

Current Status of Software Correlators Developed at Kashima Space Research Center

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History of XF-type Software Correlators

- 1960's : Mark-I
 - 144Mbits (720kHz sampling × 200sec) Processing (15-lag correlation) => 90 minutes (IBM360/50) **26.7kbps**
- 1980's : CCC* (developed by Kashima Group)
 - 16Mbits (4MHz sampling × 4sec) Processing (64-lag correlation) => 150 minutes (HP1000/A900) **1.8kbps**

Soft correlator was developed,
but it took time too much

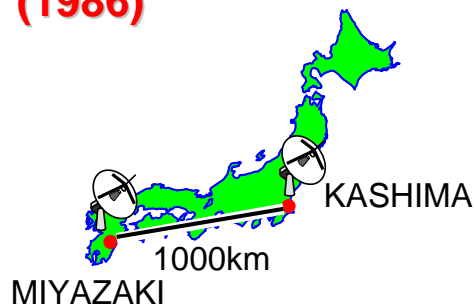
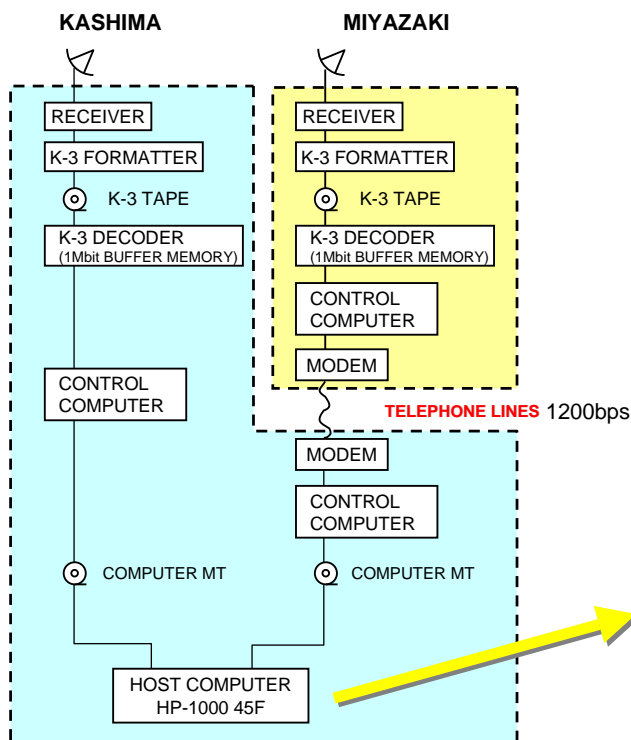


CCC developer

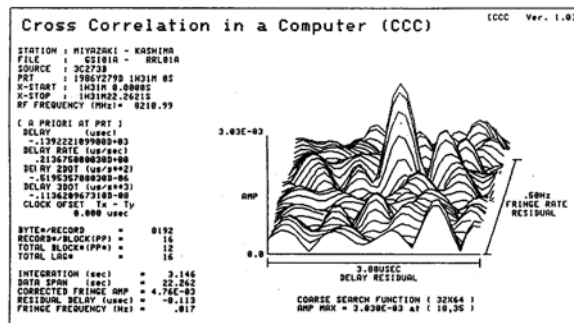
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Historical e-VLBI Experiment using Software Correlator in JAPAN (1986)



It took about **only** 10 hours to get fringes!

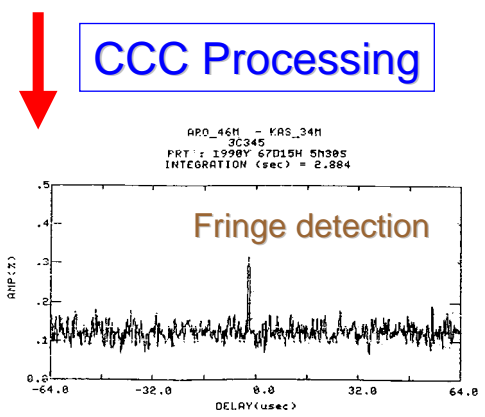


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First Canada-Japan WFC VLBI using Software Correlator (1990)



CCC was used in the first Canada-Japan Wave Front Clock VLBI experiment in 1990



on the ARO 46m Dish

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History of XF-type Software Correlators

(continued)

- 2000's : K5 Software Correlator (**Kashima**) developed by
 - 8Mbits (8MHz sampling × 1sec) Processing (32-lag correlation) => 1 sec (PC Pentium4 2GHz) **8Mbps**



K5/VSI Gigabit Software Correlator (**FX-type Kashima**)

- 100 Msamples => 1sec (PC AthlonXP-2500+) **100Mbps**

developed by Kimura-san



Note: K5 (16-ch geodetic VLBI system with PC sampler board)
K5/VSI (Gigabit VLBI system with PC-VSI interface)

