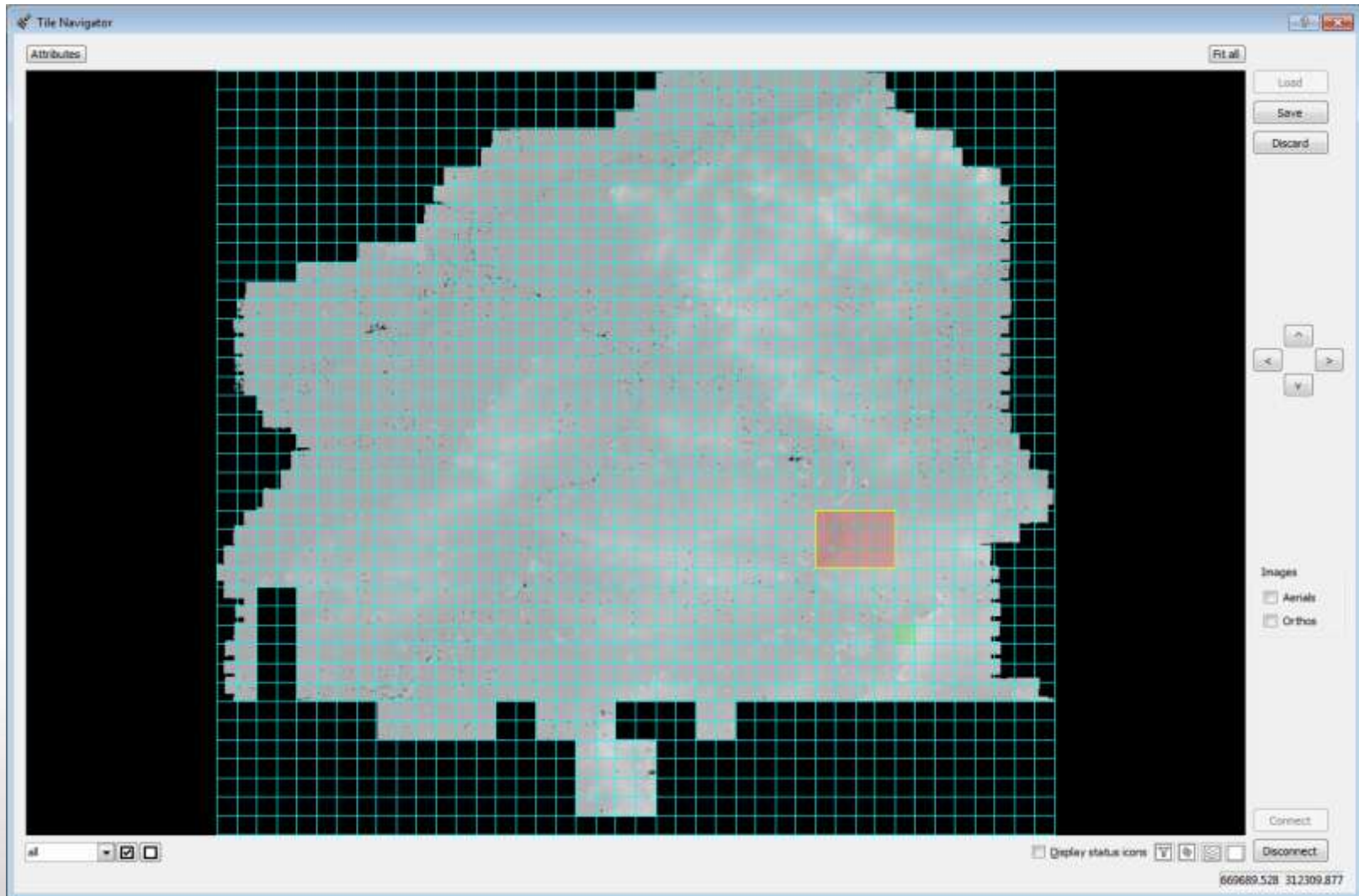
Final Matching Rate (Points / Sec) in kHz



Sum of Matching Rate of All Compute Nodes



Handling of large data sets



Basic concept

- Flat file based storage solution
- TPIX: **T**iled **P**oint **I**nde**X** 4 files:
 - *.tpix.dbf (status and attributed)
 - *.tpix.shx, *.tpix.shp (geometry polygons)
 - *.dtm (overview digital terrain model)
- DTM Toolkit: operations on TPIX (create, split, merge, convert)

