

Recent Activities of Tsukuba Correlator/Analysis Center

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VLBI Facilities operated by GSI of Japan

Tsukuba 32-m VLBI Station



Tsukuba VLBI Correlator/Analysis Center



GSI has been a network station and a correlator of IVS, and became a IVS Operational Analysis Center in January 2010.



Tsukuba VLBI Correlator

Processed IVS Sessions in 2011

Session Code	Stations	# Sessions
INT2	Ts, Wz	82
INT2	Kk, Wz	73
JAXA	Ts, Ai, Cc, Ud	1
JADE	Ts, Ai, Cc, S3, Vm, Vs, K1, Kg	8

Correlation System

K5/VSSP Software correlation System	
Software	K5/VSSP utility programs Some management programs
# Servers	Management Servers : 3 Data Servers : 39 Correlation Servers : 32
File system between servers	NFS (since 2007) Lustre File System (since 2011)

• Total 155 INT2 sessions and 9 domestic sessions were correlated without any problems.

• The databases of INT2 sessions are analyzed at Tsukuba VLBI Analysis Center, and rapid dUT1 solution is calculated.

• The correlation system is consisted of a lot of general-purpose servers, which installs K5/VSSP utility programs.



Tsukuba VLBI Analysis Center

Ultra-rapid dUT1 measurement on VLBI session
dUT1 solution is calculated within 30 minutes of the end of observation session

INT2
(155 sessions)

One dUT1 solution per session

CONT11
(1 session)

Continuous dUT1 solutions for 15 days

Processed sessions in 2011

IVS 24-hour sessions
(15 sessions)

Continuous dUT1 solutions for one day
(The sessions includes Ts and On stations)

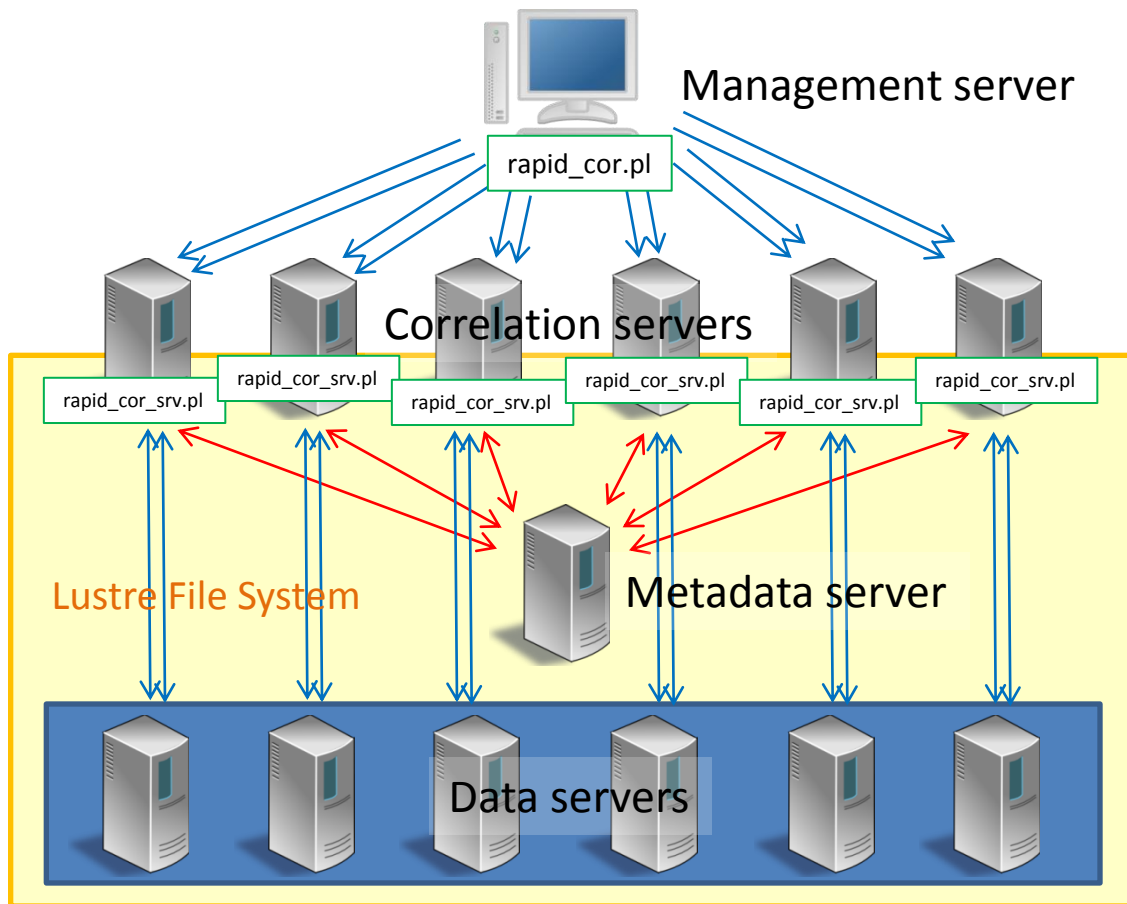
Special sessions
(2 sessions)

Continuous dUT1 solutions for several hours
(Optimum sessions for dUT1 measurement)

These solutions were used for calculation for rapid EOP solution by USNO

Improvement in 2010-2011

① New distributed processing System for Correlation



The number of process which management server threw to Correlation server is selectable. (it depends on the servers' spec)

All of the data are stored in the shared directory managed by Lustre File System

As the data is managed by Lustre File System, the access rate between correlation servers to data is not decreased due to increasing the correlation process.



Processing time on JD1109

Session Code	JADE1109(Domestic session)	
Processed Baseline	TSUKUB32 – CHICHI10	
# scans	202	
Processing System	NEW	OLD
# correlation servers	15 servers	12 servers
Maximum number of data process at one time	46	12
File system between servers	Lustre File System	NFS
Processing time	25	145

The new system enables us to shorten the processing time to one-sixth.

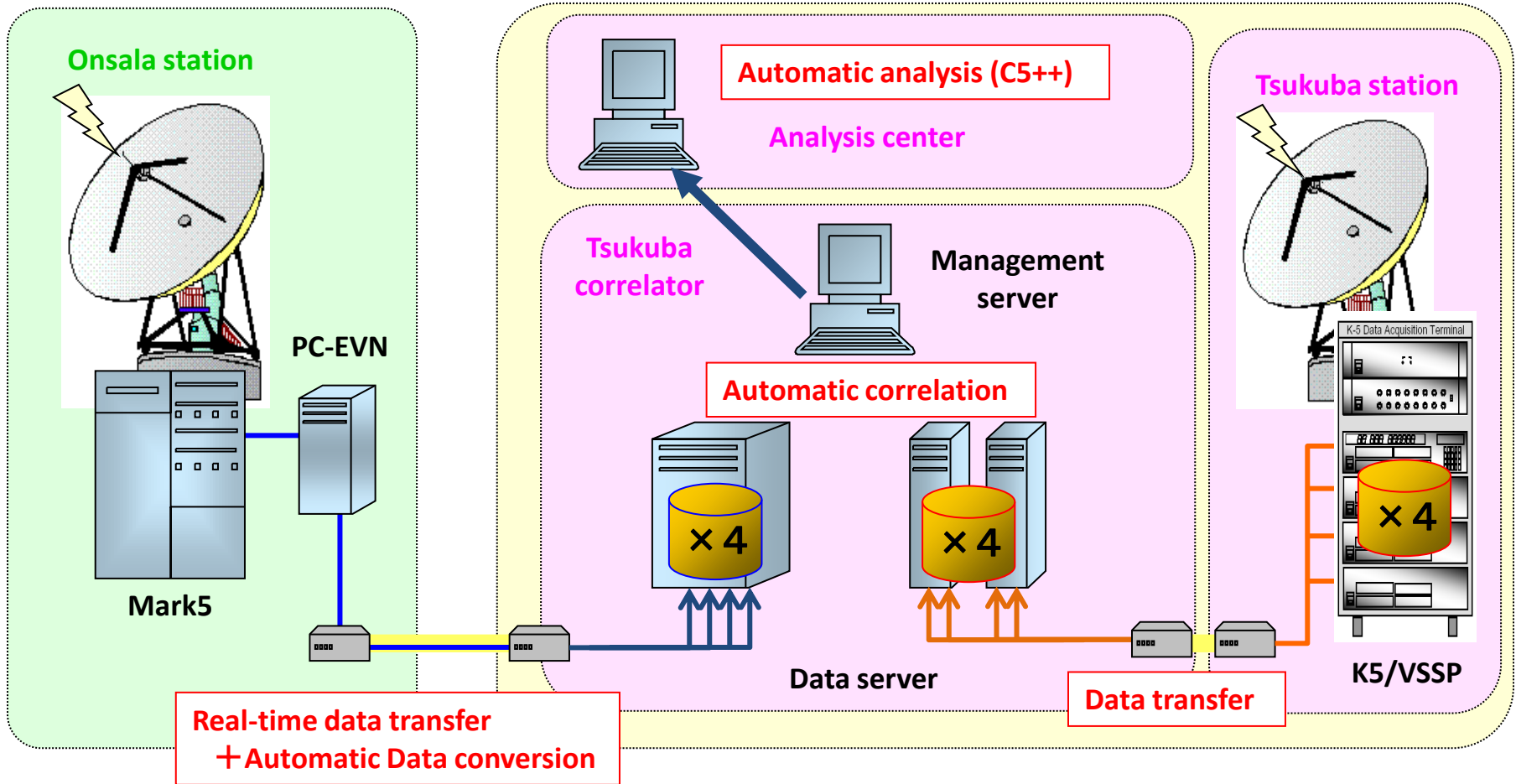
In the old system, we could not increase the number of correlation servers due to the weakness of NFS.



Processing time on JD1109

Processed Baseline	# scans	Processing time (minutes)
TSUKUB32-CHICHI10	202	25
TSUKUB32-SINTOTU3	95	12
TSUKUB32-VERAMZSW	170	20
TSUKUB32-VERAISGK	149	18
CHICHI10-VERAMZSW	163	63
CHICHI10-VERAISGK	146	59
VERAMZSW-VERAISGK	137	77
TOTAL	1062	274 (about 4.6hours)

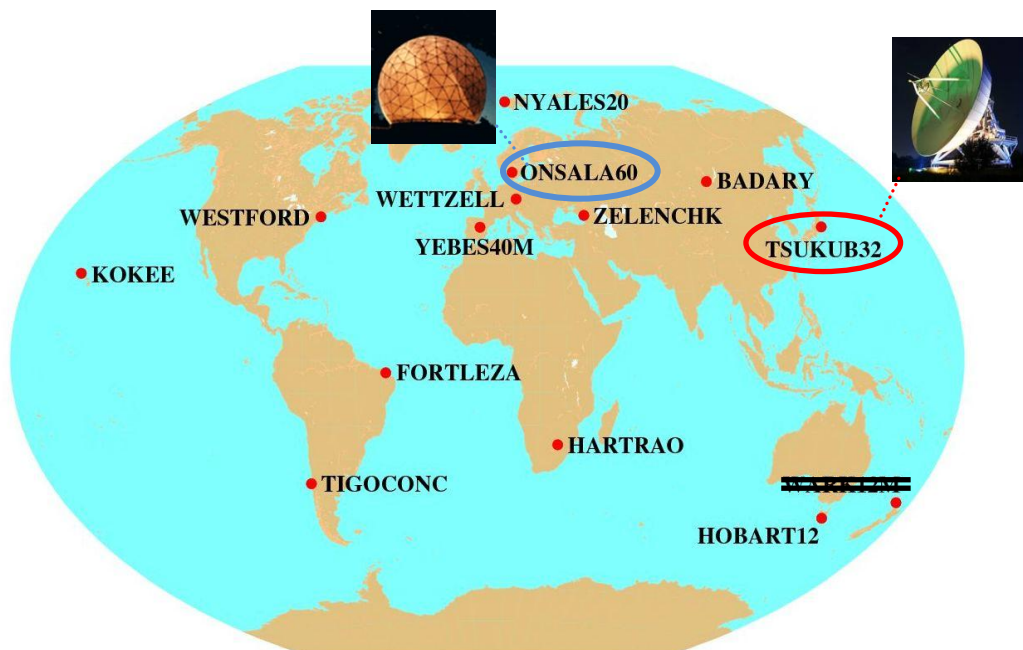
Ultra-rapid dUT1 measurement



The programs for data transfer, conversion and correlation run during the observation.
 The automated analysis program runs when enough number of scans for analysis is correlated.
 We use C5++ developed by NICT of Japan on the automatic analysis.

Ultra-rapid session on CONT11

CONT11 is a campaign of 15 days continuous VLBI sessions performed in the second half of September.



Ultra-rapid dUT1 measurement

Baseline : ONSALA60 – TSUKUB32
Correlator : Tsukuba VLBI Correlator
Analysis : Tsukuba Analysis Center

- The data was transferred to Tsukuba correlator via high-speed network in real-time.
- dUT1 values were calculated during the observing sessions.

This approach enables us to get 15 days continuous dUT1 values during the observation.