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Requirements for a Software Correlator for Geodetic Use

- Compatible with conventional hardware correlators, such as K3, KSP correlators
 - Consistent definitions in delay, clock parameters, etc.
 - Pcal phase detection
 - Check bit slip or make
 - Processing using a schedule file
- Both K5 and Mark-5 data processing

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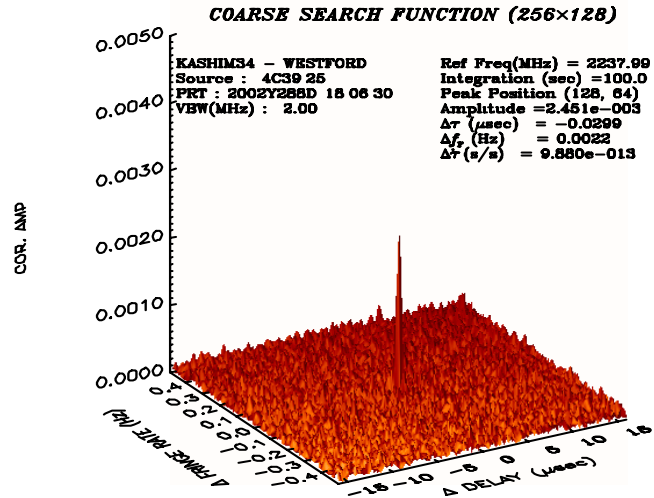
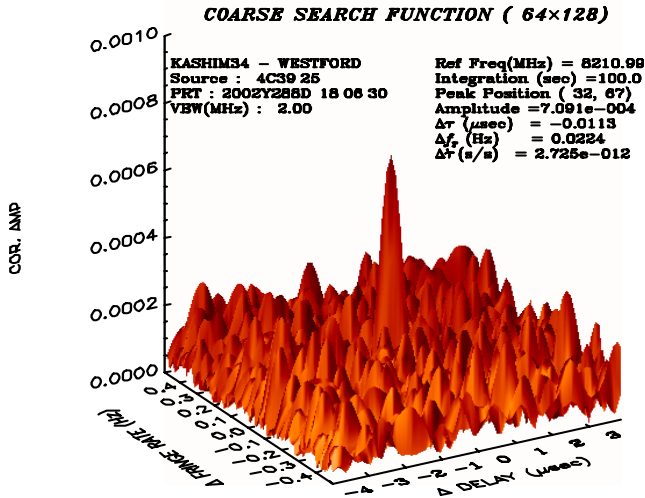
K5 - Mark5 Fringes