Tile Navigator

Attributes

Fit all

Load

Save

Discard

^

<

v

>

Images

☐ Aerials
 ☐ Orthos

Connect

Disconnect

all

☐ Display status icons
 ☐
☐
☐

Title	Filename	Status	Time	Points	FitStatus	FitTime	DTMStatus
13	euro_000_013.las	Created	2011-03-16 18:03:17	0			
14	euro_000_014.las	Created	2011-03-16 18:03:17	0			
15	euro_000_015.las	Created	2011-03-16 18:03:17	0			
16	euro_000_016.las	Created	2011-03-16 18:03:17	3995792			
17	euro_000_017.las	Created	2011-03-16 18:03:17	4983092			
18	euro_000_018.las	Created	2011-03-16 18:03:18	5013291			
19	euro_000_019.las	Created	2011-03-16 18:03:18	5160221			
20	euro_000_020.las	Created	2011-03-16 18:03:18	5187104			
21	euro_000_021.las	Created	2011-03-16 18:03:18	5421799			
22	euro_000_022.las	Created	2011-03-16 18:03:18	5131321			
23	euro_000_023.las	Created	2011-03-16 18:03:18	5241382			
24	euro_000_024.las	Created	2011-03-16 18:03:18	5413197			
25	euro_000_025.las	Created	2011-03-16 18:03:18	2485490			
26	euro_000_026.las	Created	2011-03-16 18:03:18	0			
27	euro_000_027.las	Created	2011-03-16 18:03:18	0			
28	euro_000_028.las	Created	2011-03-16 18:03:18	0			
29	euro_000_029.las	Created	2011-03-16 18:03:18	0			
30	euro_000_030.las	Created	2011-03-16 18:03:18	0			
31	euro_000_031.las	Created	2011-03-16 18:03:18	0			
32	euro_000_032.las	Created	2011-03-16 18:03:18	0			
33	euro_000_033.las	Created	2011-03-16 18:03:18	0			
34	euro_000_034.las	Created	2011-03-16 18:03:18	0			
35	euro_000_035.las	Created	2011-03-16 18:03:18	0			
36	euro_000_036.las	Created	2011-03-16 18:03:18	0			
37	euro_000_037.las	Created	2011-03-16 18:03:18	0			
38	euro_000_038.las	Created	2011-03-16 18:03:18	0			
39	euro_000_039.las	Created	2011-03-16 18:03:18	0			
40	euro_000_040.las	Created	2011-03-16 18:03:18	0			
41	euro_000_041.las	Created	2011-03-16 18:03:18	0			
10000	euro_001_000.las	Created	2011-03-16 18:03:18	0			
10001	euro_001_001.las	Created	2011-03-16 18:03:19	0			
10002	euro_001_002.las	Created	2011-03-16 18:03:19	0			
10003	euro_001_003.las	Created	2011-03-16 18:03:19	0			
10004	euro_001_004.las	Created	2011-03-16 18:03:19	0			
10005	euro_001_005.las	Created	2011-03-16 18:03:19	0			

680867.353 345535.705

- **TPIX:**
 - Effective concept
 - No special data base engine needed
 - Fast access (read 1 tile ca. 10 sec. for 10 Mio points)
 - Editing data storage for intermediate product generation
 - Data format for local editing and data control

Characteristics of point cloud

Digital Photogrammetric Camera Evaluation - Generation of Digital Elevation Models

NORBERT HAALA, Stuttgart, HEIDI HASTEDT, Birmersdorf, KIRSTEN WOLF, Zürich, CAMILLO RESSL, Wien, SVEN BALTRUSCH, Schwerin

