

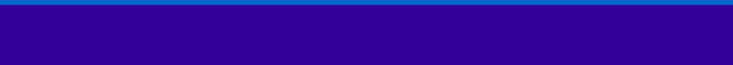


# Channel Archiver



Oct 2000

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# Channel Archiver

- Generic archiving system for EPICS
- Stores independent “Channels”  
= any Process Variable served by Channel Access
- Sampling options
  - a) periodically
  - b) on change

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# Goals

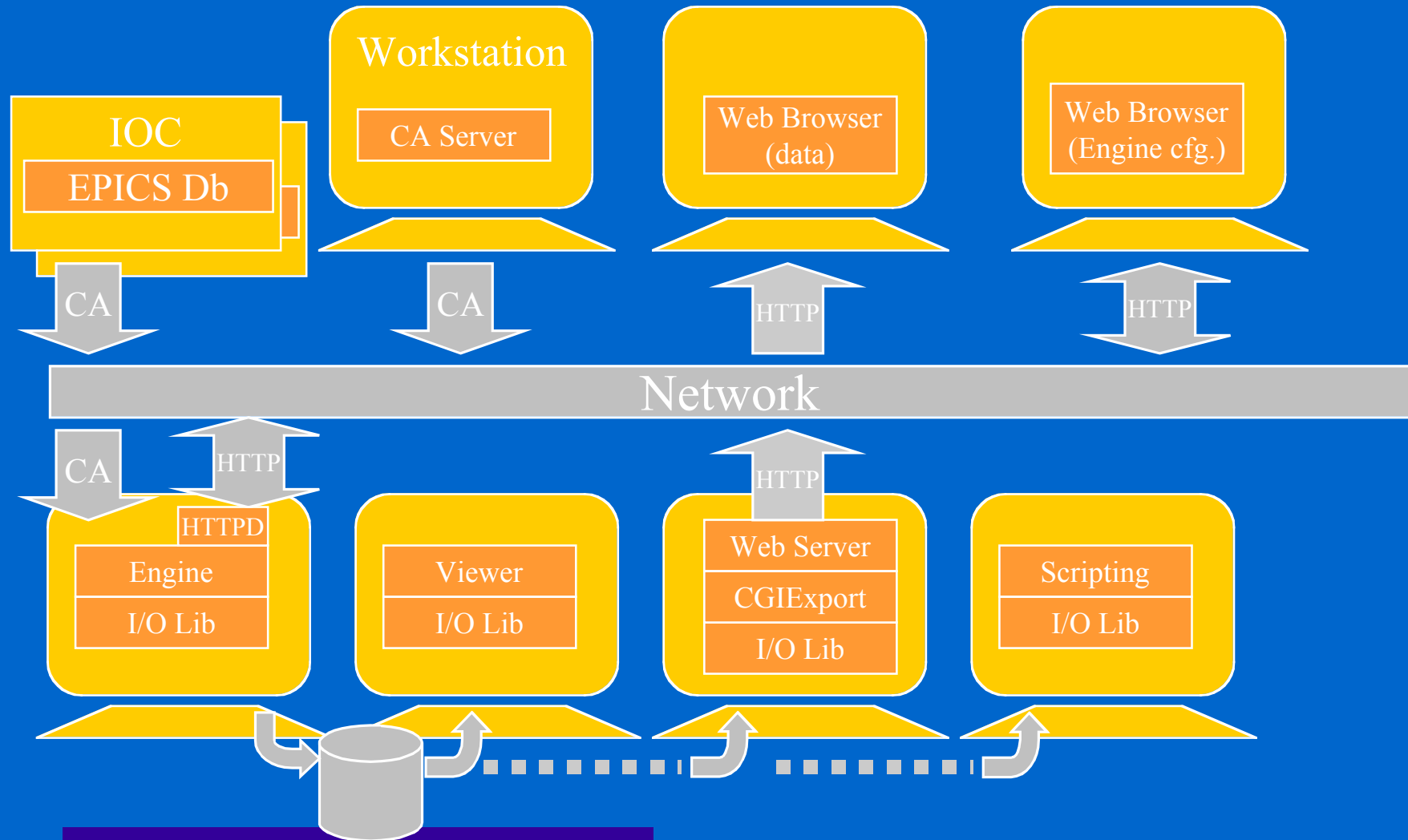
- Fast:
  - Hash-table channel lookup, binary data format with direct access to recent values.
- Generic and Portable:
  - Win32, Linux, Solaris, HPUX,...
  - Data archived: EPICS dbr\_time\_\*, providing system-independent access to float, int, string, enum, ... with time & status, units, limits, ...
- Networked:
  - Remote access to both Engine status/configuration and archived data
- Extendable:
  - I/O library meant to be extended to make Engine, CGI Tool etc. work with different storage formats
- Attractive for both casual users and “experts”
  - Web interface, Win32 archive viewer for generic access to raw samples
  - scripting support (SWIG) for automated analysis, creation of input for other programs