Oct. 15, 2002

Kashima - Westford

X band

S band



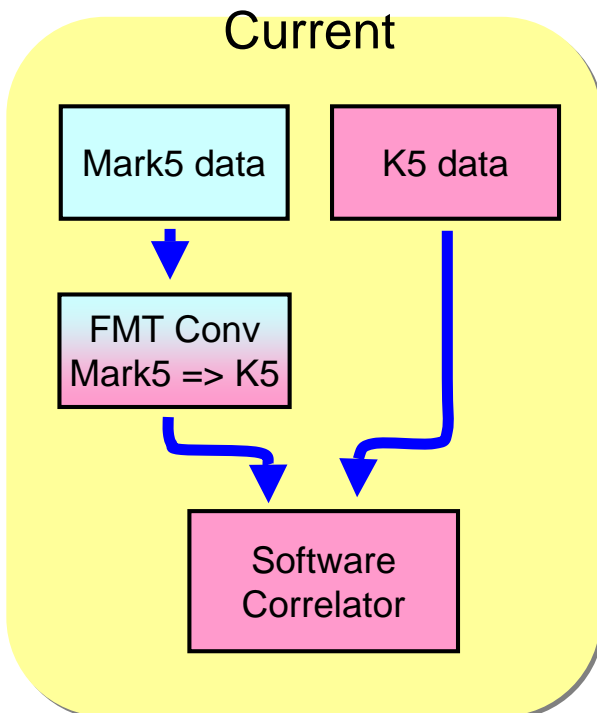
4C39.25

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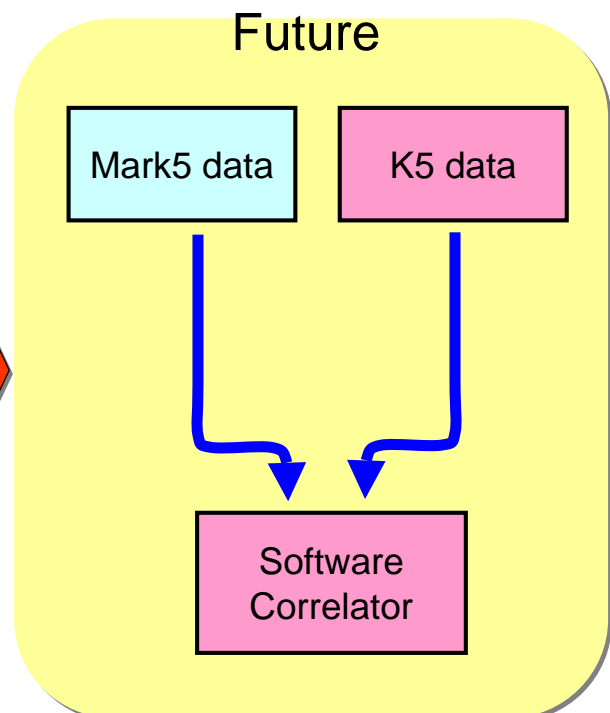


