Current Status of K5 Software Correlator

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Correlator Types

XF type

Time-series signal

Time-series signal

Multiplier → Time→Frequency →

FX type

Time-series signal → Time→Frequency

Time-series signal → Time→Frequency

Multiplier →

History of Processing Speed of Software Correlator (XF type)

YEAR	Processing condition						Processing Time	
	data rate (Mbps)	lags	integ-ration (sec)	total data (Mbits)	computer (CPU)	remarks	total	per sample lag
1967	0.72	15	200	144	IBM 360/50	Mark-I	90 minutes	2.5 usec
1977	4	36	1/60	0.067	NEAC-3100	K1	10 minutes	250 usec
1986	4	64	4	16	HP1000/45F	K3, CCC	8 hours	28 usec
1991	4	64	4	16	HP1000/A900	K3, CCC	2.6 hours	9 usec
2003	32	32	1	32	Pentium III 1GHz	K5, cor	4.56 sec	4.5 nsec
2004	32	32	1	32	AMD Athlon64 3200+	K5, cor	1.89 sec	1.8 nsec

History of Processing Speed (XF-type)
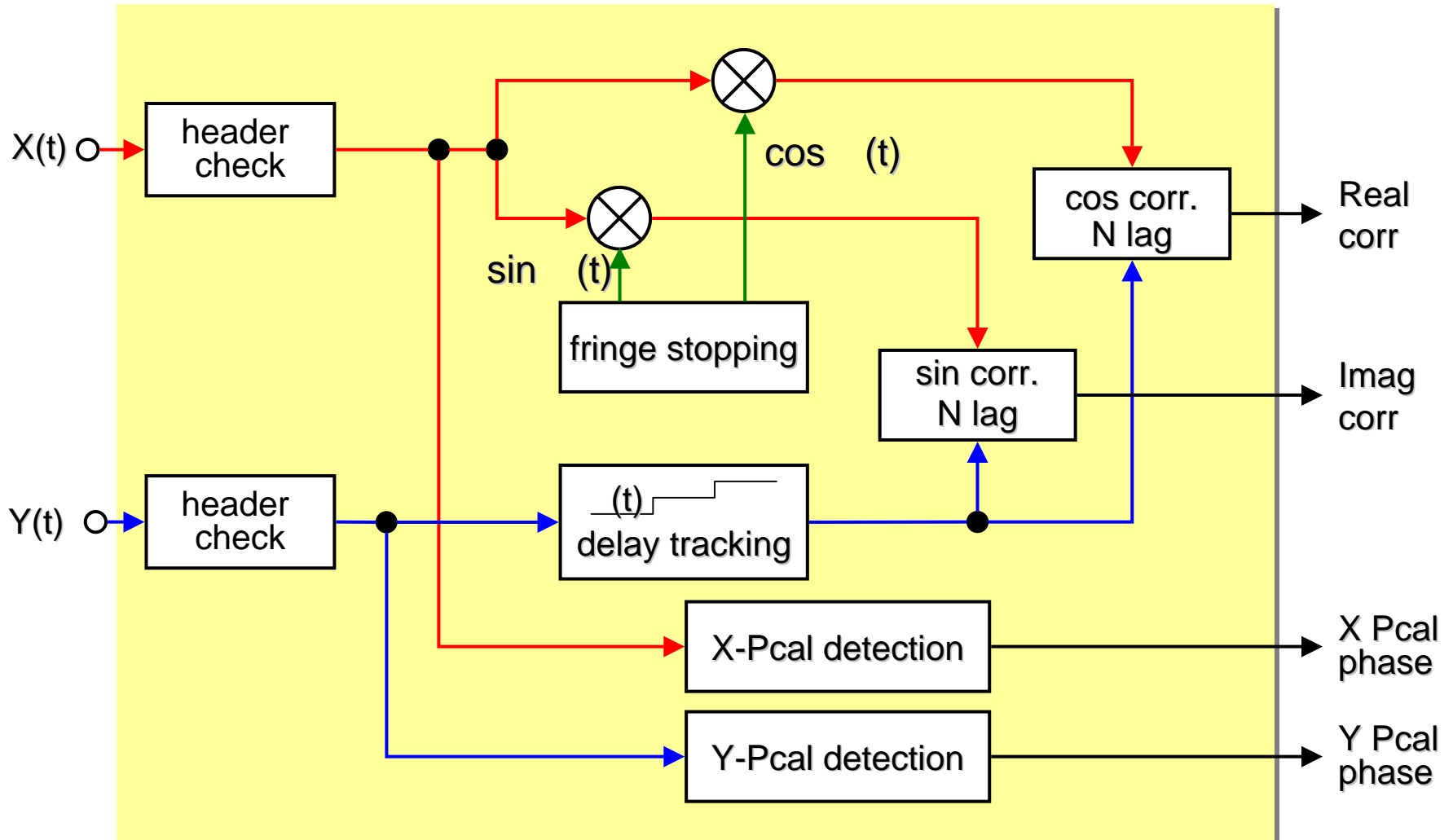## (calculation of 32-lag complex correlation)
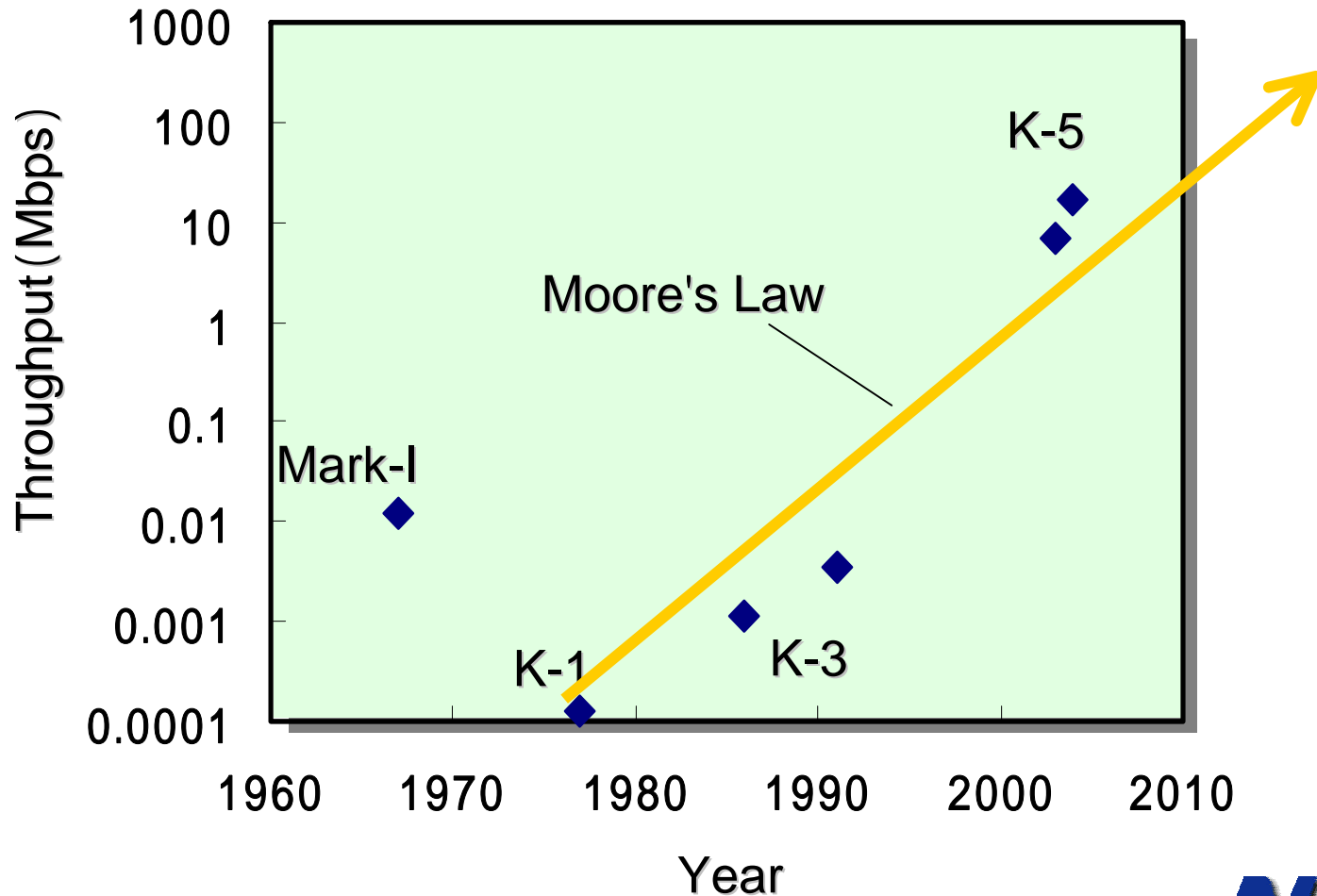
Software Correlator for Geodetic Use (K5-cor)