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## Components

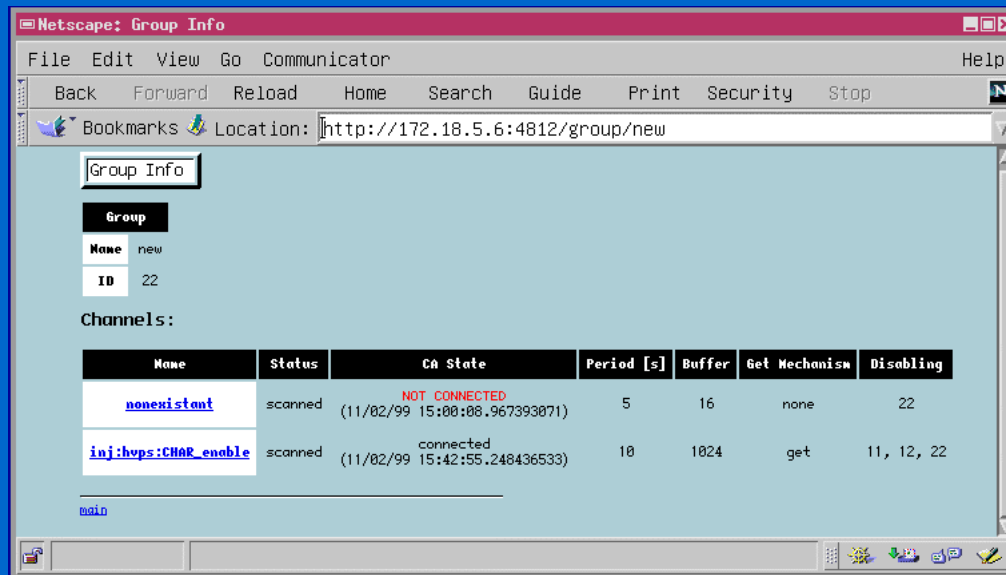
- Engine: Taking data from ChannelAccess
- CGIExport: Web access to data
- ChannelArchive ScriptingInterface: SWIG access for more sophisticated analysis
- WinBrowser: Win32 tool for fast archive browsing
- Archive I/O library: portable archive I/O, extendable for different file formats

# Interactions



# Engine

- Networked via HTTP
- Up to 10000 values/sec (450Mhz PC)
- WIN32, Linux, Solaris



Netscape: Group Info

File Edit View Go Communicator Help

Back Forward Reload Home Search Guide Print Security Stop

Bookmarks Location: <http://172.18.5.6:4812/group/new>

Group Info

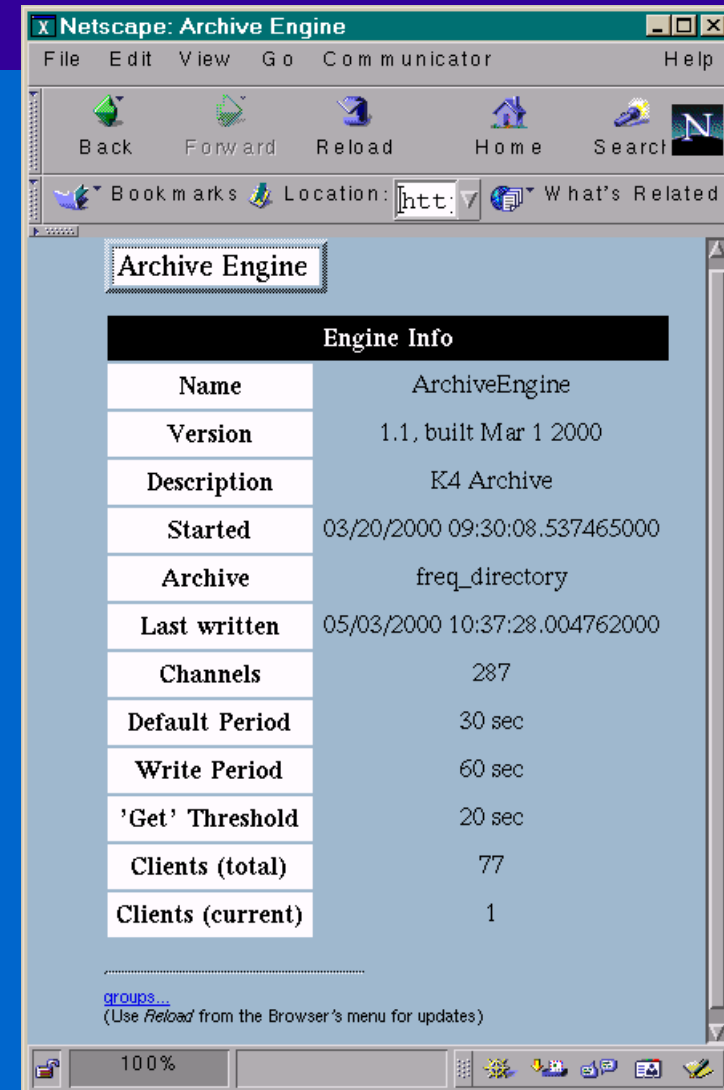
**Group**

Name	new
ID	22

Channels:

Name	Status	CA State	Period [s]	Buffer	Get Mechanism	Disabling
<a href="#">nonexistent</a>	scanned	NOT CONNECTED (11/02/99 15:00:08.967393071)	5	16	none	22
<a href="#">inj:hvps:CHAR_enable</a>	scanned	connected (11/02/99 15:42:55.248436533)	10	1024	get	11, 12, 22

[main](#)



Netscape: Archive Engine

File Edit View Go Communicator Help

Back Forward Reload Home Search

Bookmarks Location: <http://> What's Related

Archive Engine

**Engine Info**

Name	ArchiveEngine
Version	1.1, built Mar 1 2000
Description	K4 Archive
Started	03/20/2000 09:30:08.537465000
Archive	freq_directory
Last written	05/03/2000 10:37:28.004762000
Channels	287
Default Period	30 sec
Write Period	60 sec
'Get' Threshold	20 sec
Clients (total)	77
Clients (current)	1

[GROUPS...](#)  
(Use *Reload* from the Browser's menu for updates)

100%

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# Engine: Start

USAGE: ArchiveEngine [Options] <config-file> [<directory-file>]

Options:

-port <port>	WWW server's TCP port (default 4812)
-description <text>	description for HTTP display
-log <filename>	write logfile

Default directory-file: 'freq\_directory'

- Engine is ChannelAccess client: may have to set  
EPICS\_CA\_ADDR\_LIST, EPICS\_CA\_SERVER\_PORT
- TCP port has to be unique per machine
- Log-file: copy of messages/warnings

# Engine: Configuration

- ASCII File:

# Comments

!default\_period 30

!group <Another config. file>

- For building disabling groups, otherwise like an #include in C/C++

<Channel Name> <Period [sec]> [Monitor] [Disable]

- Scan period is also important for “Monitor” channels:  
It determines size of buffer.  
If more samples arrive than anticipated, “overwrites” occur.