Mixed Raw Data Processing

Current



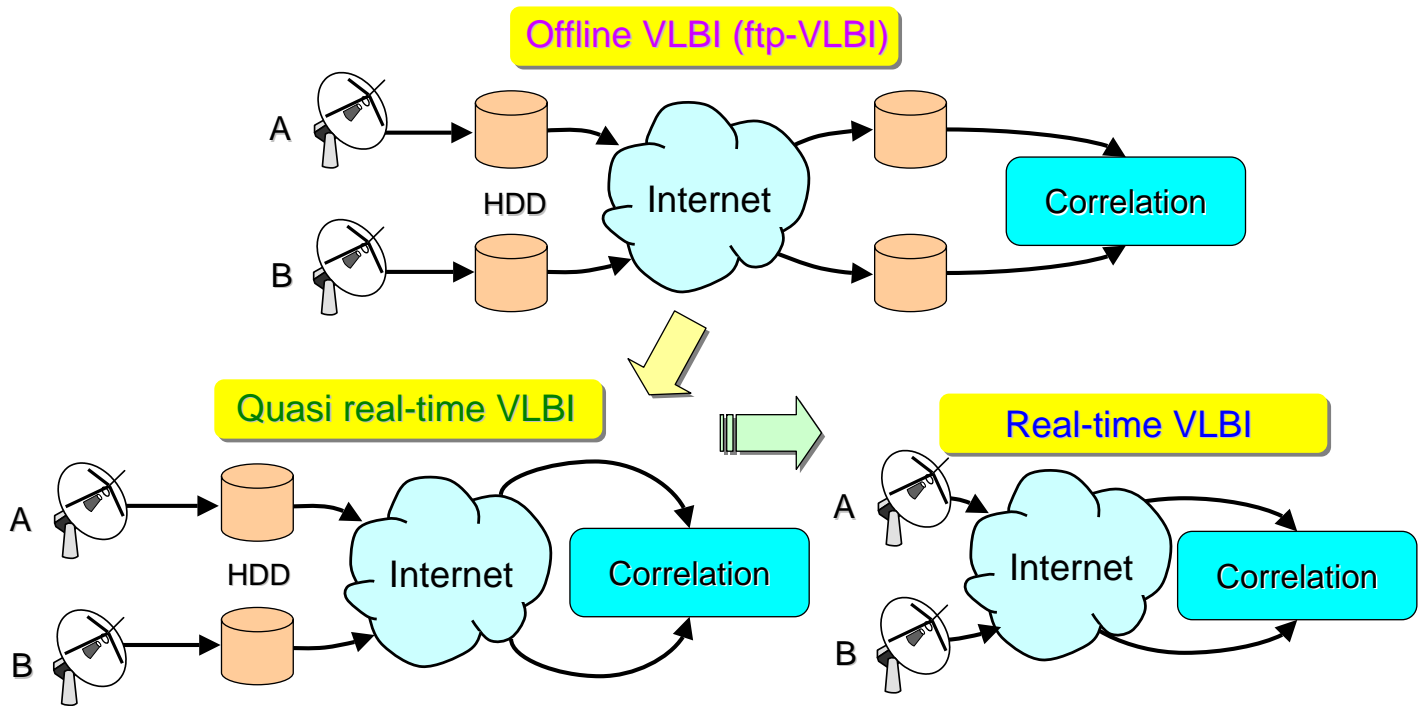
Future



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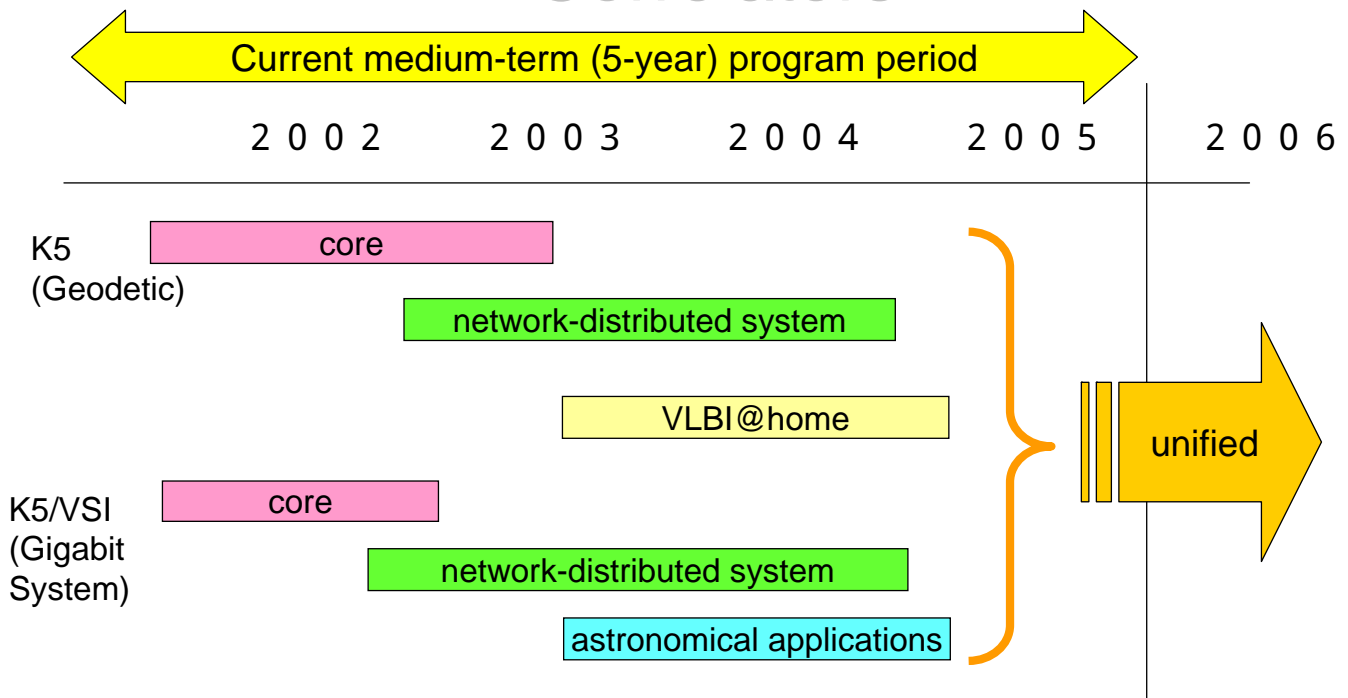
Operation Mode of Internet VLBI (e-VLBI)



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Development Plan of Software Correlators



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Benchmark Test → VLBI@home

ソフト関連器処理速度テスト

Windows(98, 2000, Me, XP)機の相関処理速度ベンチマークテストに協力してください

テスト法 (Windows機用)

testcor.khをダウンロードして適当なディレクトリで解凍してください。サイズは約50MBありますのでご注意ください。

解凍後には以下のようなファイルができます

2003/09/24 17:07	851 ape1870003RHa.txt	4ch処理用予測値ファイル
2003/09/26 03:33	847 ape1870003RHa1.txt	1ch処理用予測値ファイル
2003/09/26 03:49	159,744 cor.exe	高速版相関処理ソフト
2003/09/26 03:52	159,744 fx_cor.exe	FX型相関処理ソフト
2003/09/26 08:07	20,000,840 H1970003.dat	JD0308-08S08豊島1.1m周8MHz,1bitサンプリング,4chデータ(5秒間)
2003/09/26 08:11	4,997,120 H1970003.dat.1	JD0308-08S08豊島1.1m周8MHz,1bitサンプリング,1chデータ(5秒間)
2003/09/18 14:00	595,968 pcview.exe	フリーソフト(PC情報取得)
2003/09/26 08:32	20,000,840 R1970003.dat	JD0308-08S08豊島1.1m周8MHz,1bitサンプリング,4chデータ(5秒間)
2003/09/26 08:15	4,997,120 R1970003.dat.1	JD0308-08S08豊島1.1m周8MHz,1bitサンプリング,1chデータ(5秒間)
2003/09/26 11:11	822 test.bat	バッチファイル
2003/09/26 11:06	787 test0.bat	Cドライブから読み込んで処理をするためのバッチファイル

test.batができませんのでMSDOSモードでこのバッチファイルを実行してください。(explorerからtest.batをダブルクリックで動くはずですが、それが駄目なときはMSDOSプロンプトからの実行をお願いします。)

現在のテスト項目は、高速版相関処理(cor)での1ch処理時間計測と4ch処理時間計測のみです。テスト中はなるべく他の負荷を減らしてください。計測は数分で終了します。