K5/VSSP

- is compatible with conventional hardware correlators, such as K3, KSP correlators
  - consistent definitions in delay, clock parameters, etc.
  - PCAL phase detection ← time consuming
  - check bit slip or make
- can process both K5 and Mark-5 data
  - using format conversion software at present
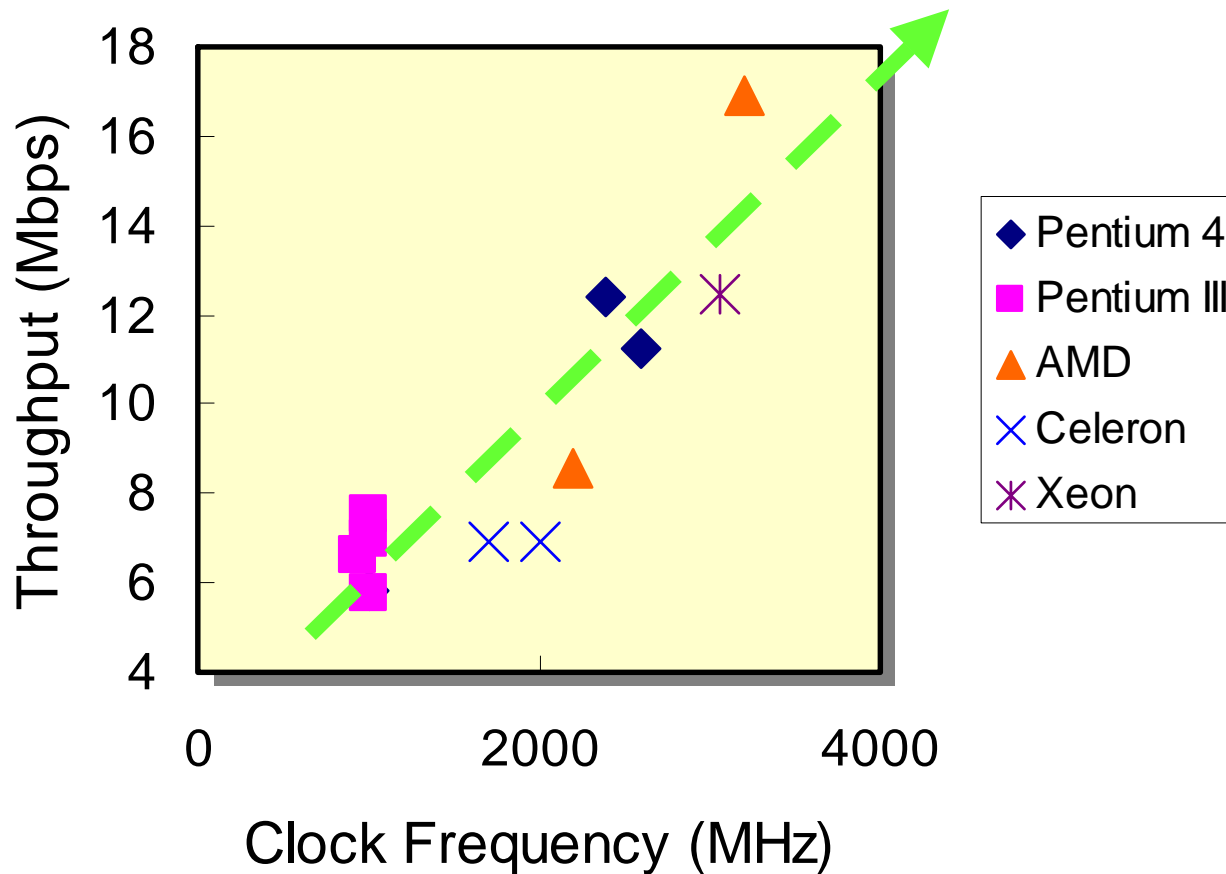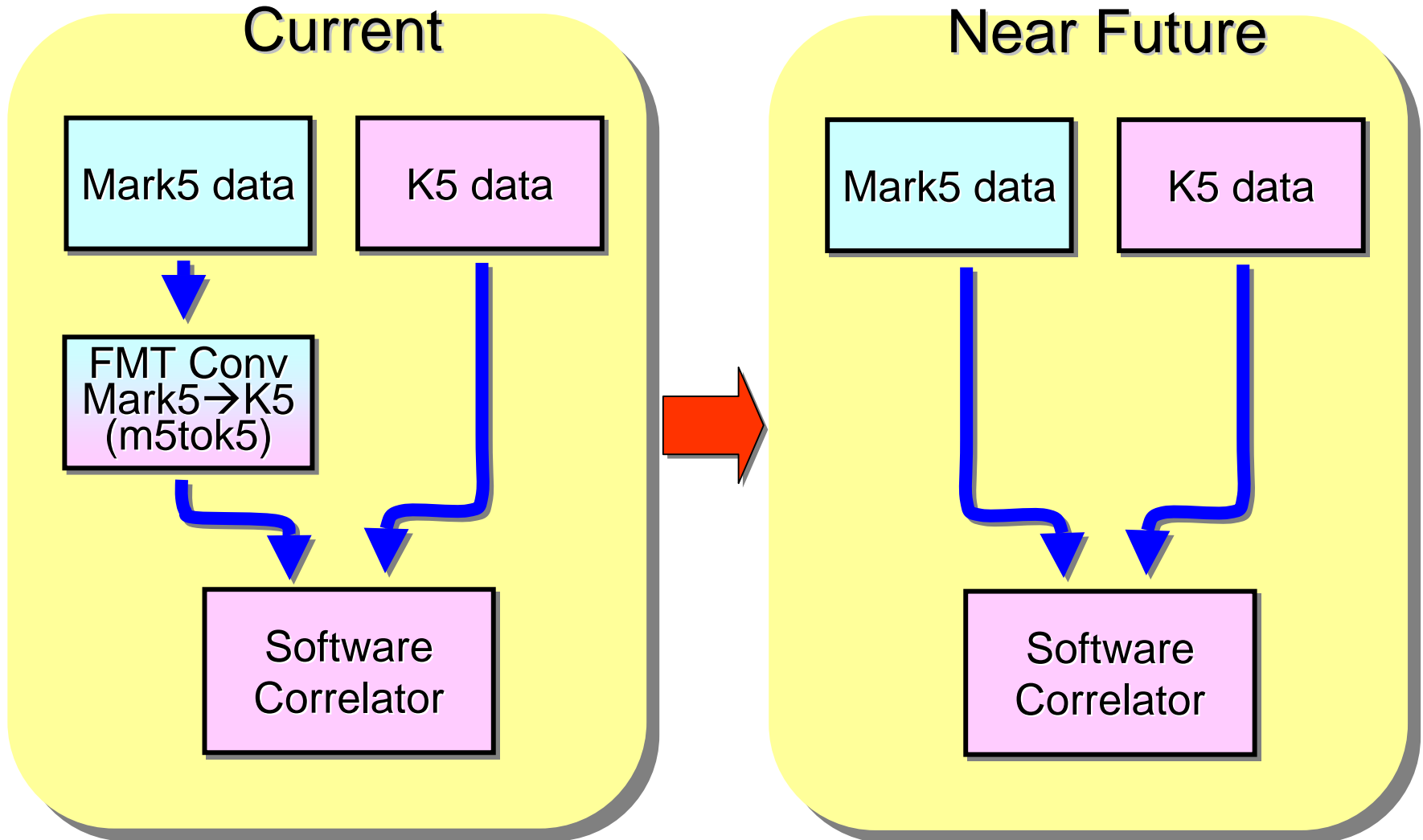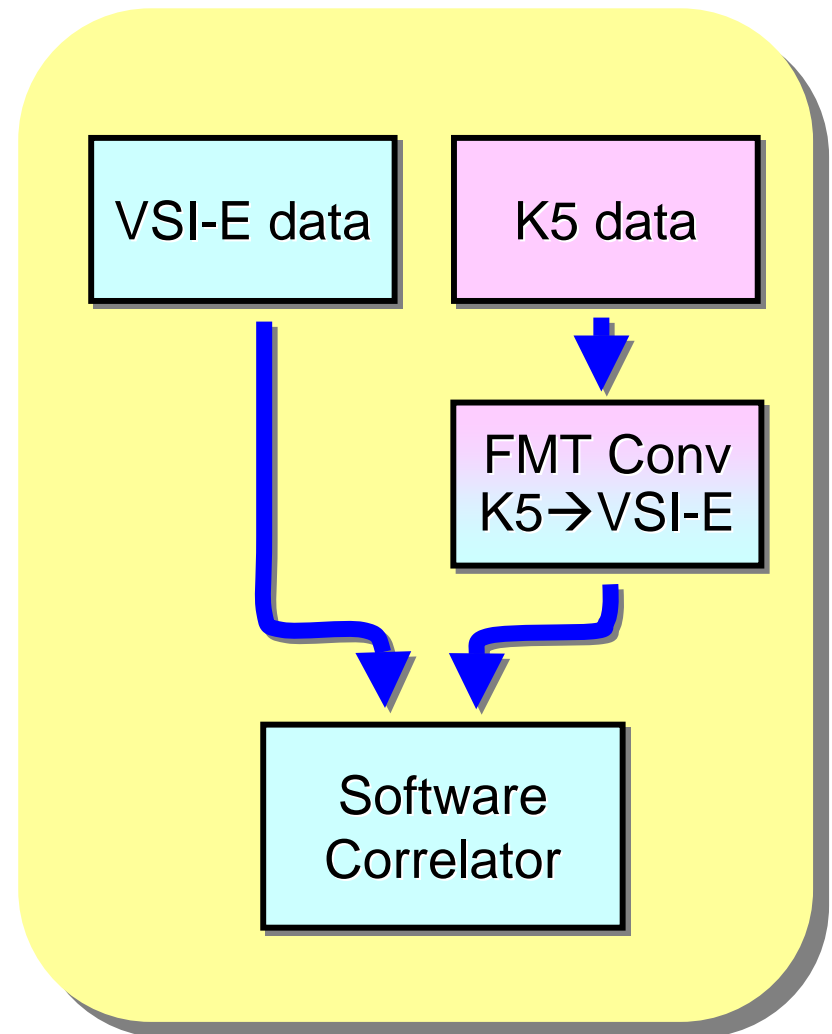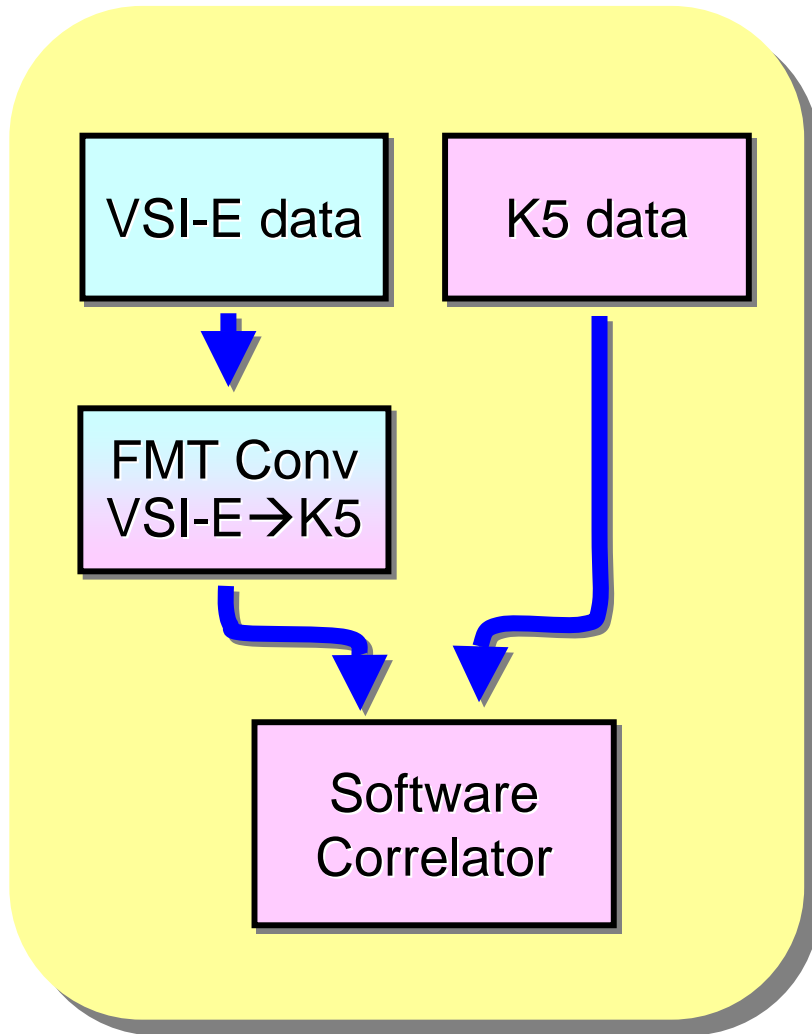 - directly near future