- Example:

```
#Archive channels of example CA server (excas)
```

```
fred Monitor
```

```
freddy Monitor
```

```
jane 5
```

```
janet 10
```



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# Engine: Groups

- “disabling” channel  $\neq 0 \Rightarrow$  group disabled:

- Main: 

```
# Main archive file
!default_period 30
!write_period 60
!group power_supply
!group another_subsystem
```

- power\_supply: 

```
# Power Supply:
# Archive only when power is on!
power_off      Monitor Disable
power_setpoint
power_readback
power_temperature
```

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# Engine: More Options

- `!write_period <seconds>`  
Time between writes to disk
- `!get_threshold <seconds>`  
Internally, CA 'get' is used for channels scanned at `period > threshold`, remaining channels are 'monitored'
- `!buffer_reserve`  
Engine keeps memory buffer per channel to buffer between writes to disk.  
Size:  $buffer\_reserve * write\_period / scan\_period$   
Since writes can be delayed by other tasks, disk activity etc., buffer is usually bigger than the minimum required (default: 3).  
If receiving "override" messages, one should
  - Check if the offending channel is tagged *Monitor*.  
In that case the *period* estimate might be too large.
  - Increase *buffer\_reserve* (global for all channels)

# Engine: Status

- URL of engine's HTTPD: `http://<machine>:<port>`
- “Client Pull”: Updates on reload
- Changes (added groups/channels) written to `cfg` subdirectory, original config. files unchanged

**Group Info - Microsoft Internet Explorer**

File Edit View Favorites Tools Help

### Channels:

Name	Status	CA State	Period [s]	Buffer	Mechanism
<a href="#">subsystem_off</a>	monitored	NOT CONNECTED (00:00:00) <>	1	16	n
<a href="#">fred</a>	monitored	connected (05/03/2000 14:42:17.481556000) kingjohn.atdiv.lanl.gov:5064	1	256	mc
<a href="#">nothere</a>	scanned	NOT CONNECTED (00:00:00) <>	5	16	n

Done Local

**Groups - Microsoft Internet Explorer**

File Edit View Favorites Tools Help

### Groups

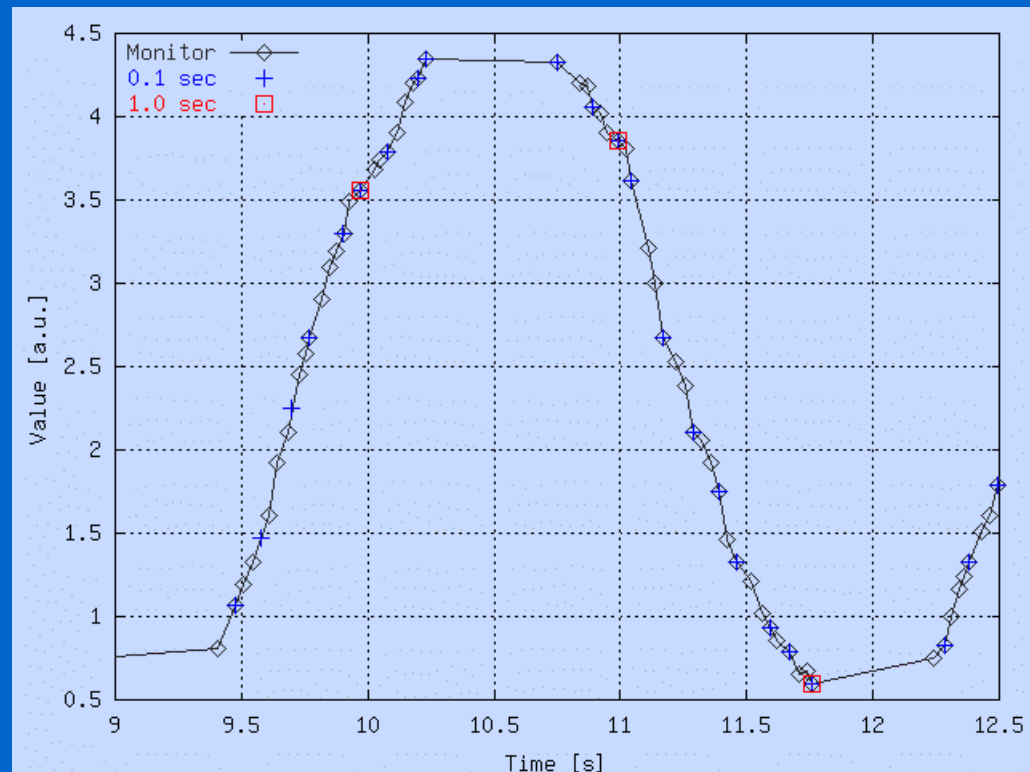
Name	ID	Enabled	Channels	Connected
<a href="#">main.cfg</a>	0	Yes	4	4
<a href="#">subsystem</a>	1	Yes	3	1