途中で「コマンドまたはファイル名が違います」というメッセージが出る場合がありますが無視してください

4ch処理終了後、CPUの情報を得るために、PCVIEWというフリーソフトウェアを起動しますが、Win98, Win2000では動作確認済みです。WinXPでも問題ないと思います。PCVIEWが起動すると別ウィンドウが開きます。そこで「CPU」タグをクリックすると以下のようにCPUの情報が得られます。「CPU一般名」および「CPU動作クロック」をメモしてください。

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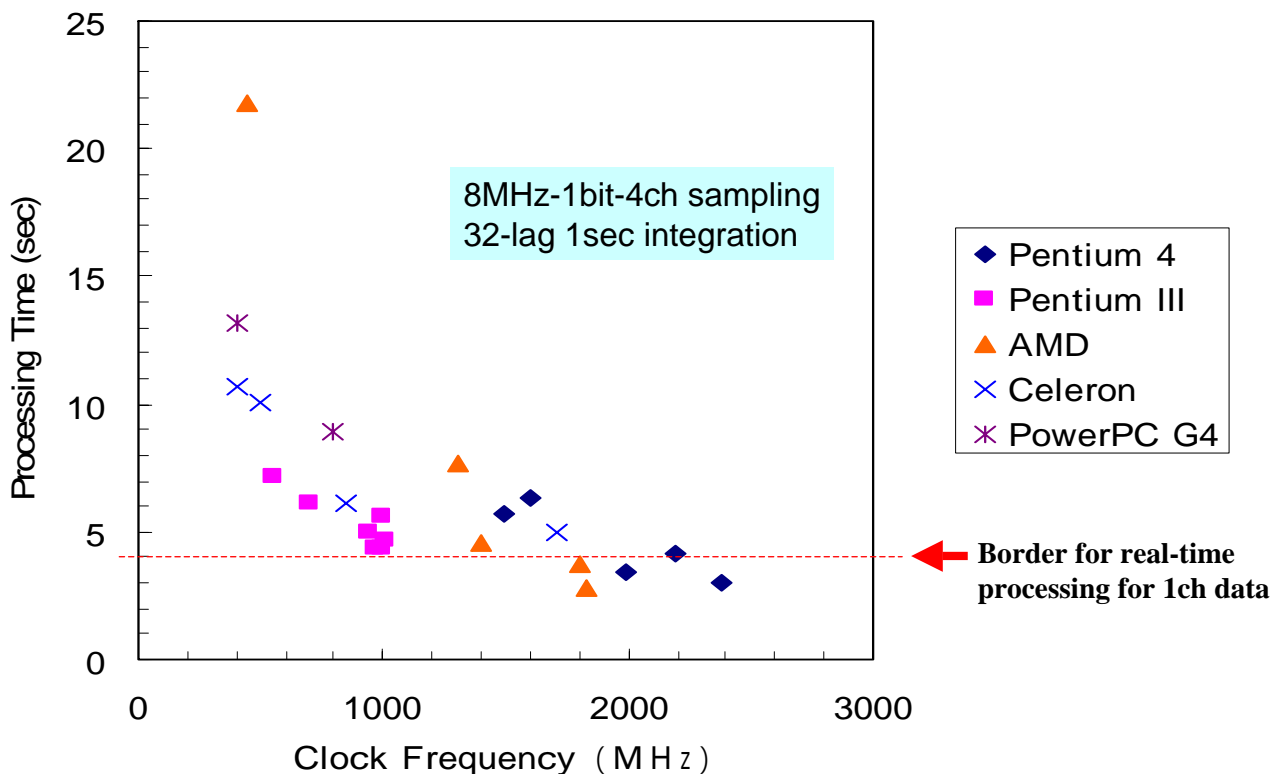
Examples of Benchmark Test Results

処理速度テスト結果(2003/11/11現在)