Block Diagram of K5-cor Correlator

Processing Speed of K5-cor (XF-type)
(calculation of 32-lag complex correlation)

Legend:
- ◆ Pentium 4
- ■ Pentium III
- ▲ AMD
- ✕ Celeron
- ✳ Xeon

Throughput (Mbps) vs. Clock Frequency (MHz)

Mixed Format Data Processing

Current

| Mark5 data | K5 data |

FMT Conv
Mark5→K5
(m5tok5)

Software
Correlator

Near Future

| Mark5 data | K5 data |

Software
Correlator

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Future Data Processing

VSI-E data → FMT Conv VSI-E→K5 → Software Correlator ← K5 data

VSI-E data → Software Correlator ← FMT Conv K5→VSI-E ← K5 data

Mark5 to K5 converter (m5tok5)
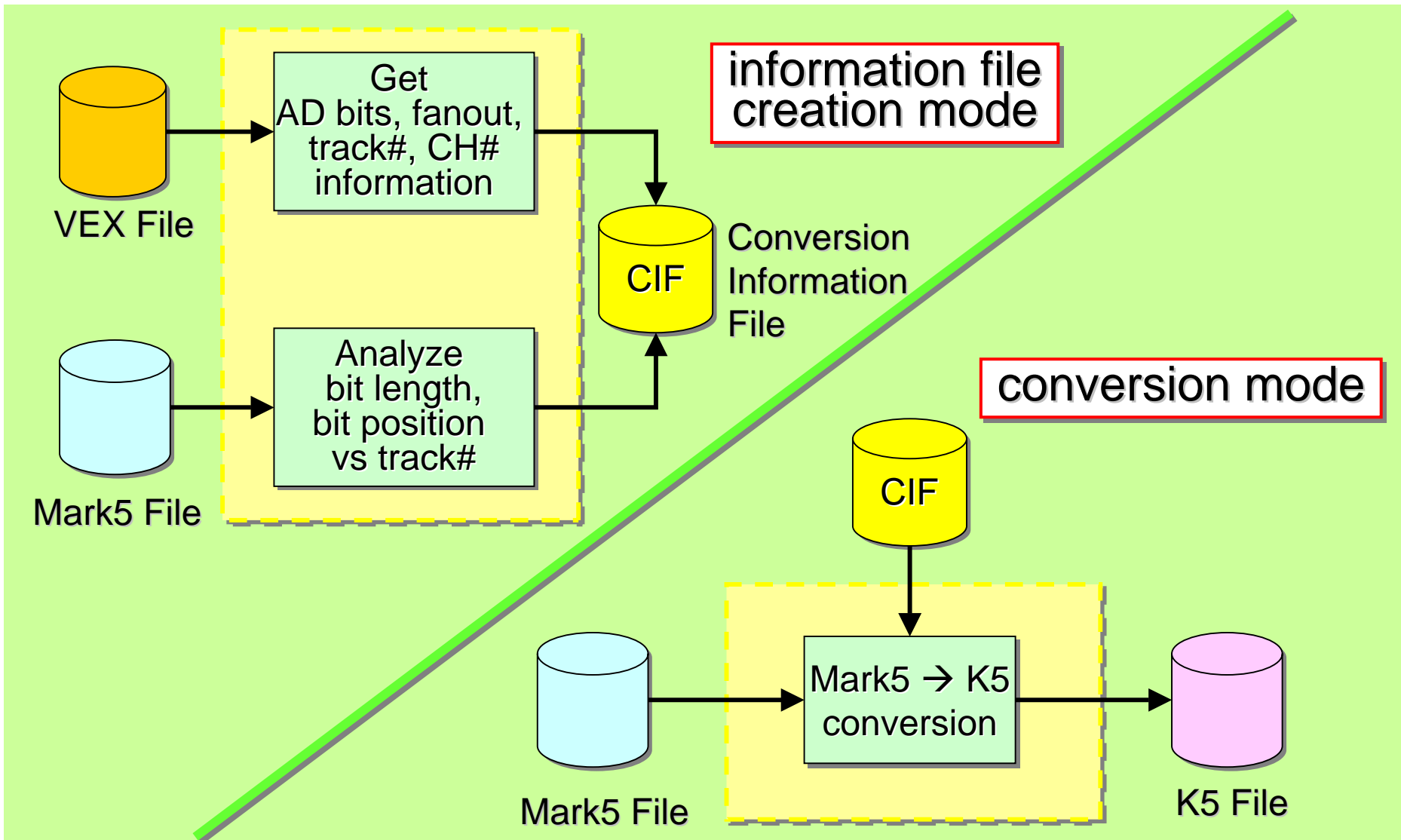
Mark5 to K5 converter (m5tok5)

supported Mark5 mode
(as of Sept.24, 2004)

bit lengths	8*, 16, 32, 64 (* never seen)
AD bits	1, 2
fanouts	1, 2, 4
coding	NRZM, NRZL(no coding)
parity	with parity, non-parity
format	Mark-IV, VLBA
total data rate (Mbps)	64, 128, 256, 512, 1024

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Mark5 to K5 converter (m5tok5)
conversion speed
(as of Sept.23, 2004)