[-Main-](#) [-Groups-](#) [-Config.-](#)  
(Use *Reload* from the Browser's menu for updates)

Local intranet

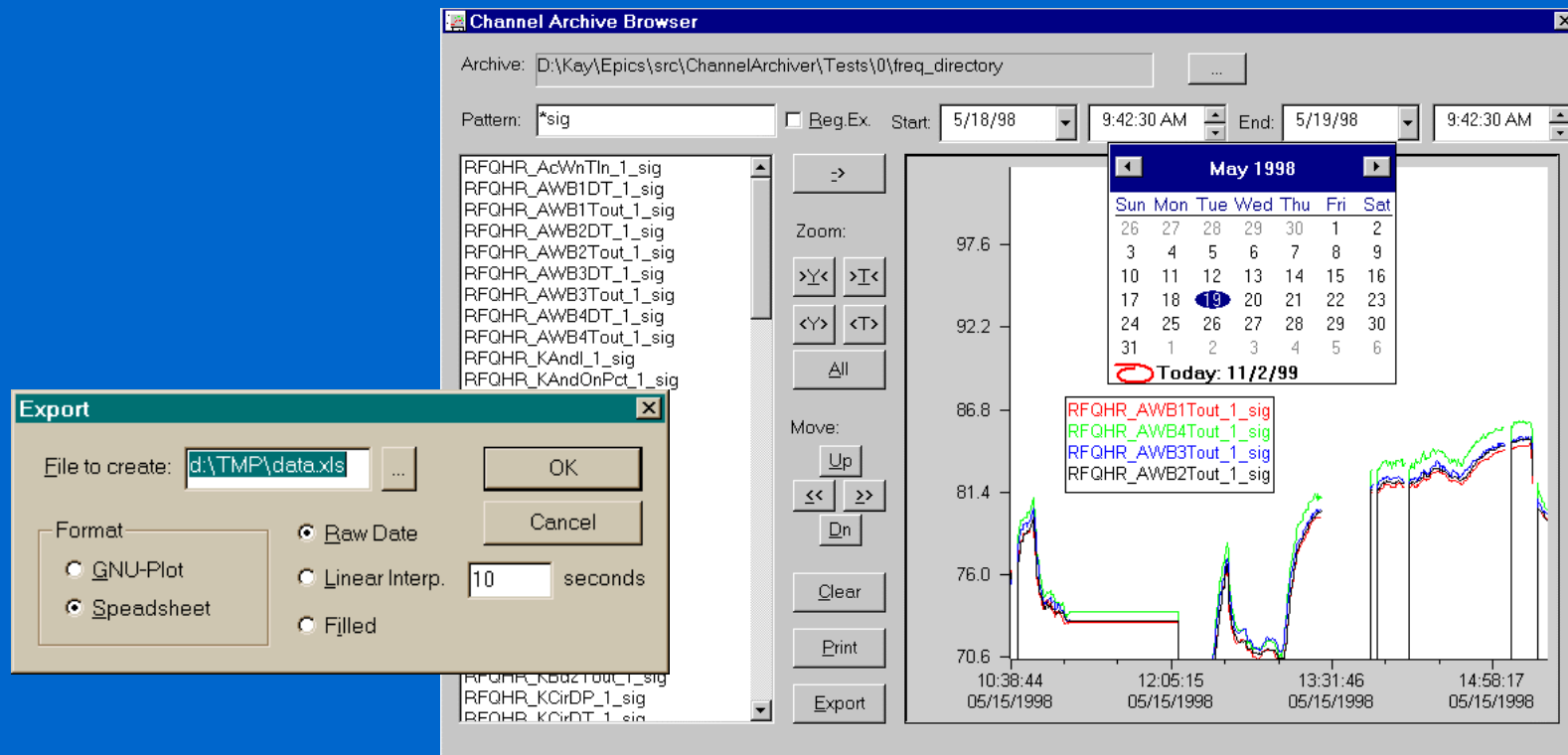
# Engine: Sampling

- Original time stamps of CA Server / IOC preserved, not adjusted/rounded to period!
- Example:  
“1.0 sec”  
⇒ every sec.,  
last value  
is saved