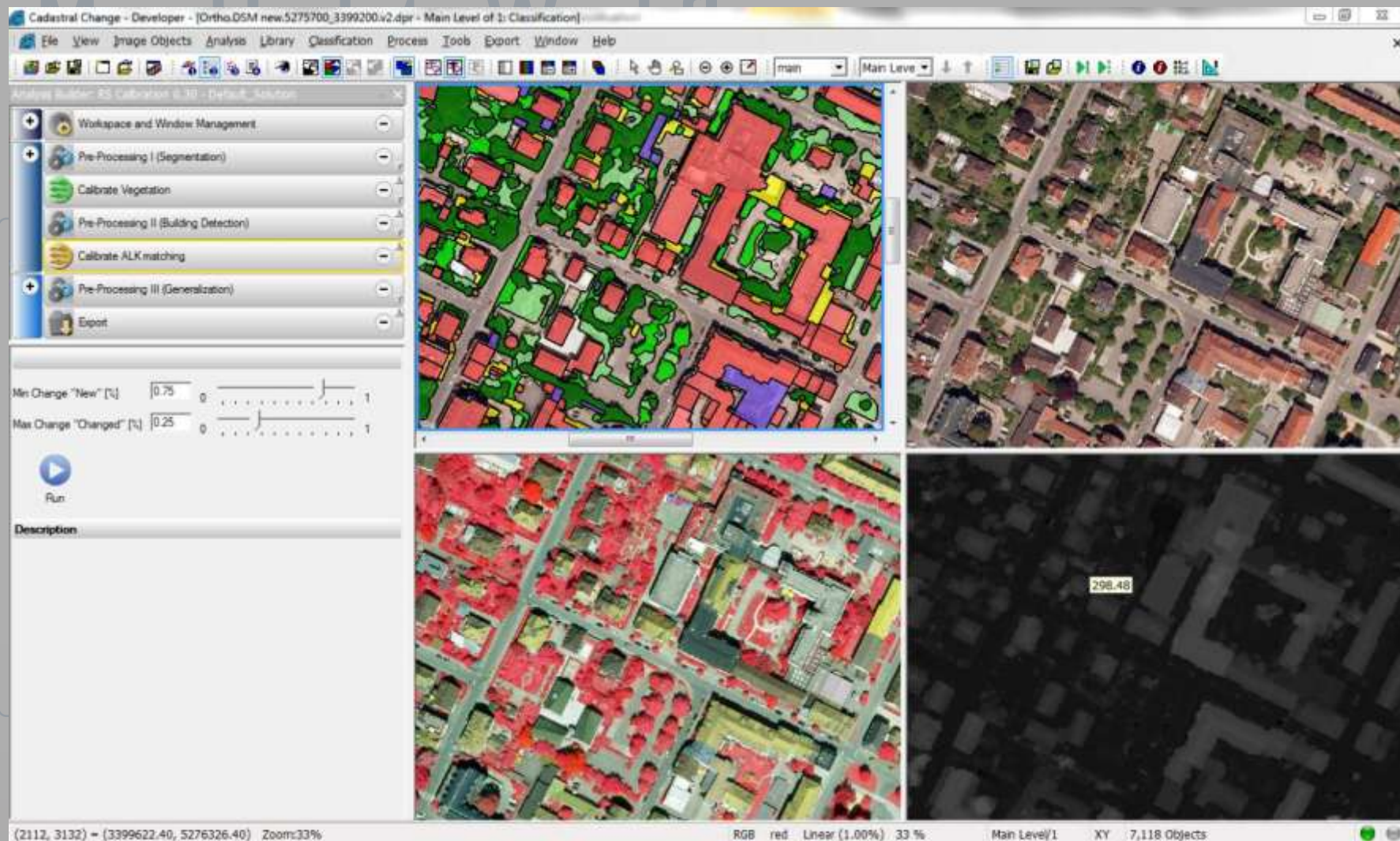
	Sensor	RMS [cm] no gross errors	Mean [cm]	Δ Max/Min [cm]		# points
LiDAR	ALS 50	3.3	0.4	9.4	-6.7	59
GSD 8cm Raster 0.2m	DMC	3.3	0.9	9.5	-6.9	60
	UltraCamX	4.8	0.6	11.7	-10.0	60
	DigiCAM	6.0	-1.7	15.5	-15.7	61
	RMK	4.6	2.4	8.2	-11.5	61
GSD 20 cm Raster 0.5m	DMC	16.2	-7.5	36.9	-30.5	61
	UltraCamX	7.5	-0.7	14.9	-16.8	60
	DigiCAM	9.6	0.5	18.9	-23.1	61
	RMK	9.5	0.7	23.9	-25.9	61

Table 1: Differences between DSM and reference points after gross errors elimination – MATCH-T DSM