Data Processing Image

Session start

00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00



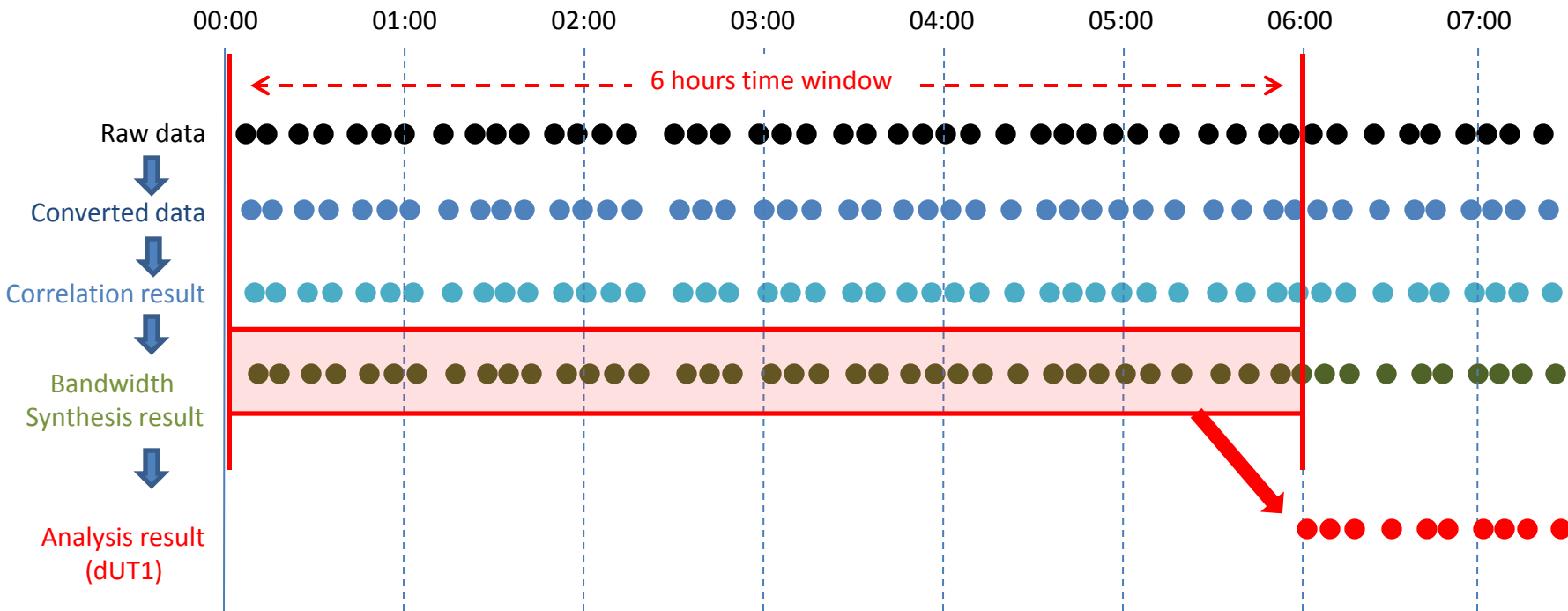
We can obtain the bandwidth synthesis results within a few minutes after the end of the observation for each scan.

Fringe search
 ---> Clock offset and rate is determined

Two analysis method
 ① 6 hours slide window mode
 ② 30 scans mode

Analysis method (6 hours slide window mode)

Session start

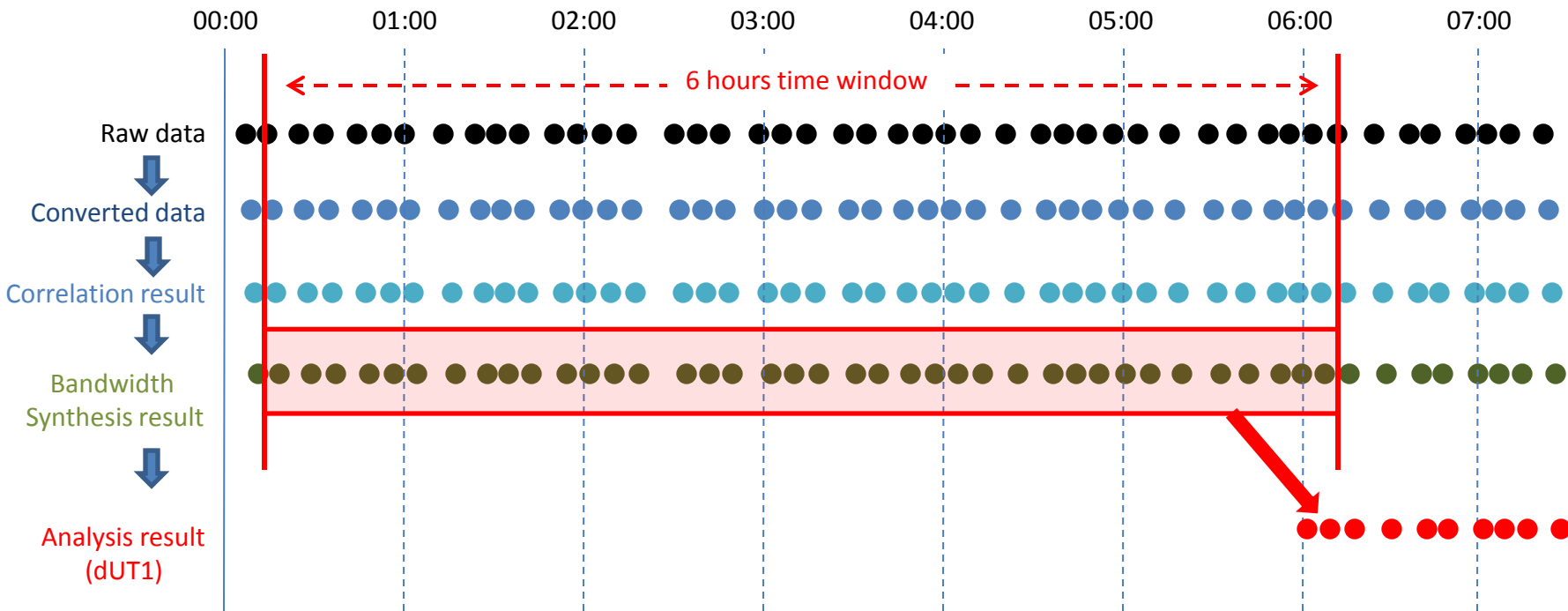


The analysis is done every scans.

The data recorded in **6 hours** before the latest scan are analyzed on each analysis.

Analysis method (6 hours slide window mode)

Session start

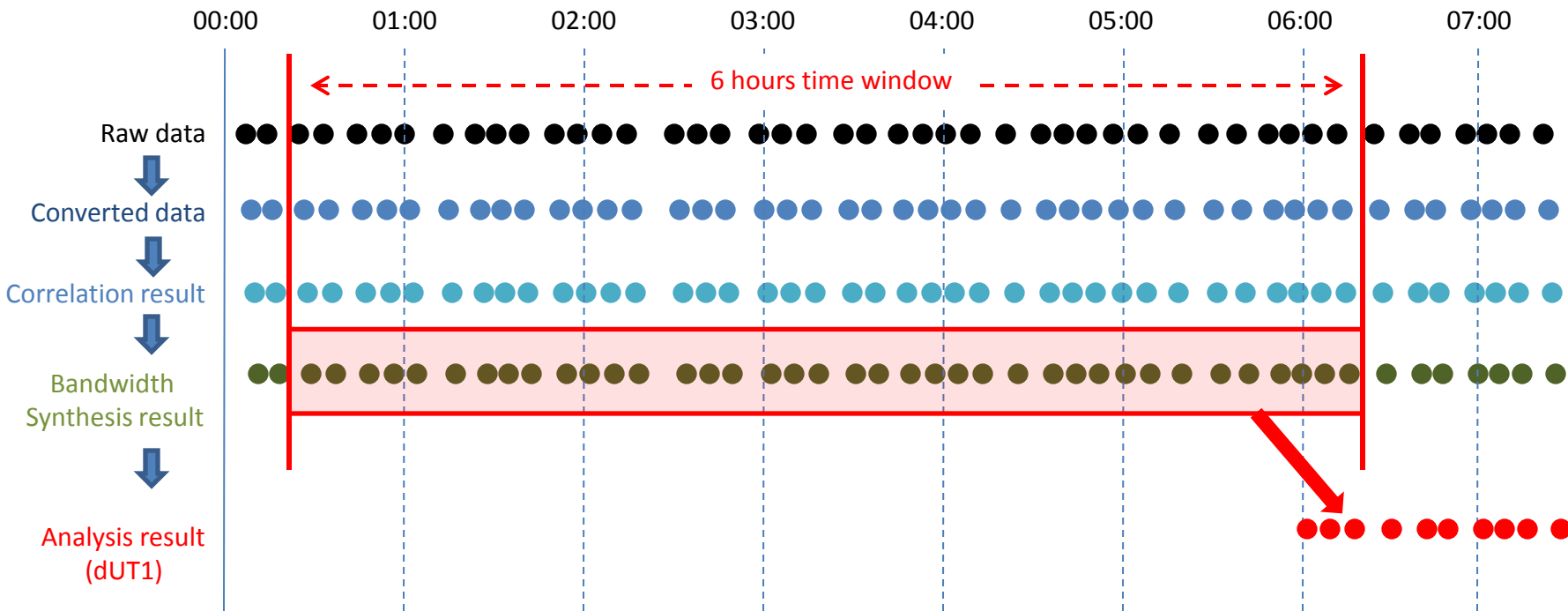


The analysis is done every scans.

The data recorded in **6 hours** before the latest scan are analyzed on each analysis.

Analysis method (6 hours slide window mode)

Session start

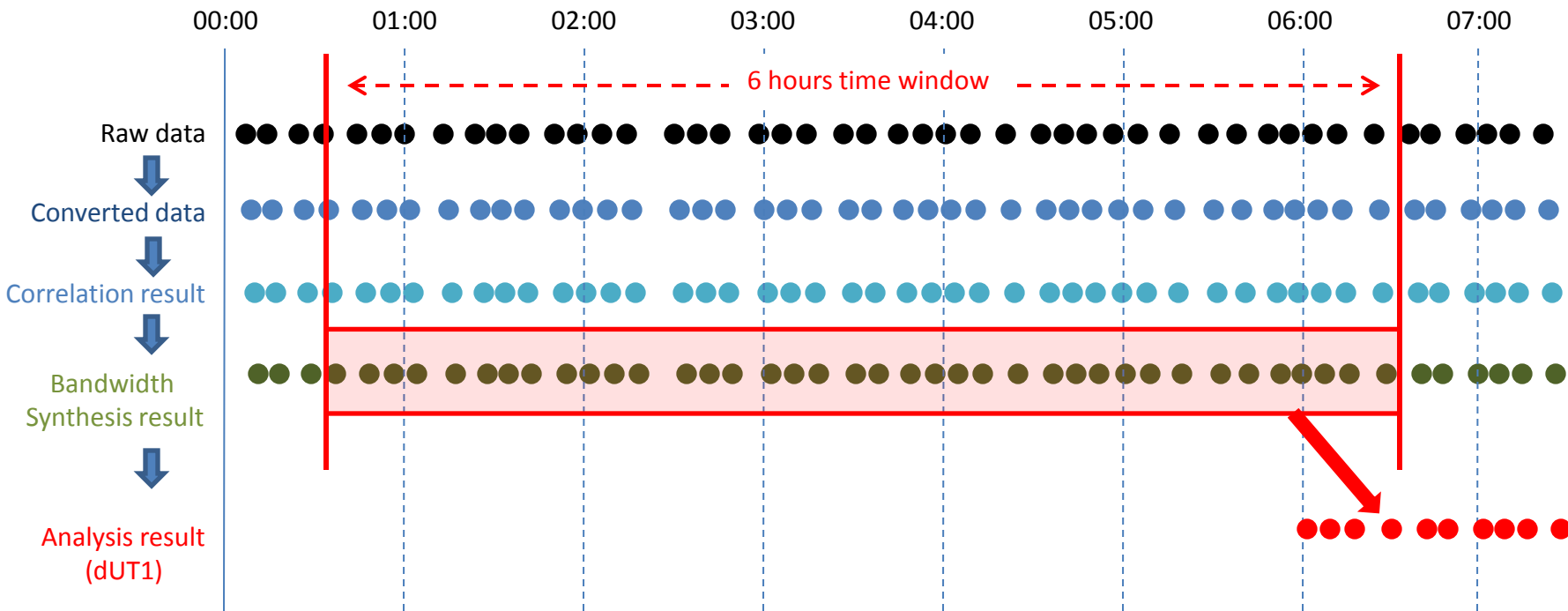


The analysis is done every scans.

The data recorded in **6 hours** before the latest scan are analyzed on each analysis.

Analysis method (6 hours slide window mode)

Session start

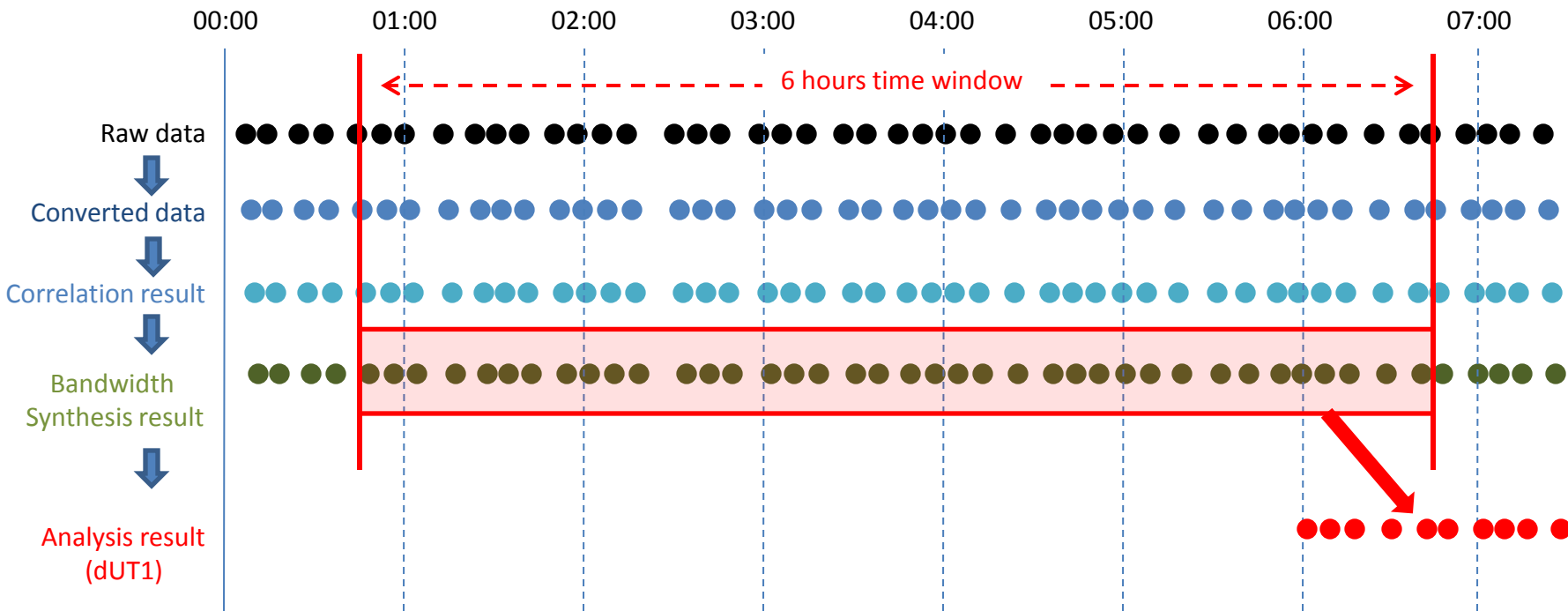


The analysis is done every scans.