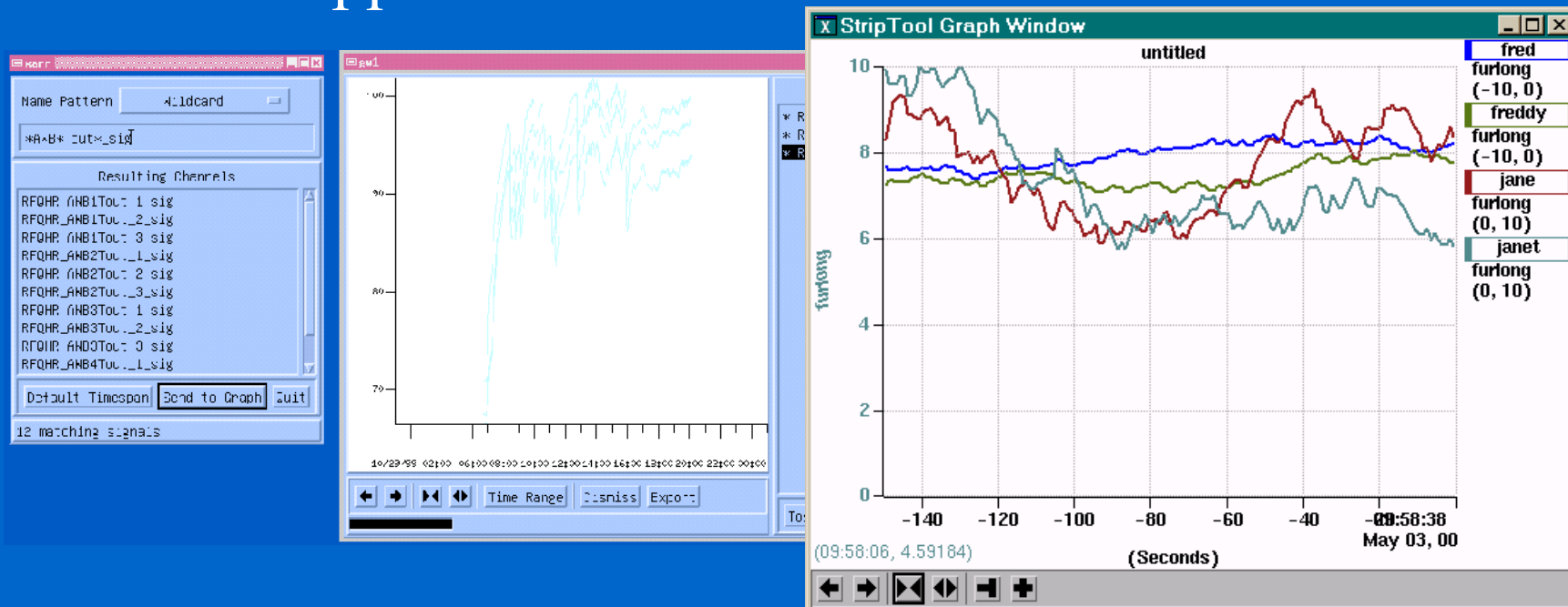
# WIN32 Browser

- Familiar User Interface
- Win. Only

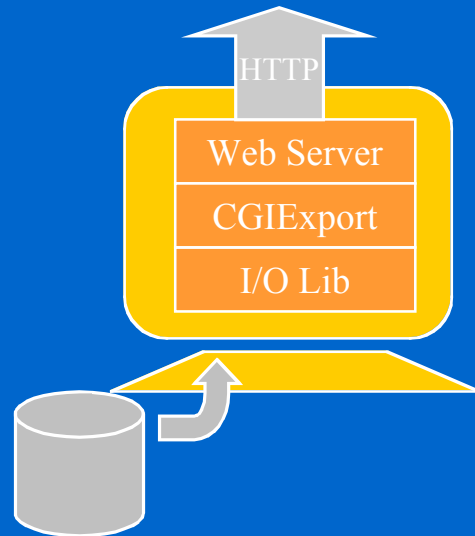


# XARR, StripTool (Chris Larrieu, JLab)

- View/Export Tools for UNIX (X11/Motif)
- XARR: access to archive via older lib.
- Plan: Support LibIO for both



# CGIExport



- For any Web Browser, any Web Server w/ CGI
- Archive Info
- Simple Plots (GNUPlot)
- Export in Spreadsheet format

EPICS Channel Archive - Microsoft Internet Explorer

File Edit View Favorites Tools Help Links »

## Channel Info

Channel	First archived	Last archived
fred	03/22/2000 17:02:28.700986000	04/24/2000 14:31:46.857792000
freddy	03/22/2000 17:02:28.701046000	04/24/2000 14:31:45.087790000
jane	03/22/2000 17:02:35.060956000	04/24/2000 14:31:44.917793000

Pattern:  (regular expression)

Names:

Interpolate:  secs, Round:  secs, Fill:  Status:

Start: Day (m/d/y)    Time (h:m:s)

End: Day (m/d/y)    Time (h:m:s)


Command:

### Command Explanation:

- **List** all channels that match *pattern*
- Show **Info** on channels that match *pattern* or a in *names* list
- **Plot** channels that match ... & are within time range
- **Get** spreadsheet intended to be saved & loaded into e.g. Excel