順位	CPU	クロック周波数(MHz)	OS	1ch処理(秒)	4ch処理(秒)	測定者	備考
1	Intel(R) Xeon(TM)	3065.84	Windows	0.734	2.781	H.T.	
2	AMD AthlonXP-2500+	1833	Windows	0.781	2.782	M.K.	M.K.自宅PC
3	Pentium 4	2539.1	Win XP	0.797	2.953	GSI S.K.	
4	Pentium 4	2386.55	Win XP	0.766	2.969	S.A.	Dell
5	Pentium 4	2539.09	Win XP	0.813	3.047	GSI S.K.	
6	Intel Xeon	2776.41	Win2000 on VMware	0.831	3.064	GSI S.K.	
7	Pentium 4	1993.94	Windows	0.937	3.422	J.N.	
8	Pentium 4	1993.94	Windows	0.938	3.546	GSI K.T.	DELL DIMENSION 8200
9	Pentium 4	2008.89	WinXP	1.000	3.578	GSI S.K.	
10	AMD AthlonXP-2400+	2000.07	WinXP	0.969	3.594	GSI MI	
11	AMD AthlonMP-2200+	1800	Windows	0.922	3.703	M.K.	
12	Pentium 4	2194.60	Windows	1.109	4.156	J.N.	共用PC
13	Pentium III	997.43	Windows	1.250	4.328	RI	
14	Pentium III-M	965.62	WinXP	1.151	4.366	H.O.	ノートPC
15	AMD Opteron-240	1400	Windows	1.188	4.563	M.K.	
16	Pentium III	1002.27	Win2000	1.342	4.657	T.K.	SONY VAIO PCV-RX70K
17	Pentium III	934.99	Win2000	1.432	4.947	T.K.	日通機初期K5
18	Celeron	1703.86	Win2000	1.312	4.968	T.K.	KaRAS制御PC
19	Pentium III	996.77	Windows	1.592	5.588	H.K.	
20	Pentium 4	1495.15	WinXP	1.516	5.703	Y.K.	Compaq Evo D300/SF
21	Pentium III-M	844.61	WinXP	1.642	5.708	GSI S.K.	ノートPC(VAIO)
22	Celeron	851.51	Windows	1.732	6.139	RI	RI自宅PC
23	Pentium III	701.59	Windows	1.802	6.159	H.T.	
24	Pentium 4	1600	Windows	1.641	6.344	M.K.	M.K.自宅PC
25	Pentium III	696.41	Win2000	1.903	6.509	GSI MI	
26	Pentium III	551.18	Windows	2.140	7.187	H.O.	
27	AMD Athlon Model 4	1302.3	WinMe	2.030	7.690	Y.K.	Y.K.自宅PC(Compaq Presario)
28	Celeron	500.02	Win98	2.52	8.4	GSI MI	DynabookSS
29	PowerPC G4	800	Mac	3.32	8.93	RI	RI私物(PowerBook G4)
30	Celeron	501.14	Win98	2.690	10.050	J.N.	J.N.自宅PC
31	Celeron	399.92	Win98	3.52	10.71	Y.K.	Toshiba DynaBook SS 3380V
32	PowerPC G4	400	Mac	4.78	13.2	RI	Power Mac G4

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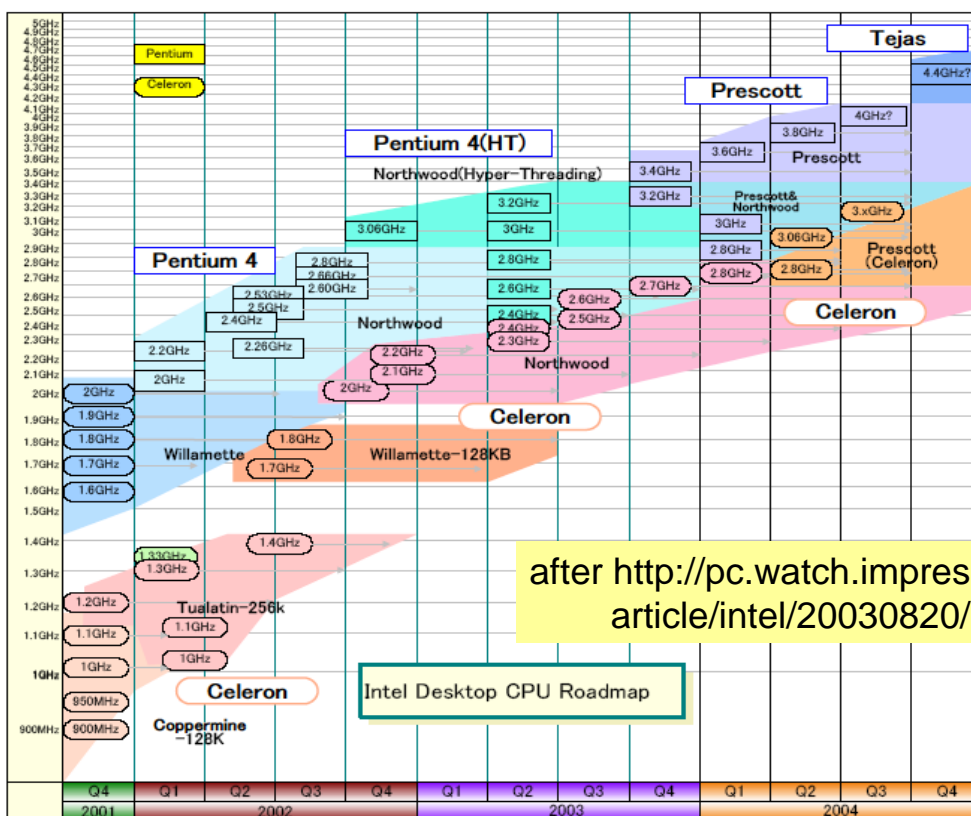
Benchmark Test Results