The data recorded in **6 hours** before the latest scan are analyzed on each analysis.

Analysis method (6 hours slide window mode)

Session start

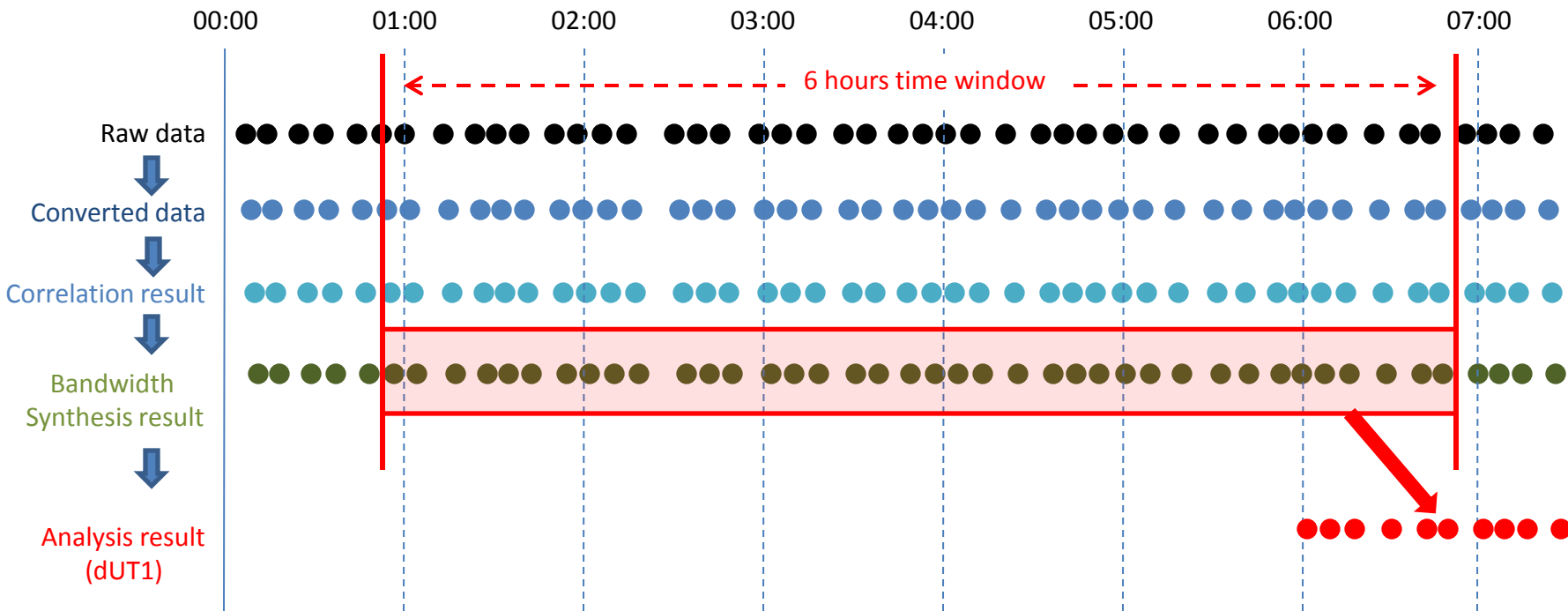


The analysis is done every scans.

The data recorded in **6 hours** before the latest scan are analyzed on each analysis.

Analysis method (6 hours slide window mode)

Session start

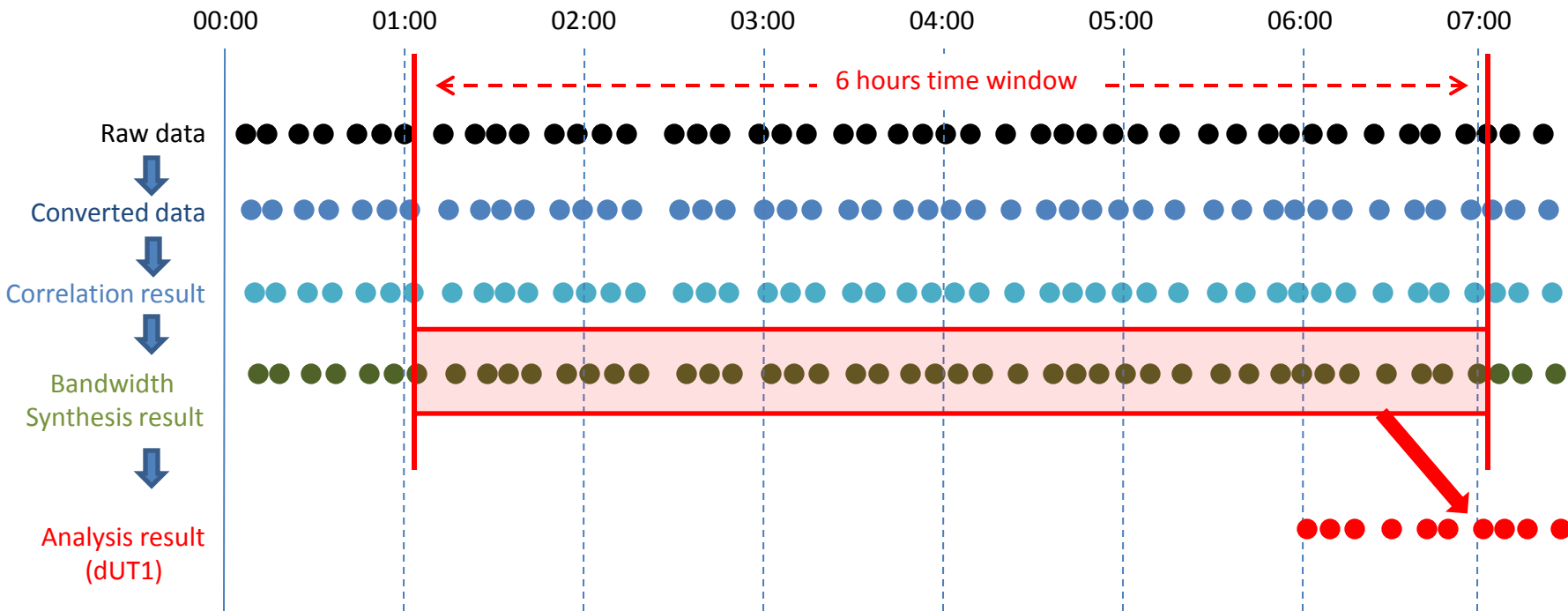


The analysis is done every scans.

The data recorded in **6 hours** before the latest scan are analyzed on each analysis.

Analysis method (6 hours slide window mode)

Session start

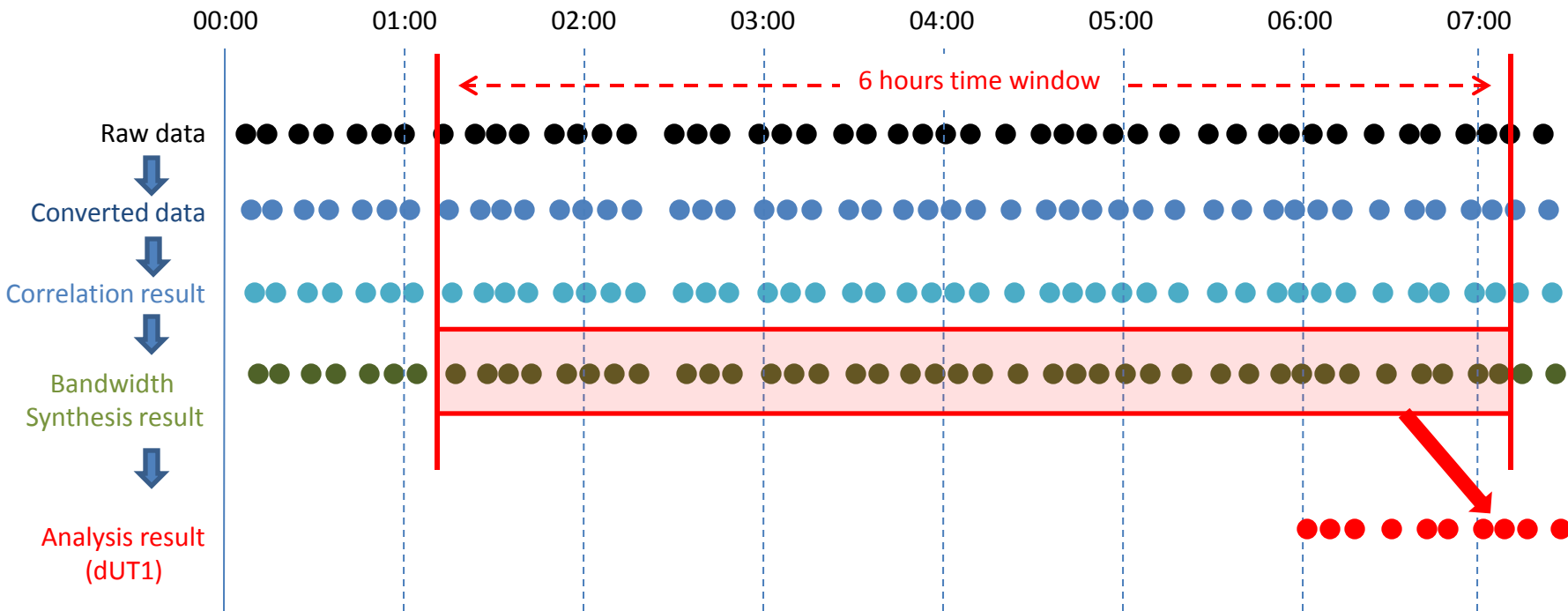


The analysis is done every scans.

The data recorded in **6 hours** before the latest scan are analyzed on each analysis.

Analysis method (6 hours slide window mode)

Session start

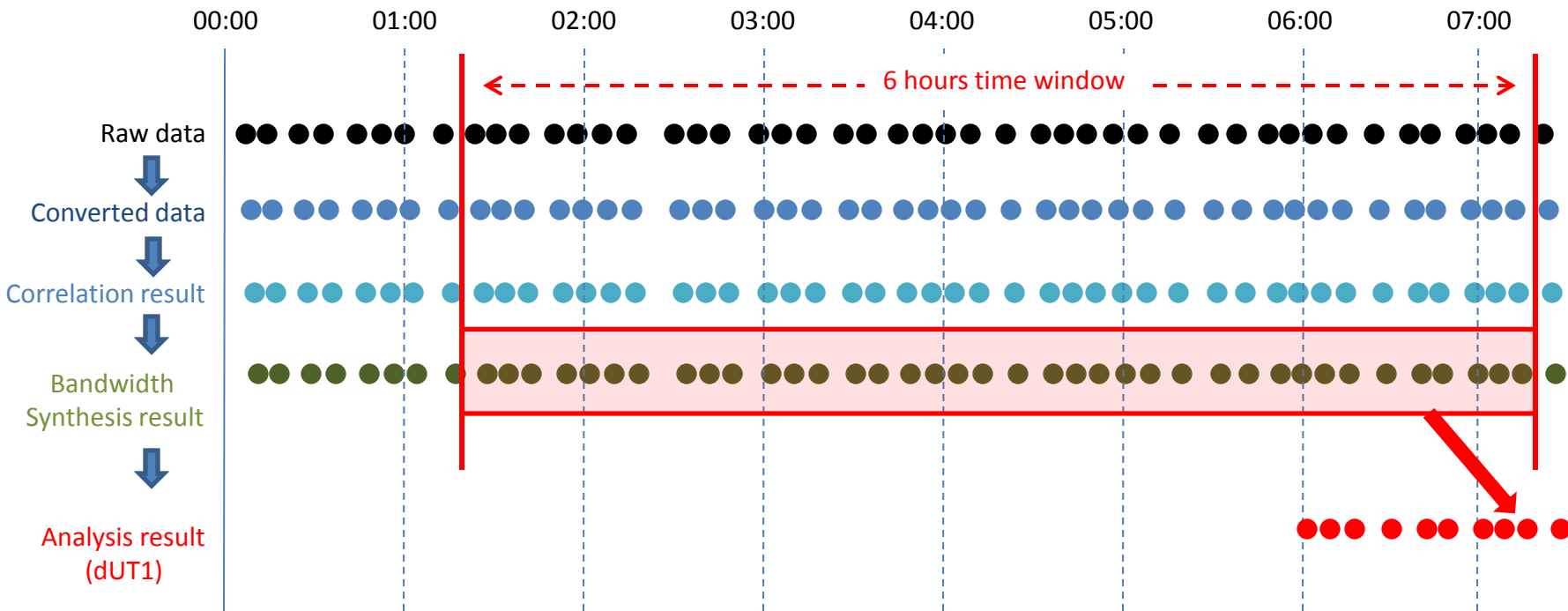


The analysis is done every scans.

The data recorded in **6 hours** before the latest scan are analyzed on each analysis.