### Hints concerning...

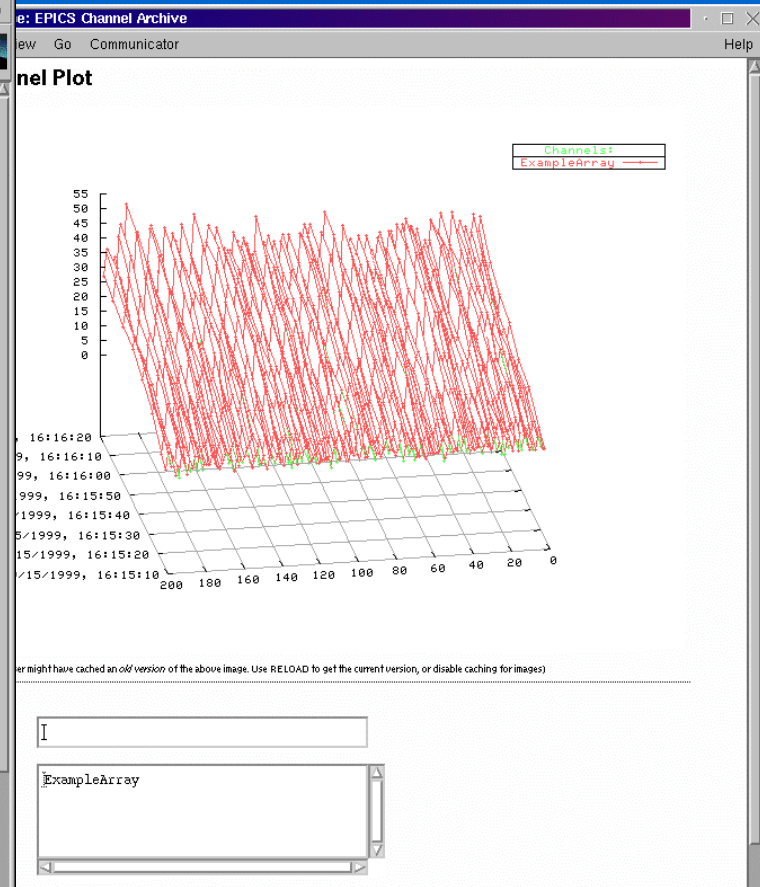
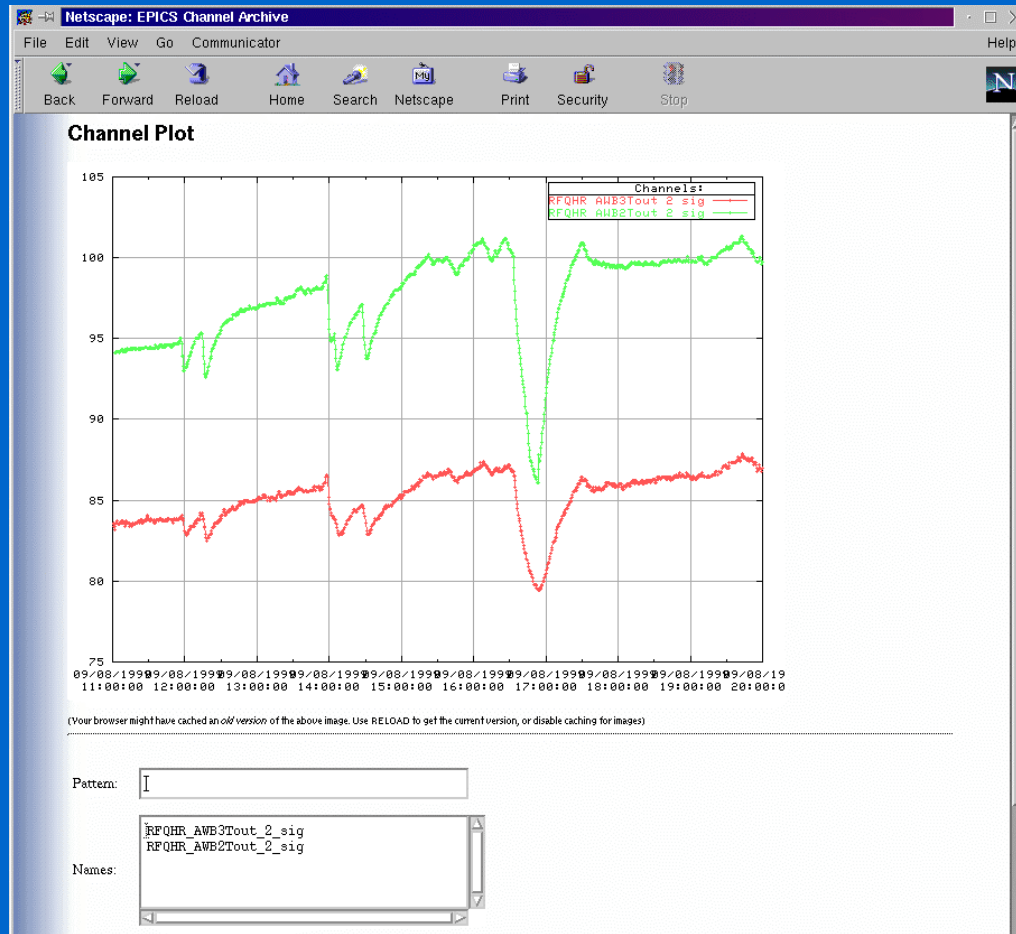
- [pattern Expressions](#)
- [the round field](#)
- [Spreadsheet programs](#)



Requests/comments?  
[E-Mail: Kay-Uwe Kasemir](mailto:Kay-Uwe.Kasemir)

Done Local intranet

# CGIExport: Plots





# CGIExport: Spreadsheet Options

- Original Time Stamps:  
ill-suited for Spreadsheets
- “Fill” missing values  
by repetition
- Linear Interpolation  
for given period