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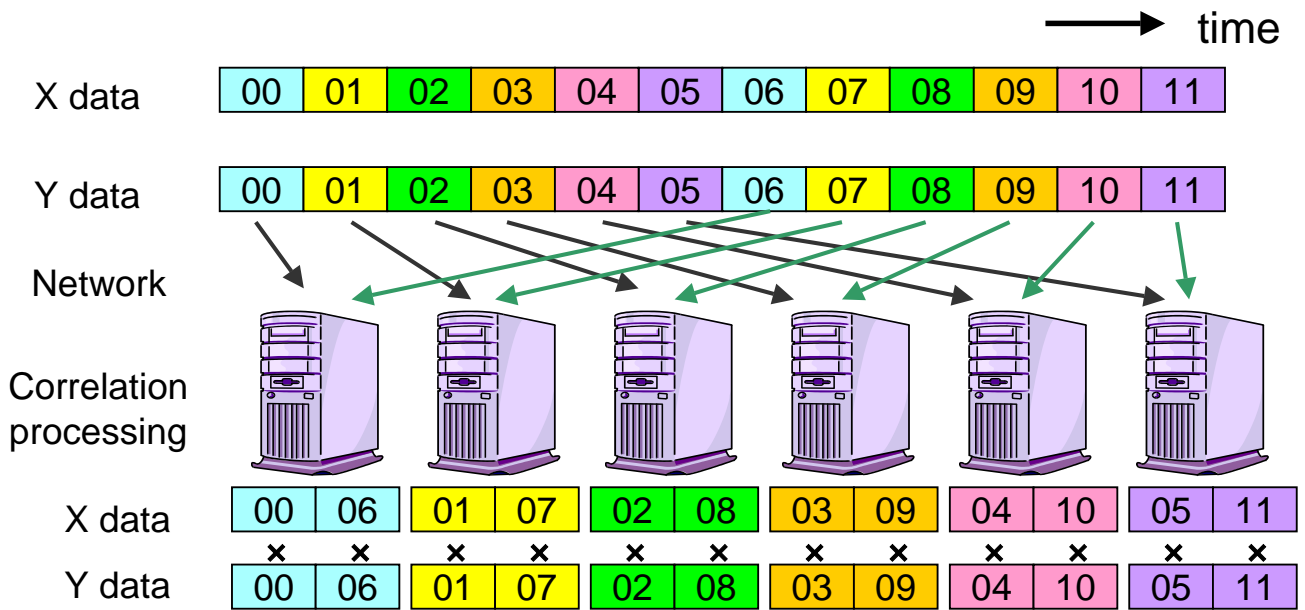
Intel Roadmap