Analysis method (6 hours slide window mode)

Session start

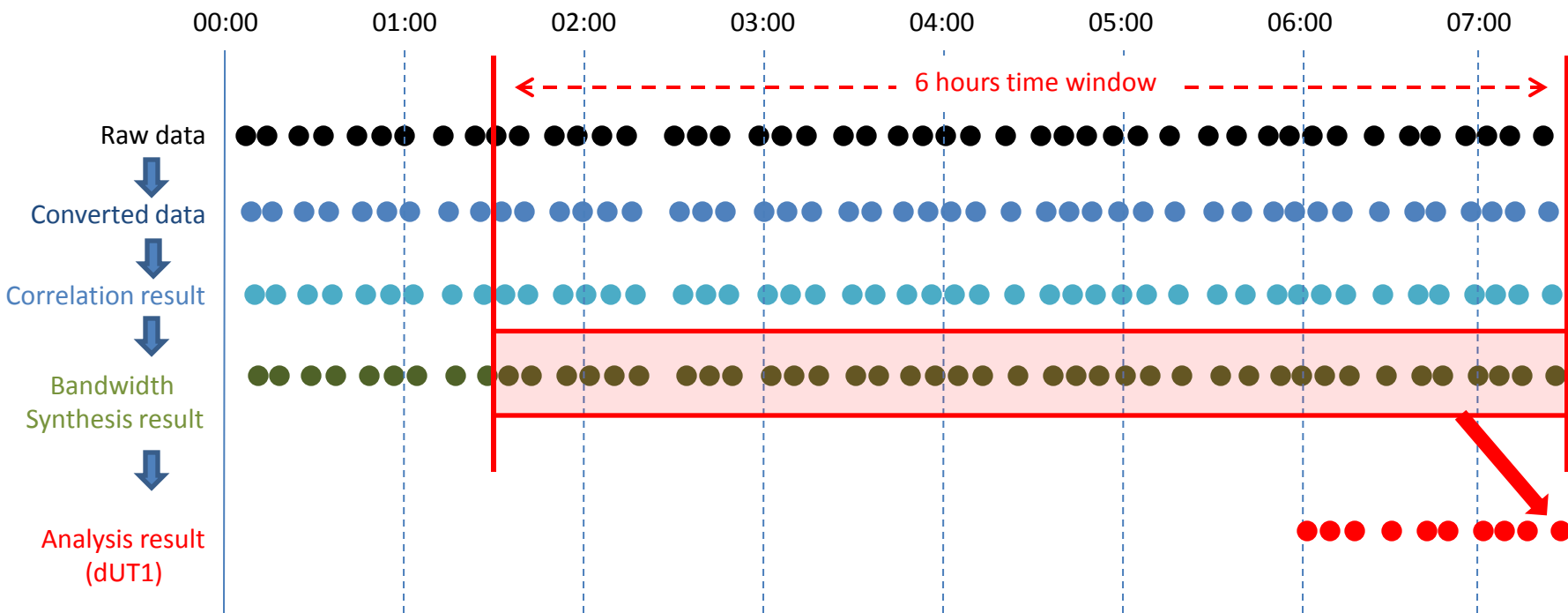


The analysis is done every scans.

The data recorded in **6 hours** before the latest scan are analyzed on each analysis.

Analysis method (6 hours slide window mode)

Session start



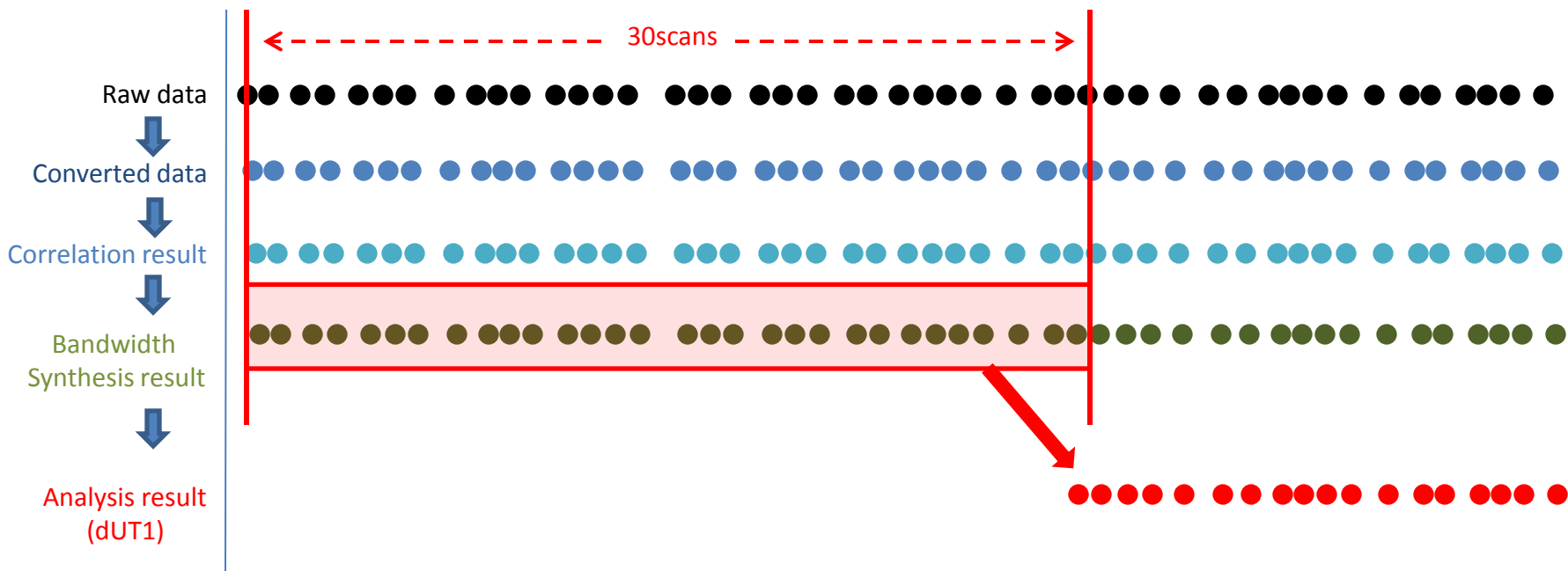
The analysis is done every scans.

The data recorded in **6 hours** before the latest scan are analyzed on each analysis.

Analysis method (30 scans slide window mode)

Session start

00:00



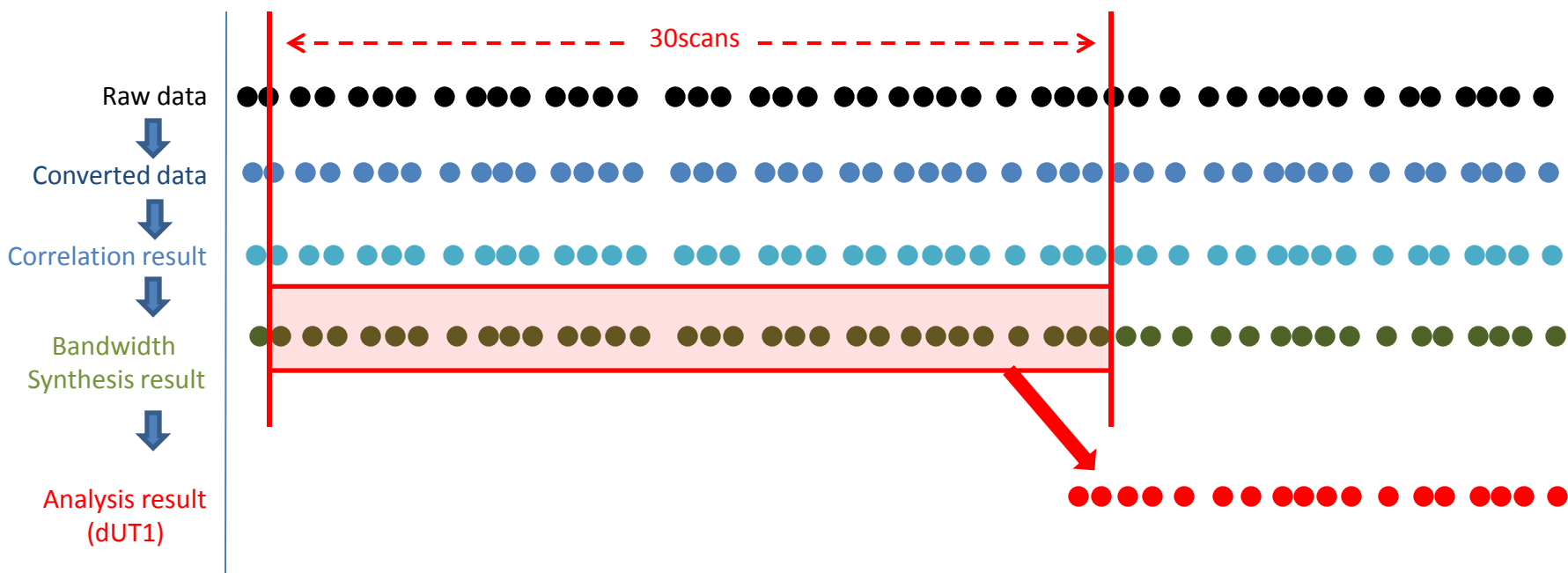
The analysis is done every scans.

The data of **30 scans** before the latest scan are analyzed on each analysis.

Analysis method (30 scans slide window mode)

Session start

00:00



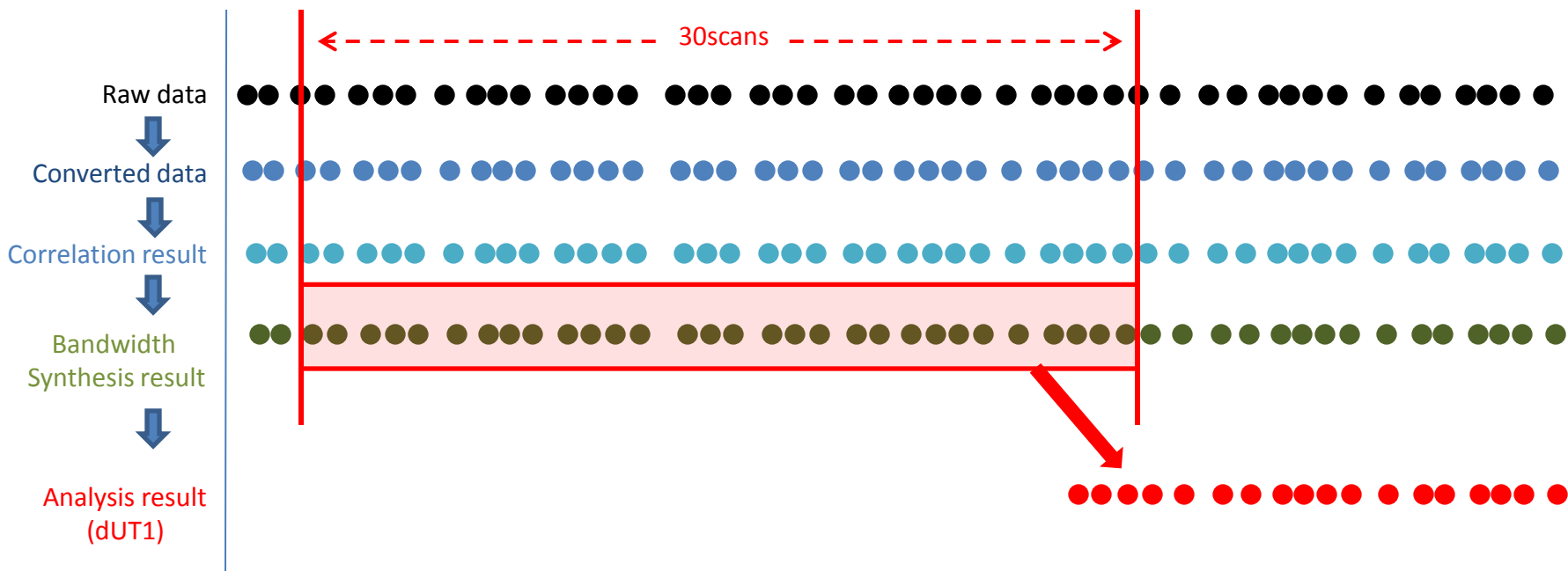
The analysis is done every scans.

The data of **30 scans** before the latest scan are analyzed on each analysis.

Analysis method (30 scans slide window mode)

Session start

00:00



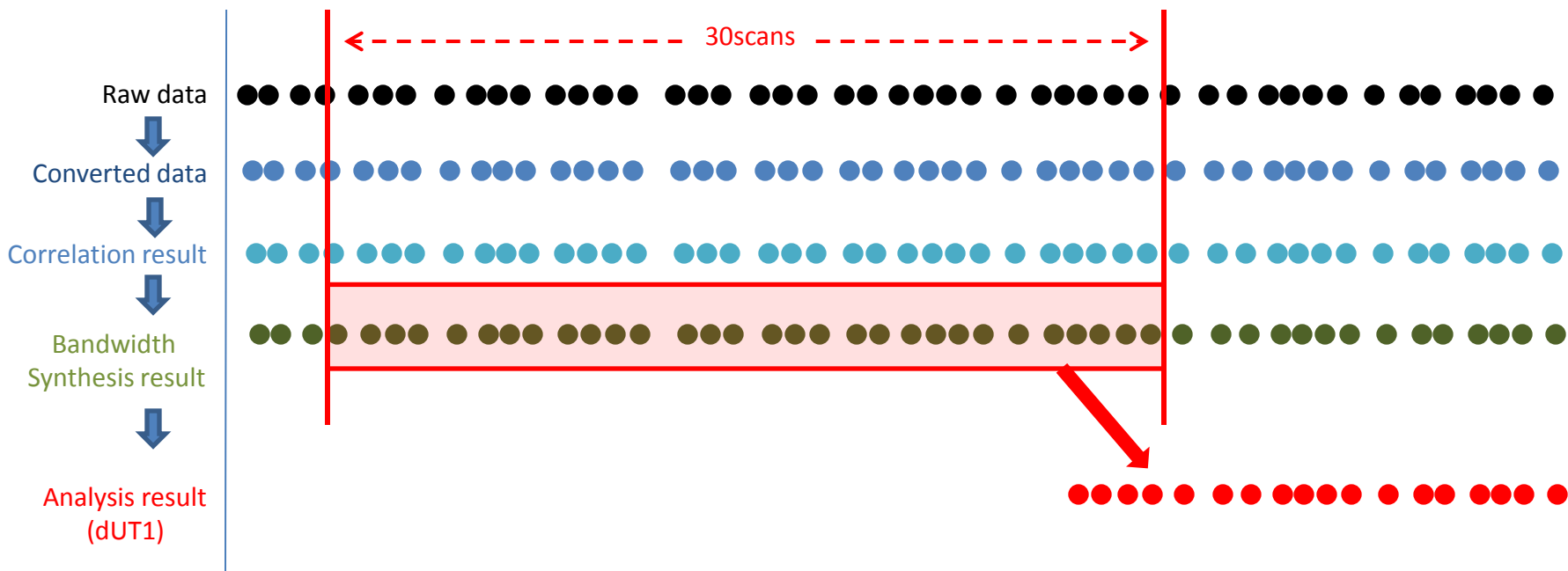
The analysis is done every scans.