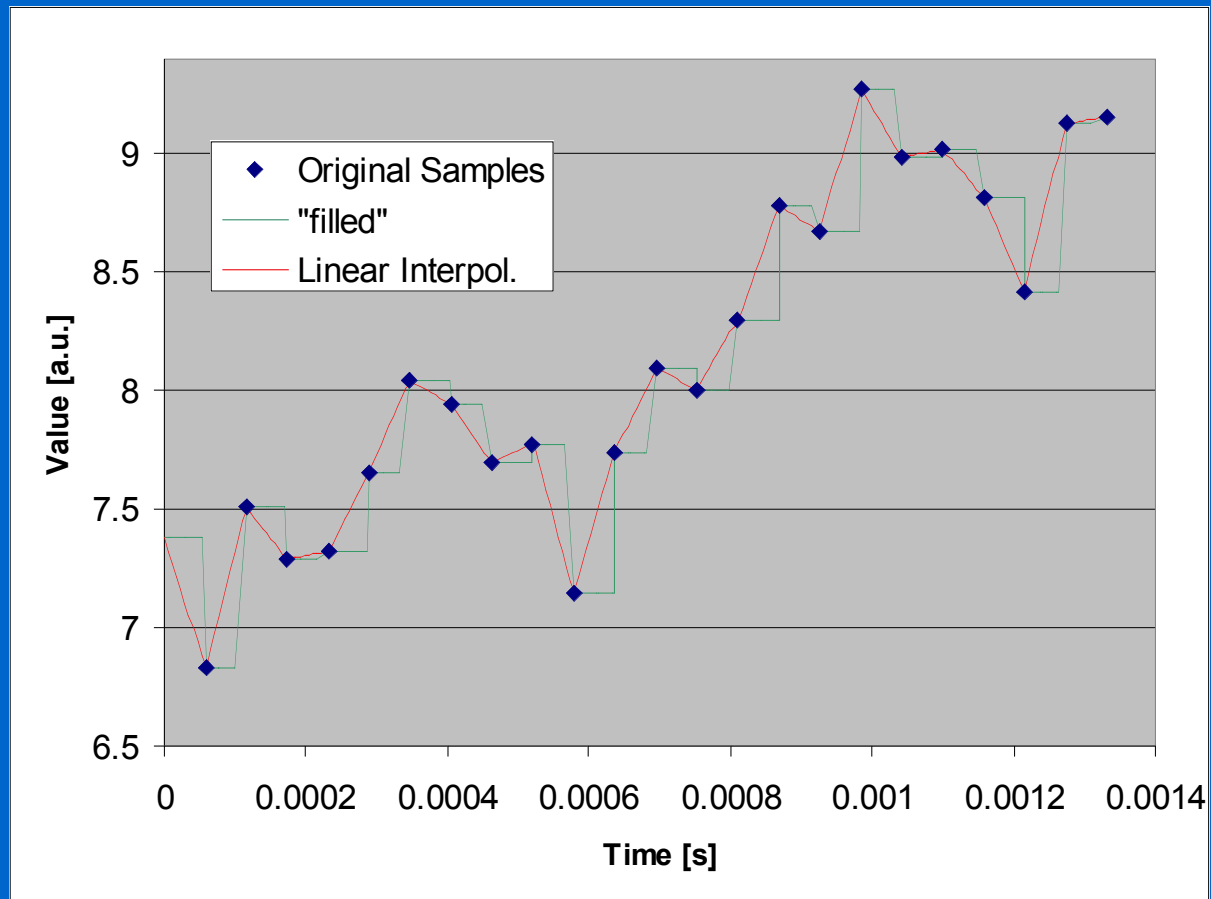
Time	A	B
3/22/00 17:02:28.700	0.071824	#N/A
3/22/00 17:02:28.701	#N/A	-0.08601
3/22/00 17:02:37.401	0.054358	#N/A
3/22/00 17:02:37.511	#N/A	-0.11178

Time	A	B
3/22/00 17:02:28.700	0.071824	#N/A
3/22/00 17:02:28.701	0.071824	-0.08601
3/22/00 17:02:37.401	0.054358	-0.08601
3/22/00 17:02:37.511	0.054358	-0.11178
3/22/00 17:02:39.411	0.139948	-0.11178

Time	A	B
3/22/00 17:02:28.700	0.071824	#N/A
3/22/00 17:02:28.701	#N/A	-0.08601
3/22/00 17:02:30.000	0.069216	-0.08981
3/22/00 17:02:32.000	0.065201	-0.09566
3/22/00 17:02:34.000	0.061186	-0.10151
3/22/00 17:02:36.000	0.057171	-0.10736

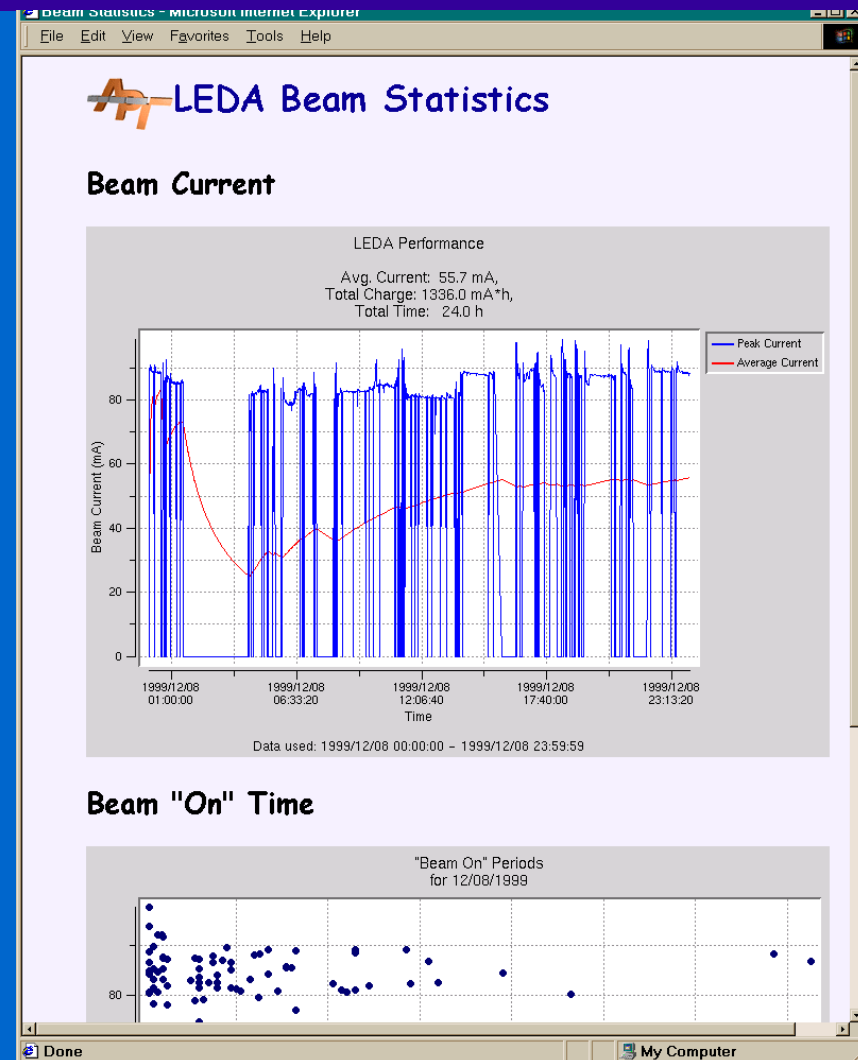
(initial #N/A until all channels have valid value)