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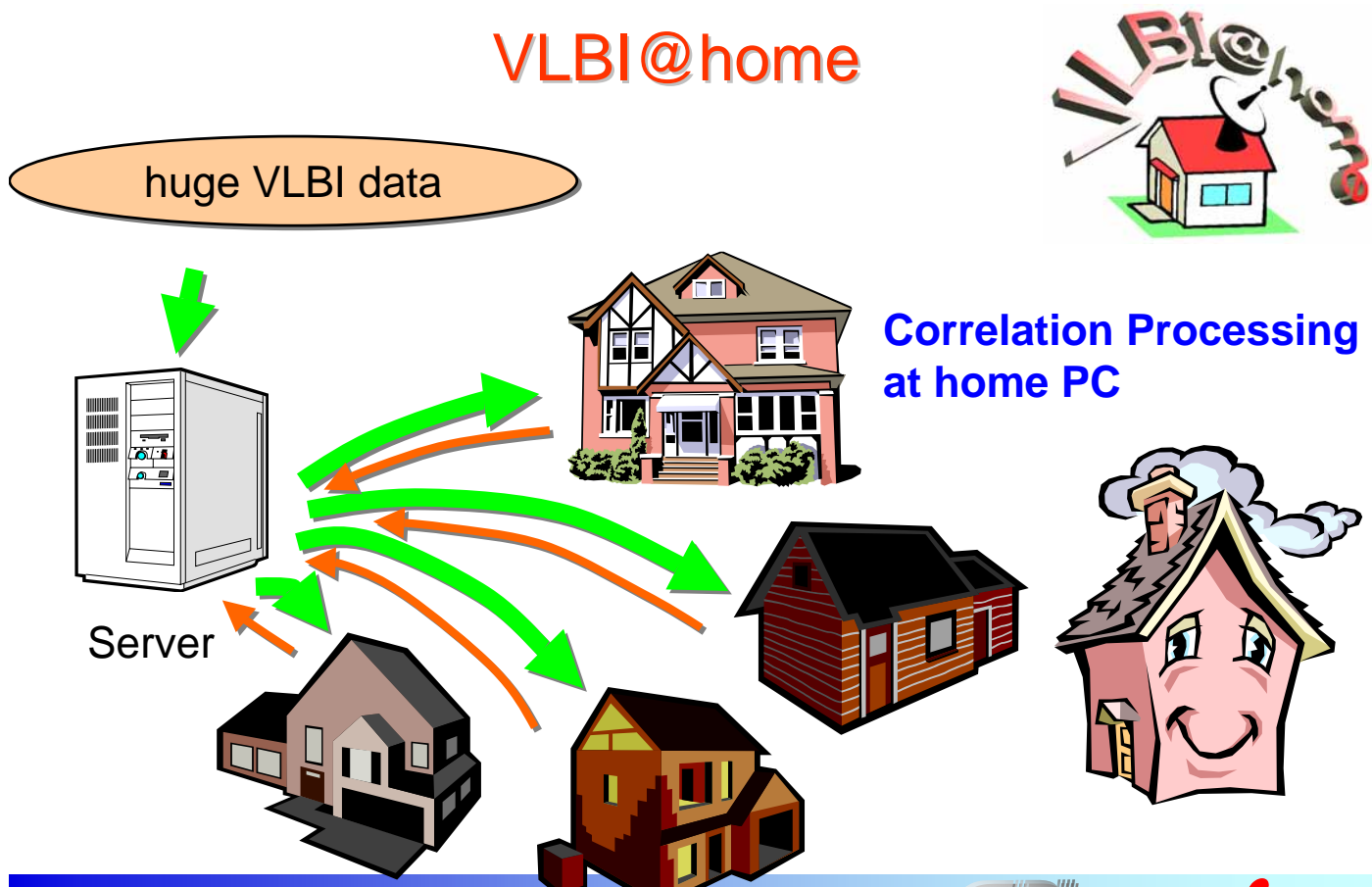
Time-segmented Distributed Correlation Processing



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VLBI@home



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VLBI@home @office

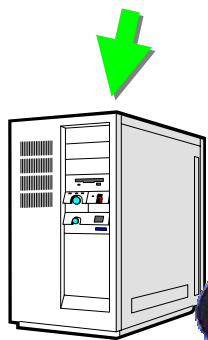
huge VLBI data

time-segmented (e.g. 1sec step) data

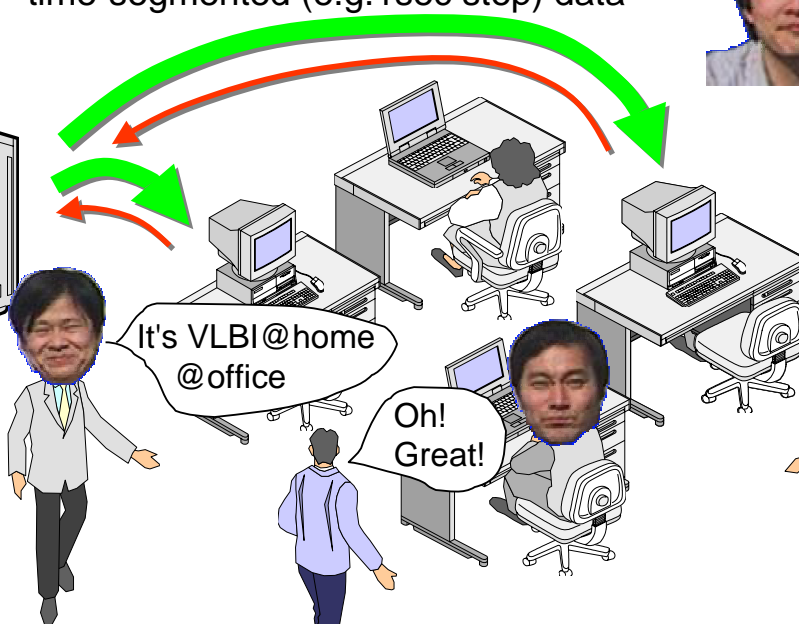
I'm developing
....



Takeuchi-san



Server



Idle PCs
contribute data
correlation

It's VLBI@home
@office

Oh!
Great!

How about
VLBI@home
at your office!

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Summary

- Software Correlator for geodetic use can process 10 Mbps data in real-time at present time.

Note: Ultra High-Speed Software Correlator developed by Kimura for K5/VSI has a processing speed faster ten or more times (100MSPS data in real-time)

Near Future Plans

- Network distributed processing (VLBI@home)
- Real-time Internet VLBI



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