The data of **30 scans** before the latest scan are analyzed on each analysis.

Analysis method (30 scans slide window mode)

Session start

00:00



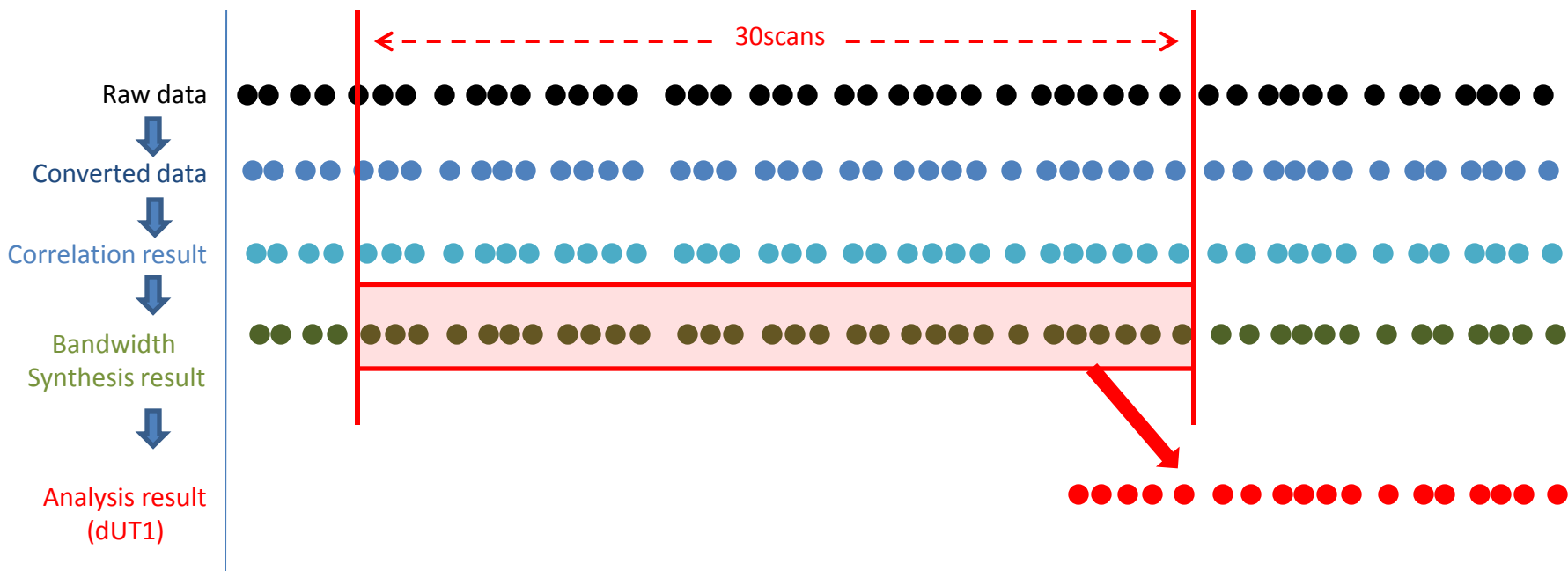
The analysis is done every scans.

The data of **30 scans** before the latest scan are analyzed on each analysis.

Analysis method (30 scans slide window mode)

Session start

00:00



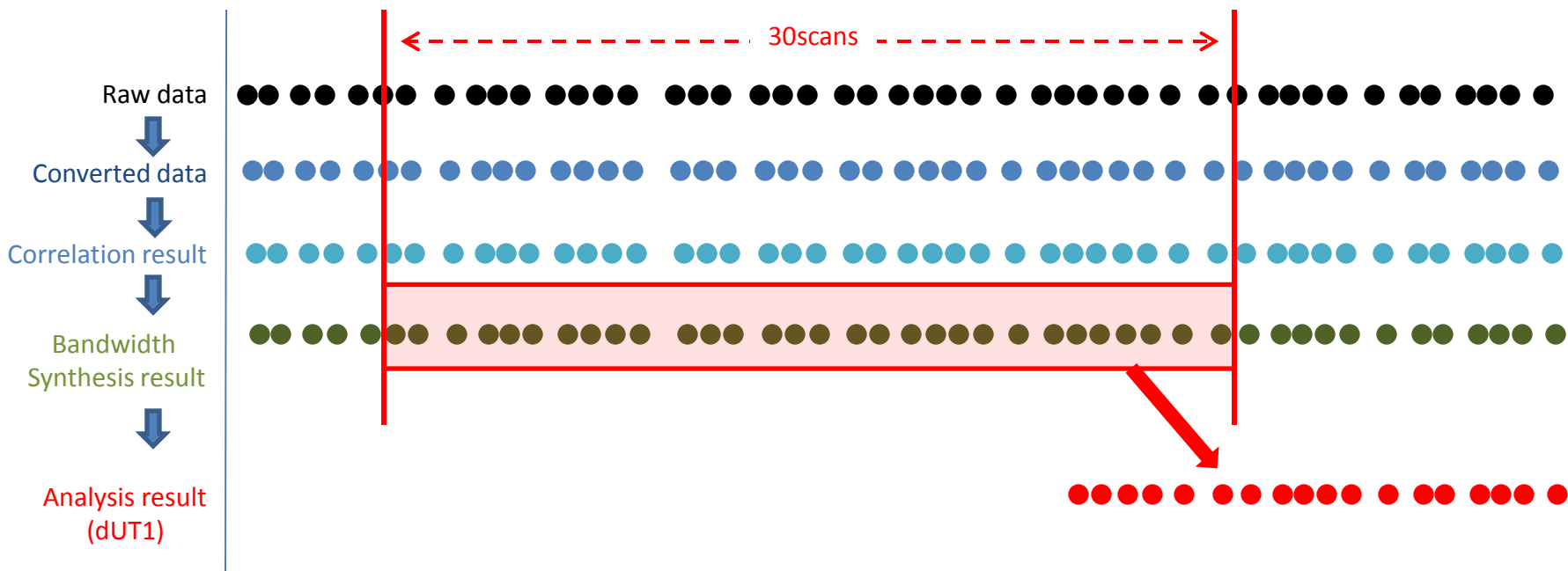
The analysis is done every scans.

The data of **30 scans** before the latest scan are analyzed on each analysis.

Analysis method (30 scans slide window mode)

Session start

00:00



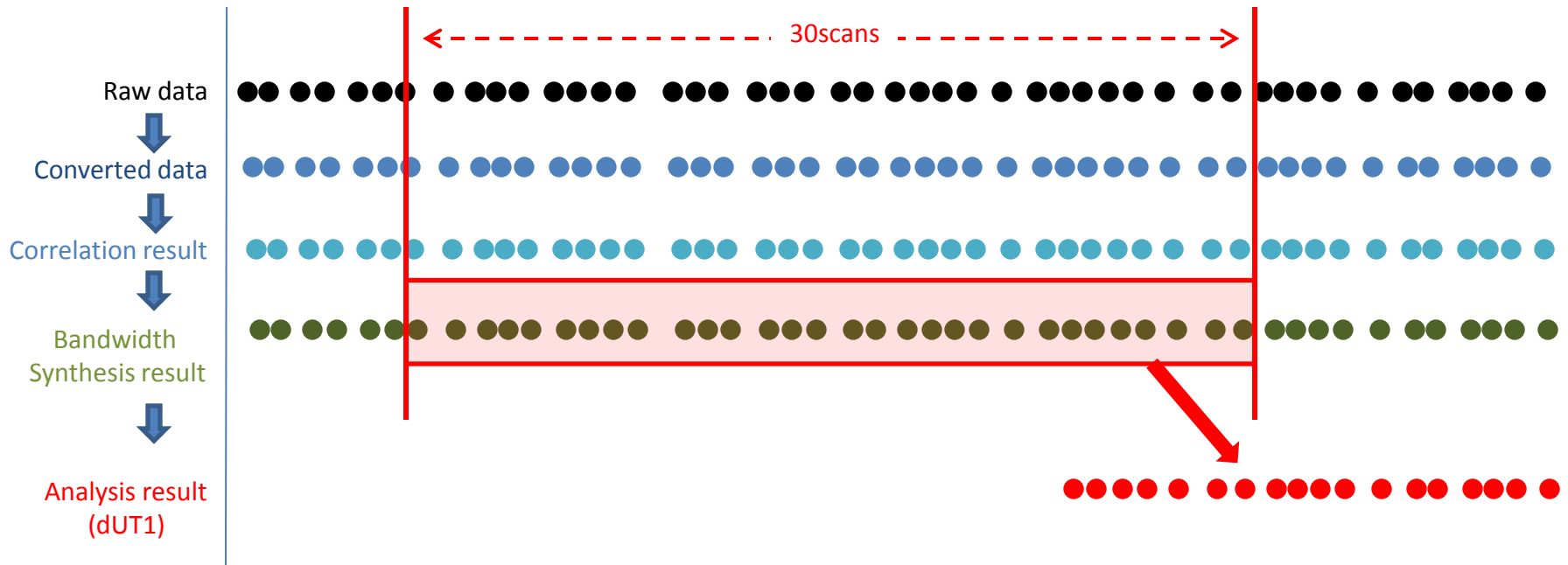
The analysis is done every scans.

The data of **30 scans** before the latest scan are analyzed on each analysis.

Analysis method (30 scans slide window mode)

Session start

00:00



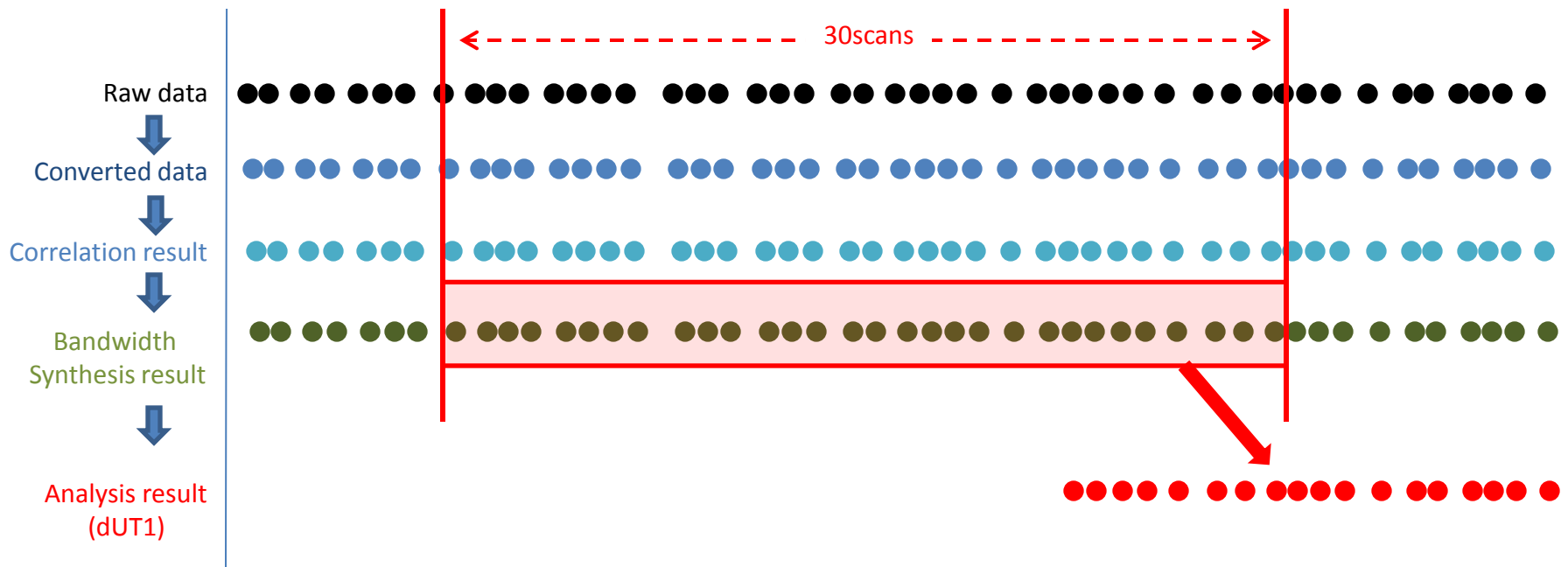
The analysis is done every scans.

The data of **30 scans** before the latest scan are analyzed on each analysis.