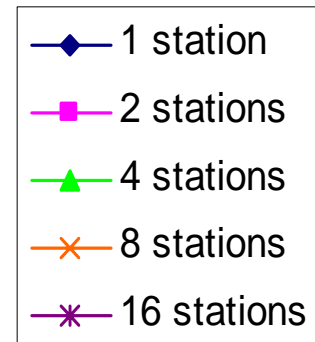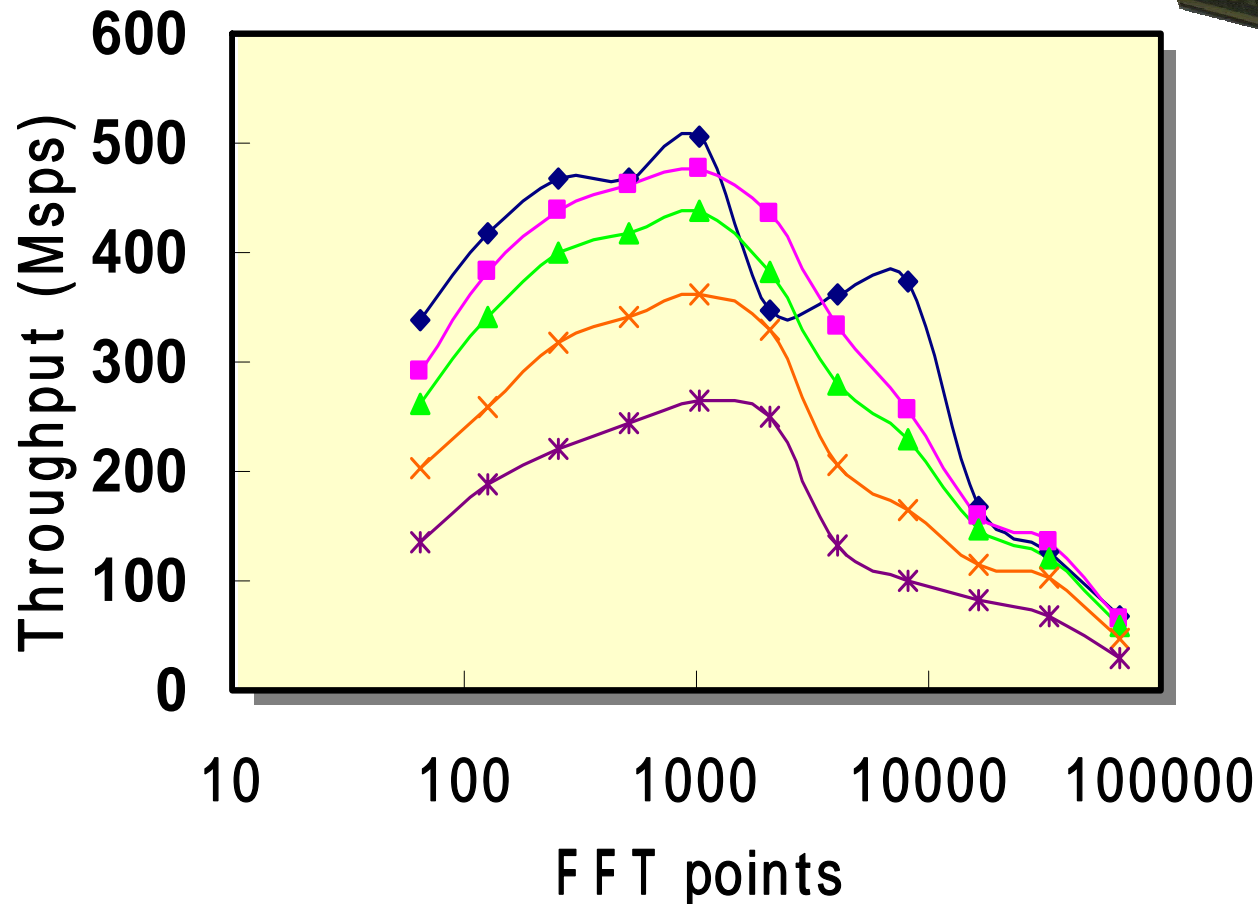| Mark5 data				conversion rate
format	coding	parity	bit lengths	
VLBA	NRZM	with-	32	18 Mbps
Mark-IV	NRZM	with-	32	18 Mbps
Mark-IV	No (NRZL)	non-	32	25 Mbps
Mark-IV	No	non-	16	35 Mbps
Mark-IV	No	non-	64	19 Mbps

CPU: Pentium III 1GHz

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Processing Speed of FX-type Software Correlator (Kimura's Software Correlator)
PC: Xserve G5 (2GHz Dual)

K5/VSI

Throughput (Msps) vs points

Legend:
- 1 station
- 2 stations
- 4 stations
- 8 stations
- 16 stations

Conclusions

- Processing speed of software correlator (K5-cor : XF type) for geodetic use is
  - 17Mbps with the AMD Athlon64 3200+ processor for 32-lag complex correlation
  - 8Mbps with the Pentium III(1GHz) processor for 32-lag complex correlation
  - 34Mbps with the AMD Athlon64 3200+ processor for 16-lag complex correlation
  - 16Mbps with the Pentium III(1GHz) processor for 16-lag complex correlation

Conclusions (continued)

- Processing speed of FX type software correlator (Kimura Software) is
    - about 100Msps(sample per second) with the AMD Athlon 1.6GHz Dual processor for 512-8192 lags
    - about 500Msps with the Xserve G5 (2GHz Dual) processor for 1024 lags
        - ➔ corresponding to 1Gbps for 2bit A/D data

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Future Plans

- Network distributed processing
  - ➜ almost realized by VLBI@home
- Real-time K5-VLBI
  - ➜ continuous development of K5 VLBI server and client software
- Correlation of VSI-E data
  - ➜ extension of "m5tok5"