Solar Suitability Map

- **Solution**
 - Automatic generation of a solar suitability map
- **Customer**
 - Netzbetreibergesellschaft Berlin-Brandenburg (NBB), Germany
- **Data**
 - RGB (0.04 m)
 - CIR (0.04 m)
 - LiDAR (> 4 pts/m²)
 - Building footprints (Vector)
- **Results**
 - Roof types
 - Roof part suitability (slope, orientation)
- **Area**
 - 469 ha, Berlin, Germany



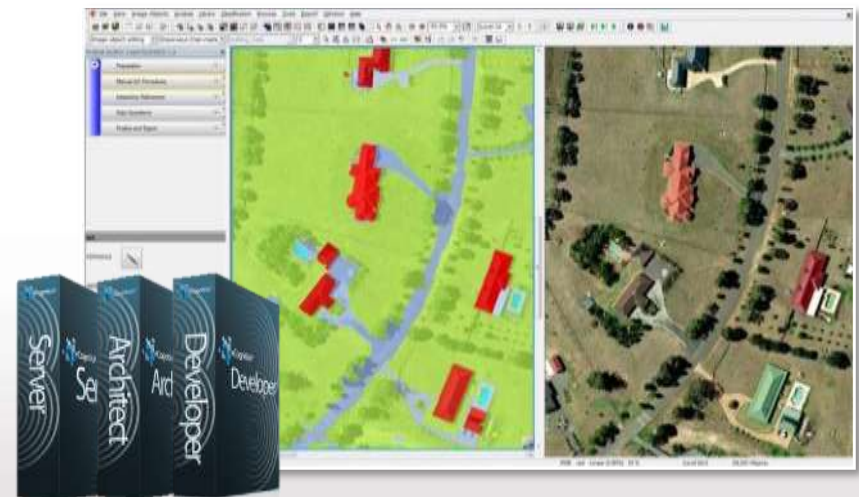
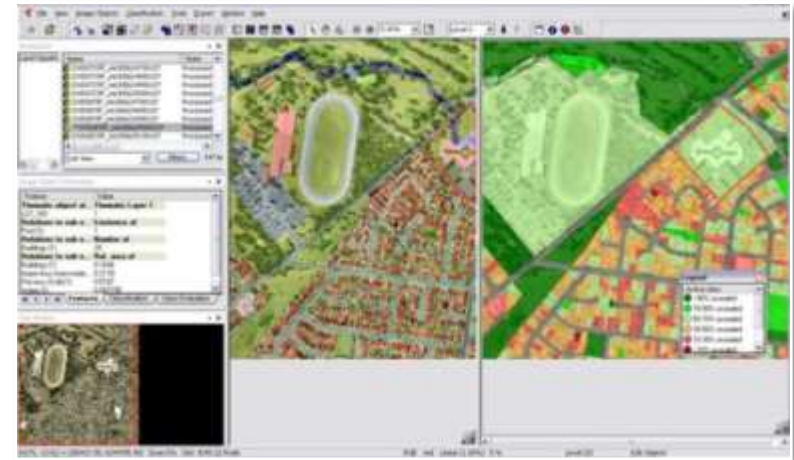
Automatic Land Cover Mapping

- **Solution**
 - Automatic land cover mapping
- **Customer**
 - AAM Group, Australia
- **Data**
 - RGB + NIR (0.1 m)
 - Rasterized LiDAR (1 m)
 - Last pulse
 - First pulse
- **Results**
 - Roof Tops
 - Roof Cover Types
 - Vegetation Heights
 - Road Surface Types
- **Accuracy**
 - 85 % (50 km²)



Automated Land Cover Mapping

- **Solution**
 - Automated land cover mapping
 - Manual QA/QC
- **Customer**
 - Fairfield City Council, Australia
- **Data**
 - RGB
 - CIR
 - LiDAR
- **Results**
 - 10 land cover classes



MATCH-T DSM

- High performing DSM processing on 64 bit Windows (XP, Vista, Win 7 and Win Server)
- Optimized utilization of hardware capacity
- Batch processing capabilities
- Easy integration into any third-party workflow

Version	Elapsed Time [h]	Estimated Height Accuracy [m]	# 3D Points
5.3	9	0.158	18053543
5.4	1	0.123	79159299