Analysis method (30 scans slide window mode)

Session start

00:00



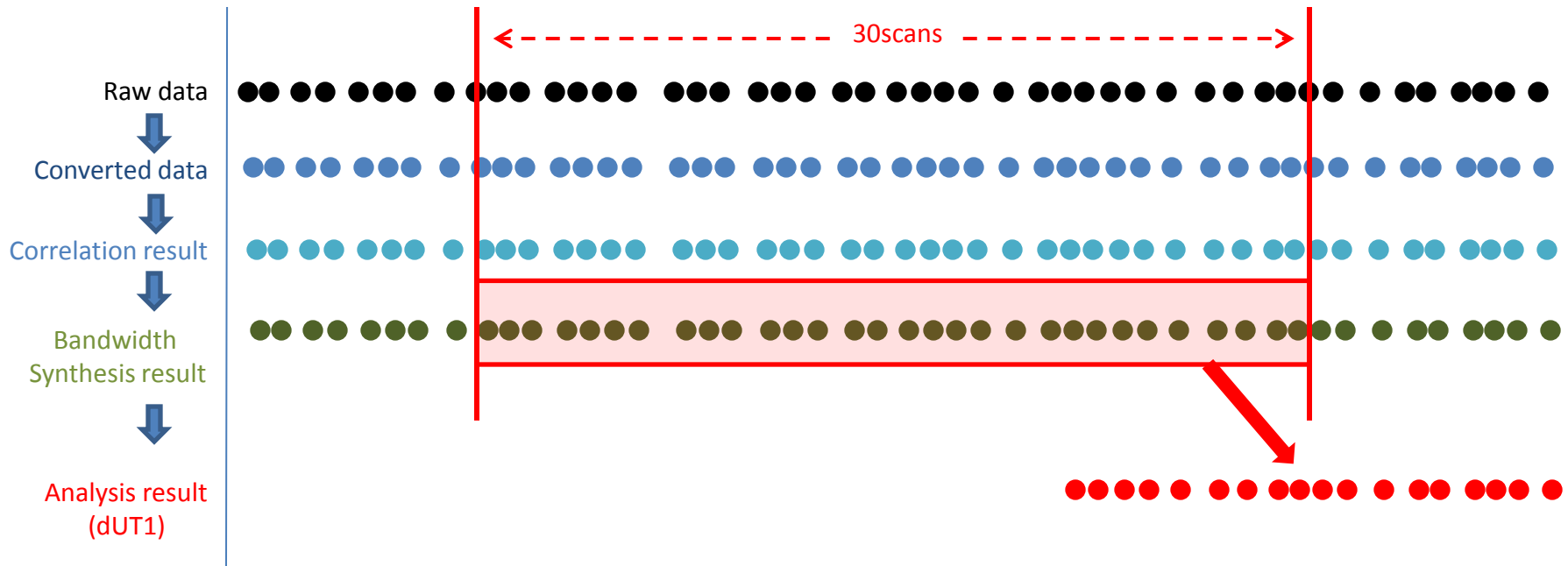
The analysis is done every scans.

The data of **30 scans** before the latest scan are analyzed on each analysis.

Analysis method (30 scans slide window mode)

Session start

00:00



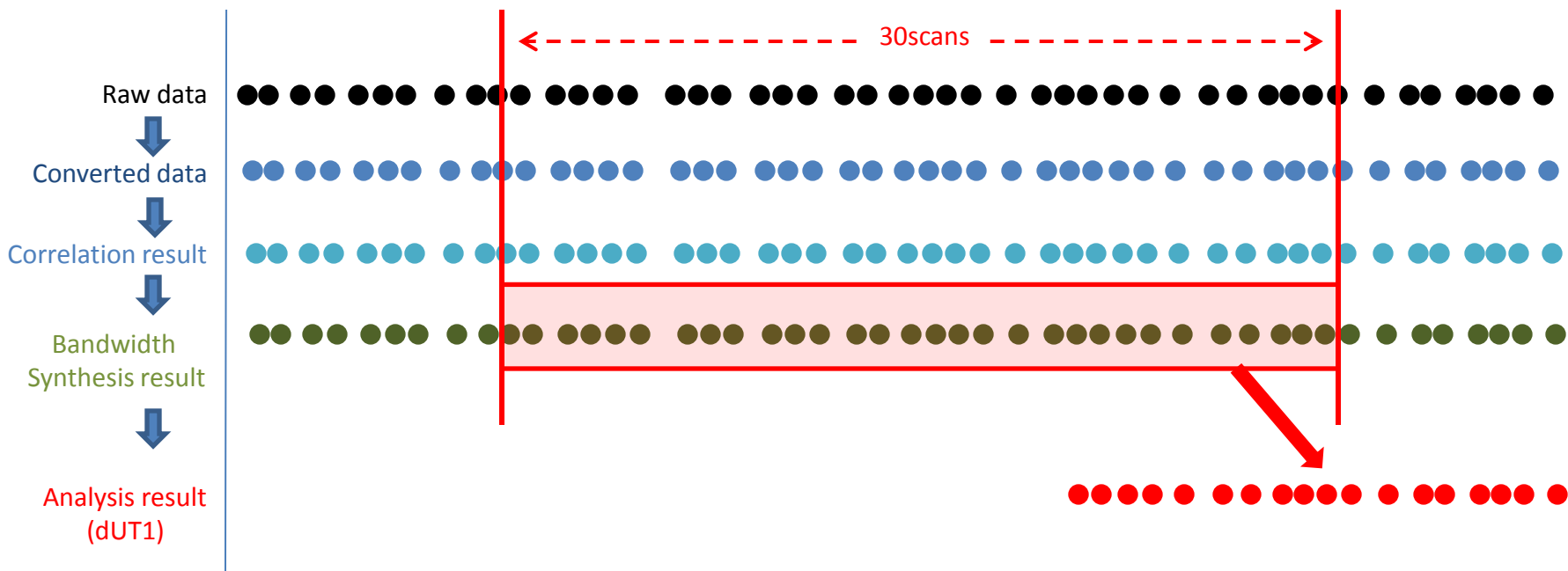
The analysis is done every scans.

The data of **30 scans** before the latest scan are analyzed on each analysis.

Analysis method (30 scans slide window mode)

Session start

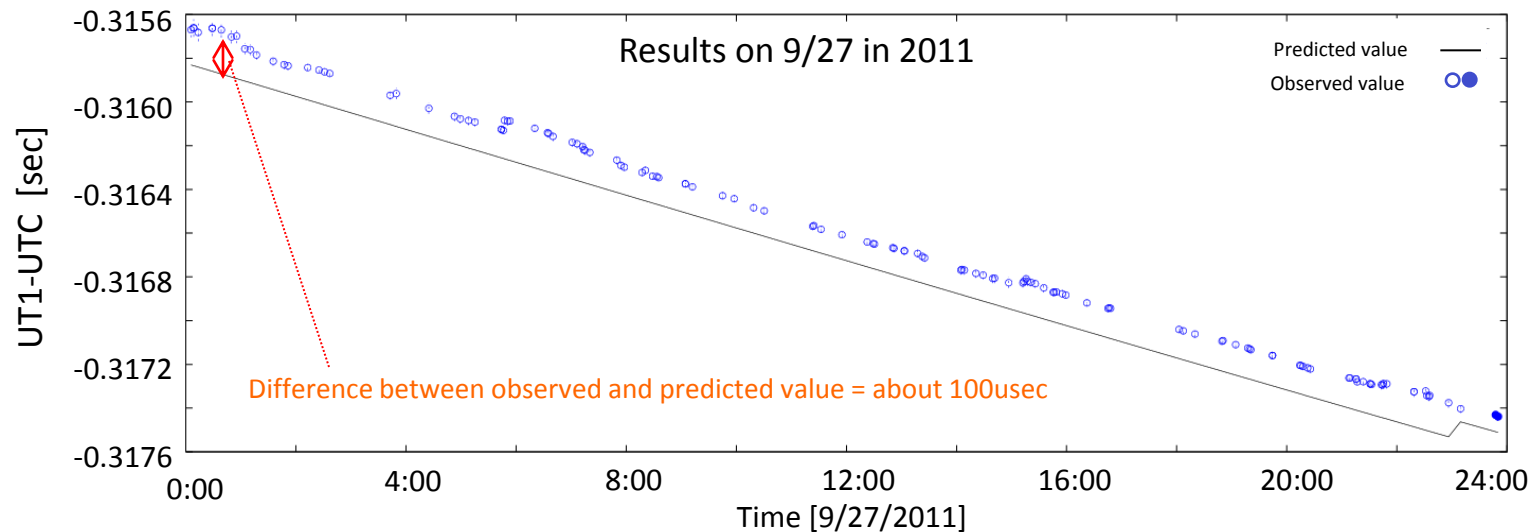
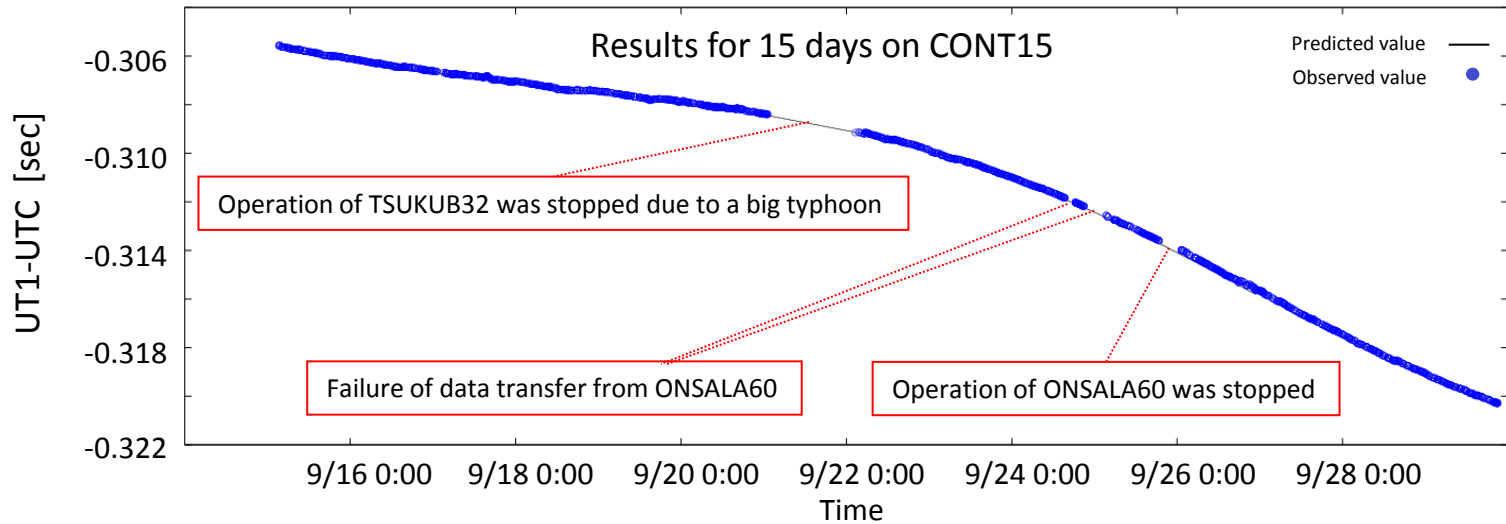
00:00



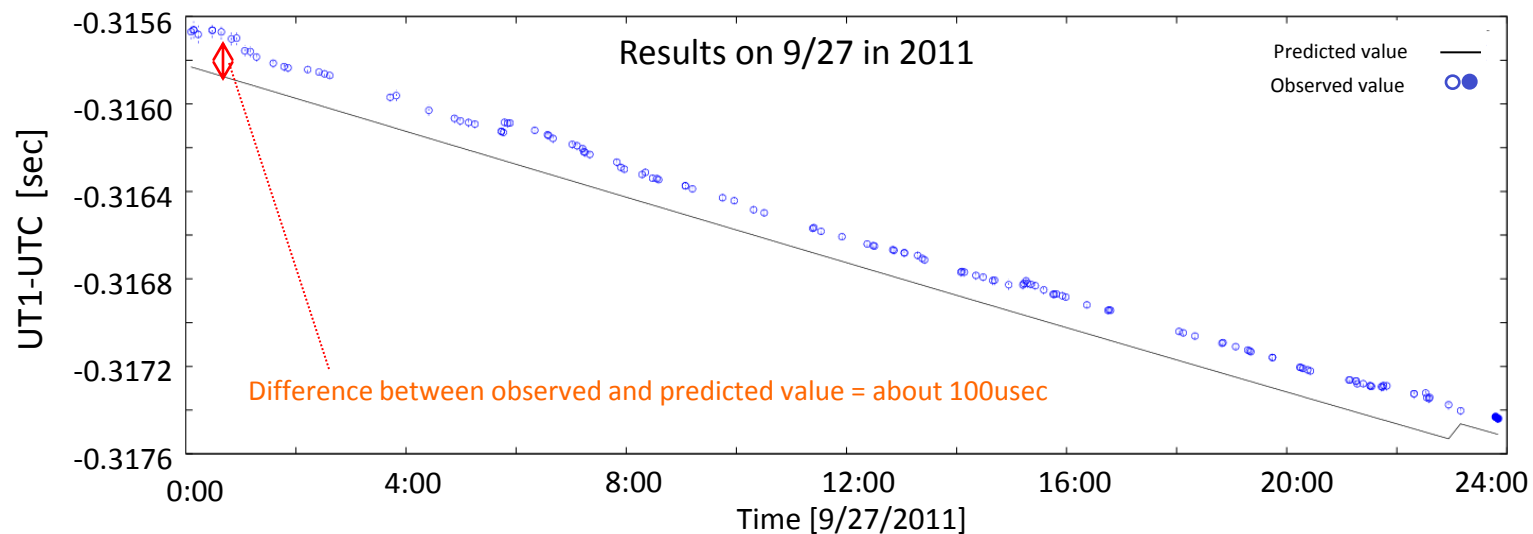
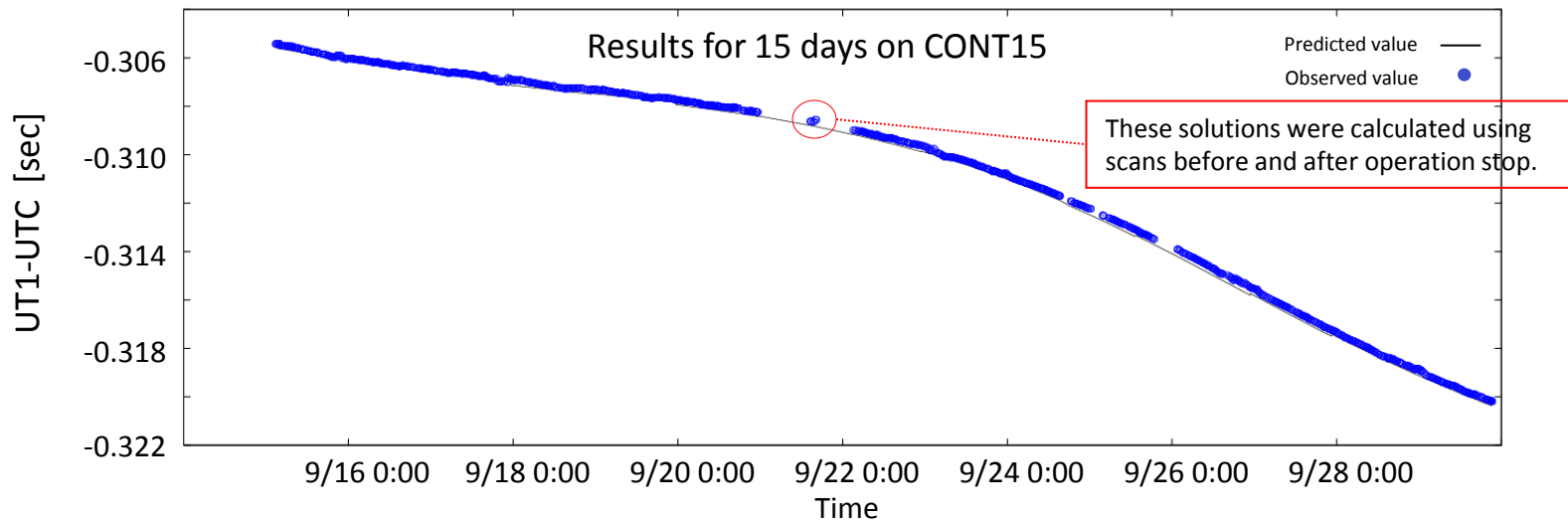
The analysis is done every scans.

The data of **30 scans** before the latest scan are analyzed on each analysis.

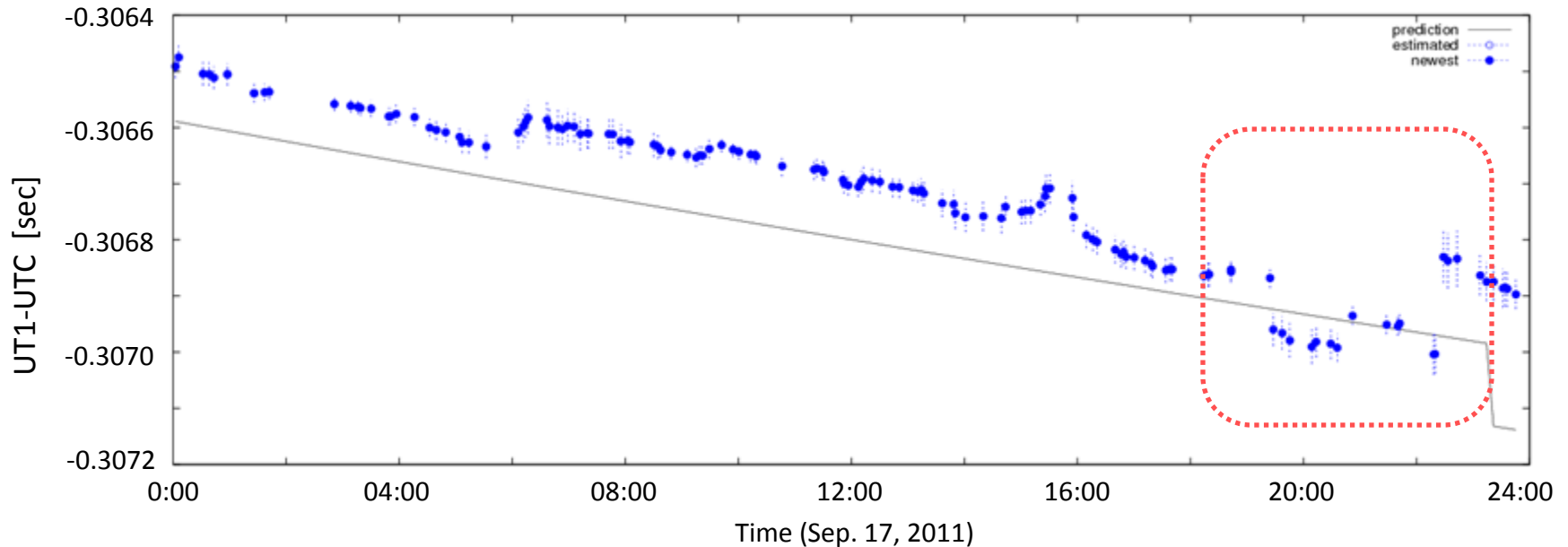
dUT1 results (6 hours mode)



dUT1 results (30 scans mode)



Problem of analysis with 30 scans mode



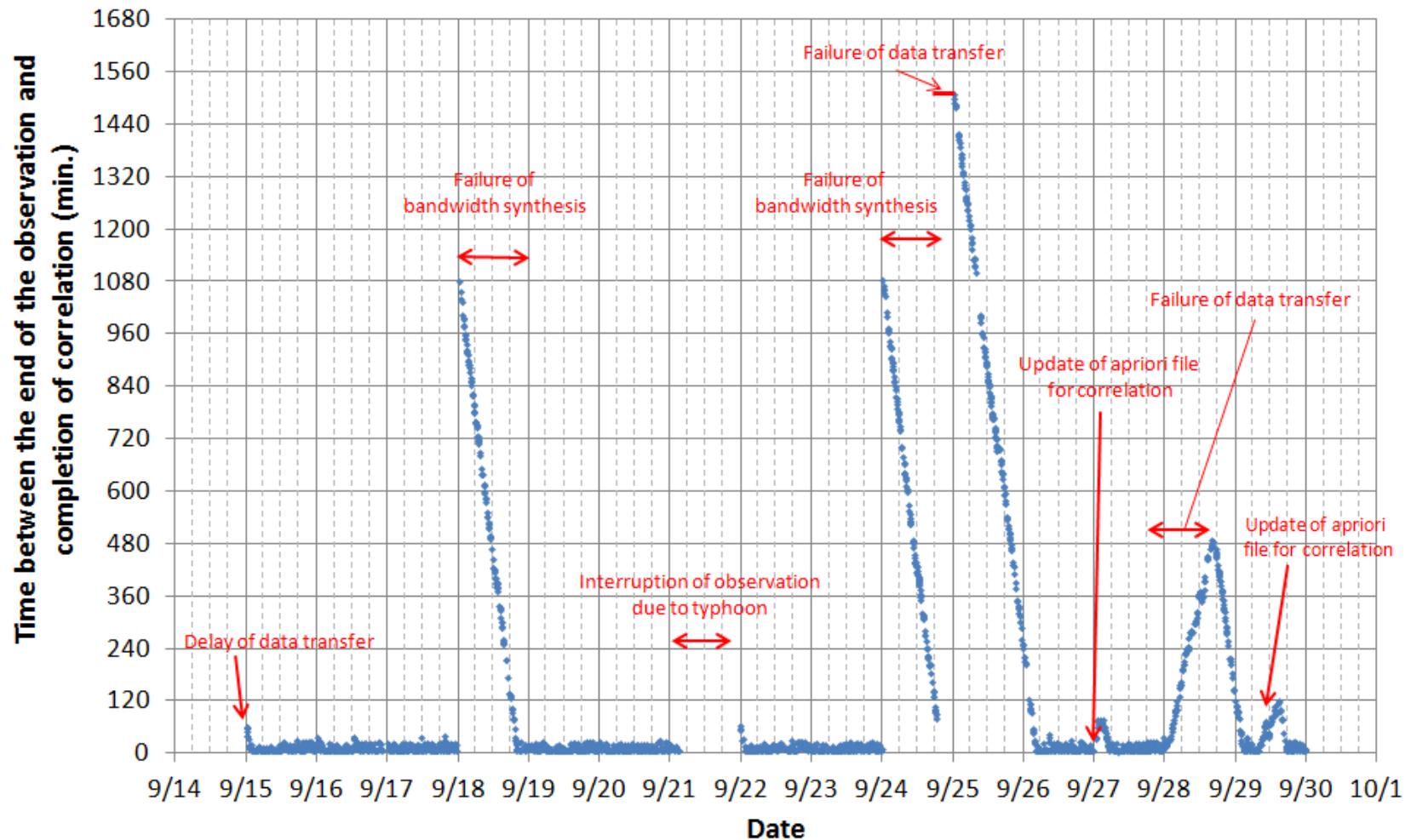
When the wrong scan is included in the analysis, the solution is not stable.



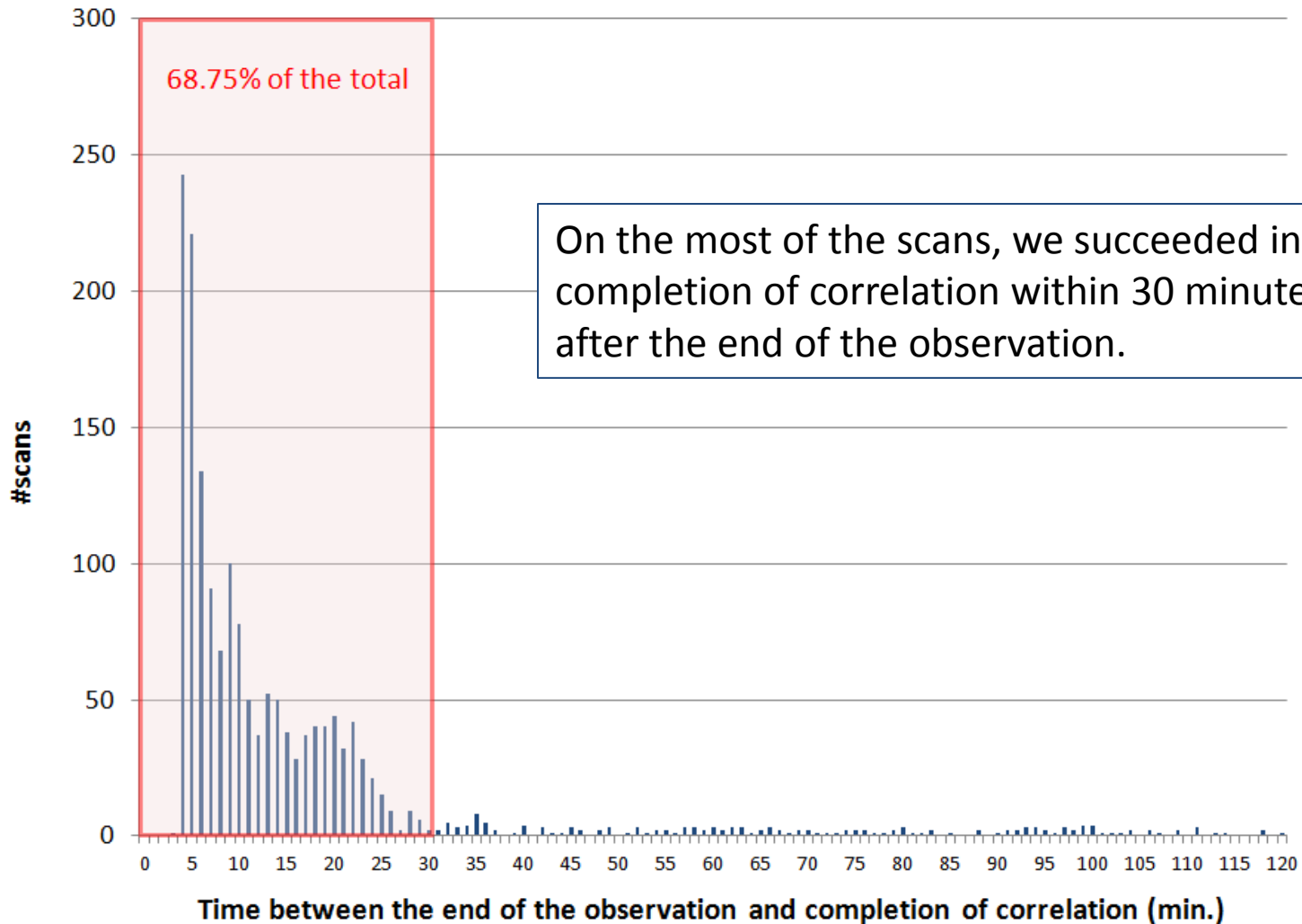
We have to add a new function to remove wrong scan on the analysis program.

Processing time

Analysis latency of each scan

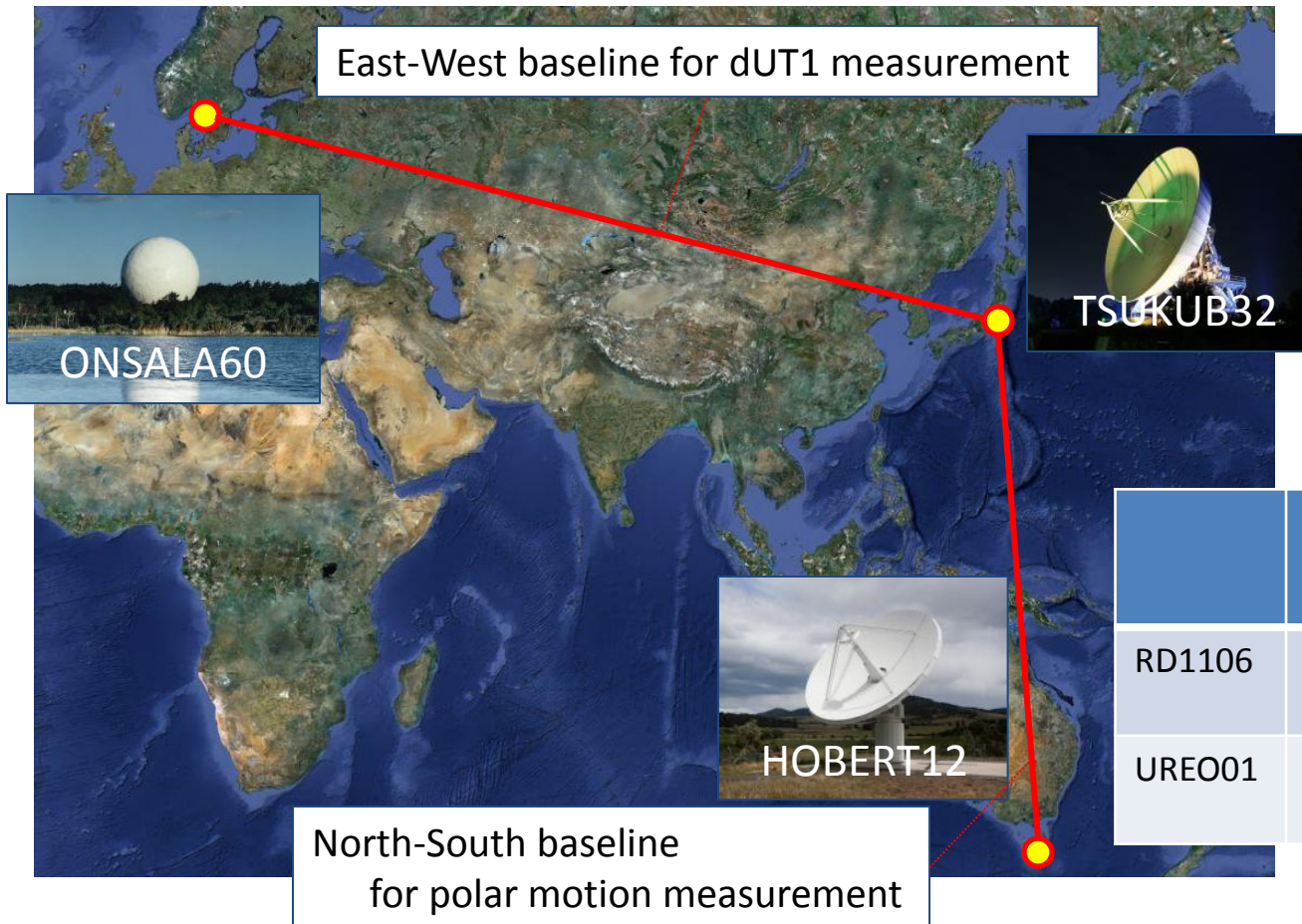


Processing time



Ultra-rapid EOP measurement

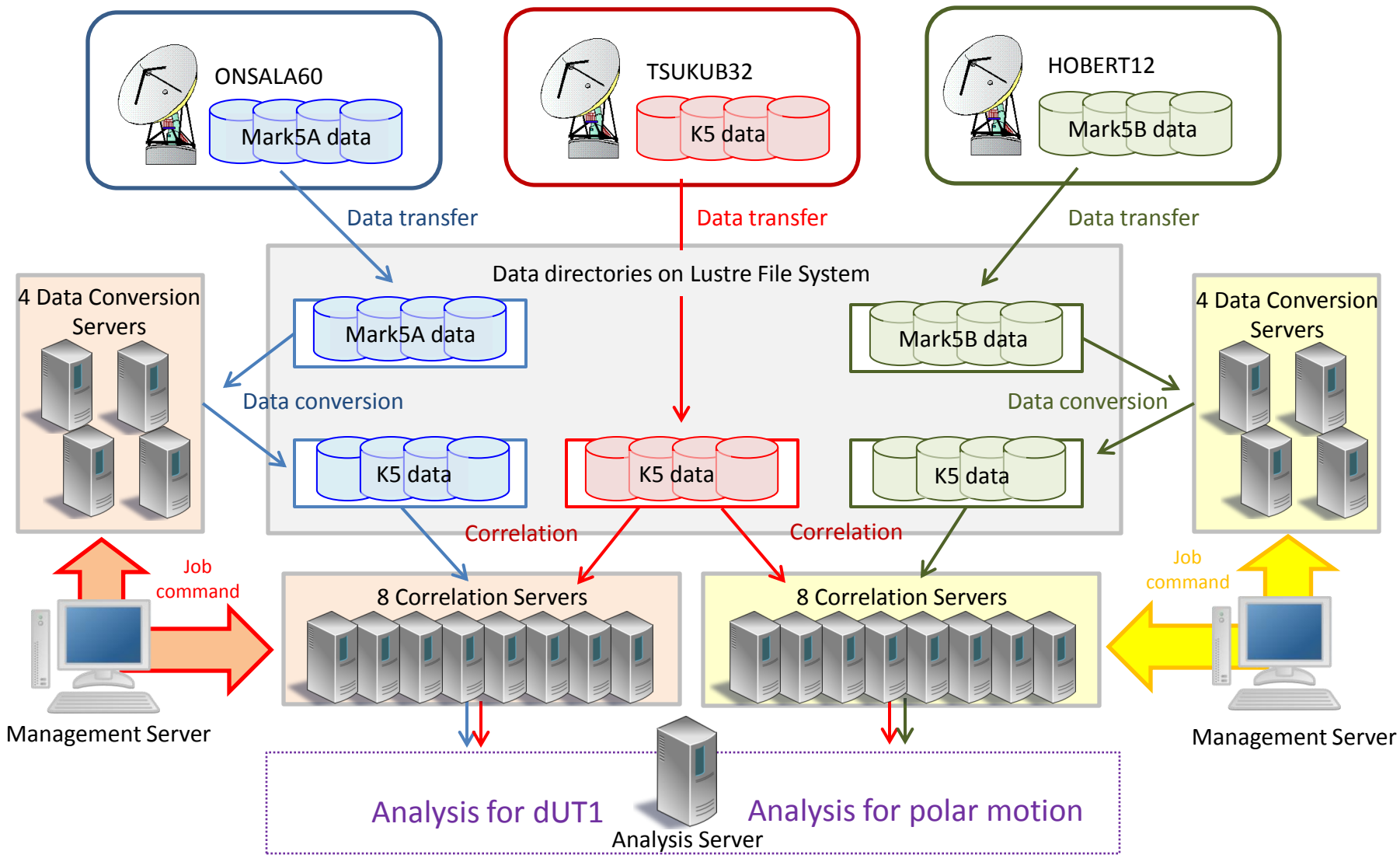
The experiments for ultra-rapid EOP measurement were implemented on HOBERT12, ONSALA60 and TSUKUB32 stations.



The 1st experiment was implemented on RD1106, and the 2nd was a special session optimized for EOP measurement.

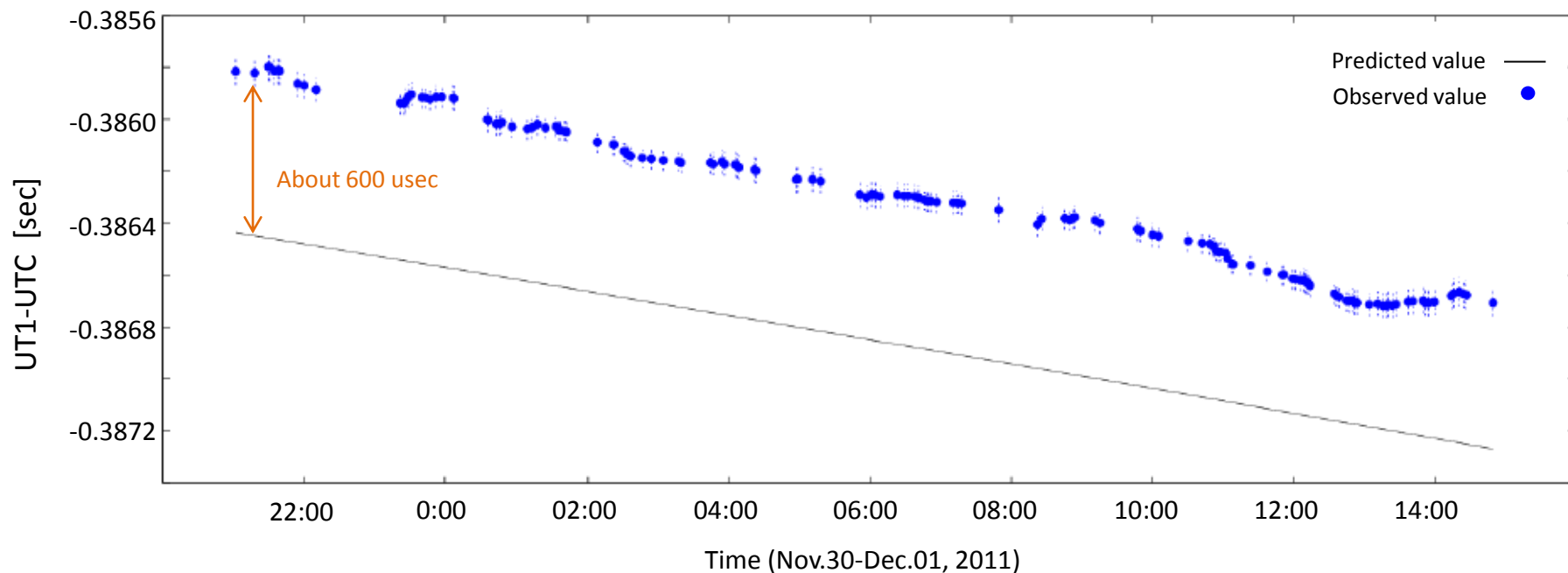
	Date	#Scan (Ts-On)	#Scan (Ts-Hb)
RD1106	Nov. 29, 2011	80	67
UREO01	Nov. 30, 2011	254	303

Ultra-rapid EOP measurement

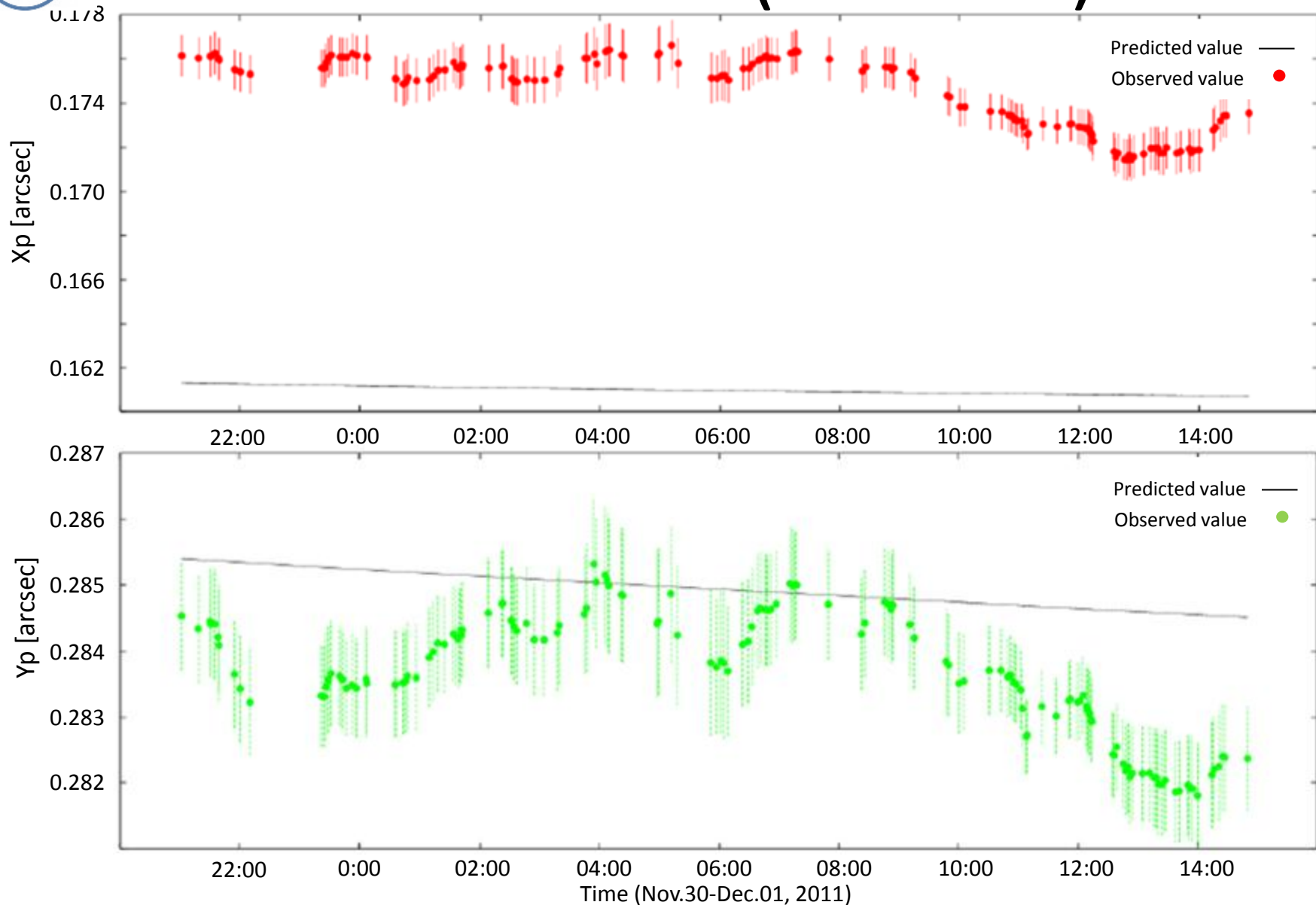


dUT1 (UREO01)

Although we failed in rapid data transfer from HOBERT12 during the observation, EOP values were obtained within 24 hours after the end of the observation session.



Polar Motion (UREO01)





Future Plan

- Analysis to determine the optimum slide window for each session.
- Ultra-rapid dUT1 measurements on all of the 24-hour sessions which includes ONSALA60 and TSUKUB32 stations.
 - The solutions will be put on IVS data center.
- We want to succeed in obtaining EOP values during the observation session.
 - Next experiments with ONSALA60 and HOBERT12 are planed in 2012.

Acknowledgments

Thank you for all of your support

- **The member of NICT, Japan**

Development of Analysis program “C5++”

Advice for the analysis of the ultra-rapid sessions

- **The member of Onsala and Hobert stations**

Cooperation in the Ultra-rapid sessions



Thank you for your attention!