# CGIExport: “Fill”, “Interpol.”, ...



# Scripting Interface

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- Not optimal for “end users”, but allows programmers to
  - provide adjustable scripts: Time/Y Plot, X/Y Plot, List,...
  - automatically generate e.g. daily statistics for Web
  - write filters for Matlab, Mathematica, ...
  - answer questions like: “How often was XX below 10.0 and for how long?”

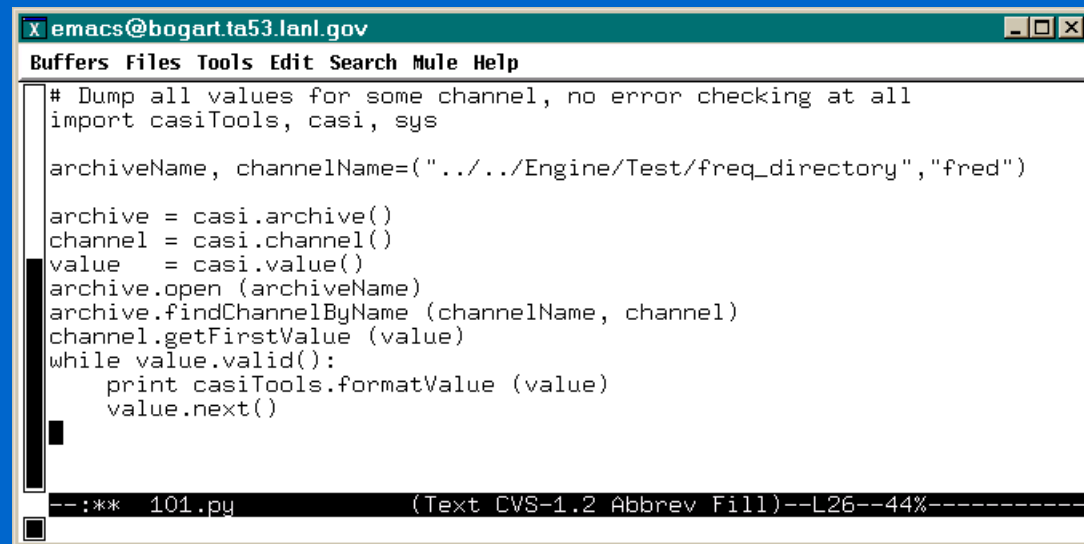


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## CASI: Channel Archive Scripting Interface

- SWIG - based:
  - allows access from tcl, perl, python
  - available for Win32 and Unix
  - Available Examples: tcl/tk and python
  - for Win32 and Linux: loadable module

- API:
  - Plain adaption of ChannelArchive LibIO



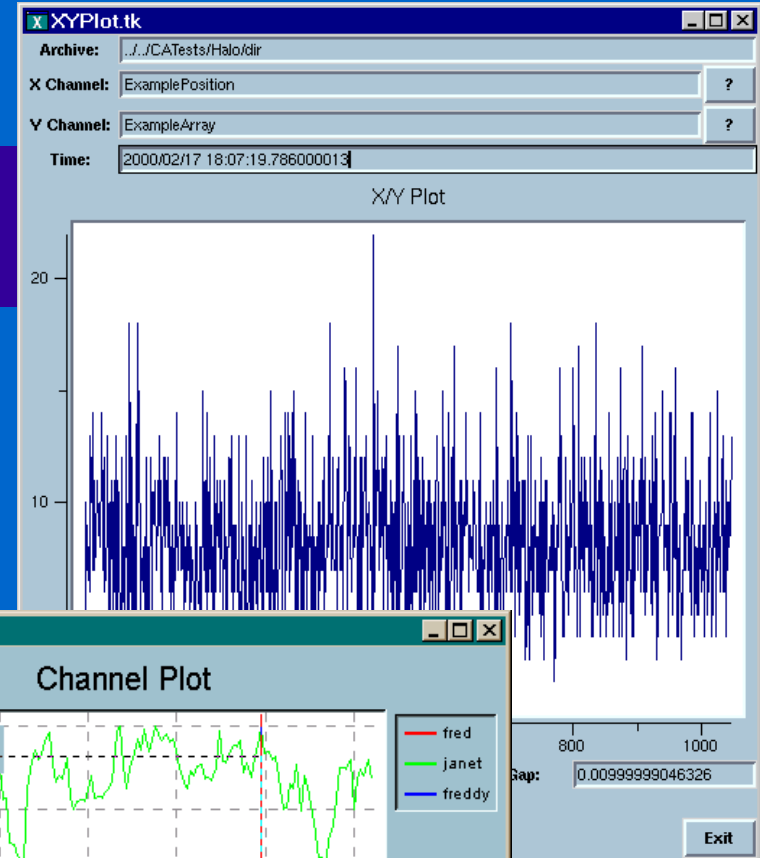
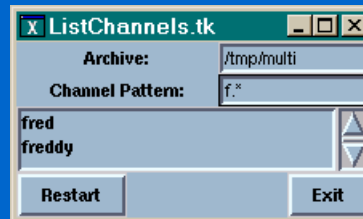
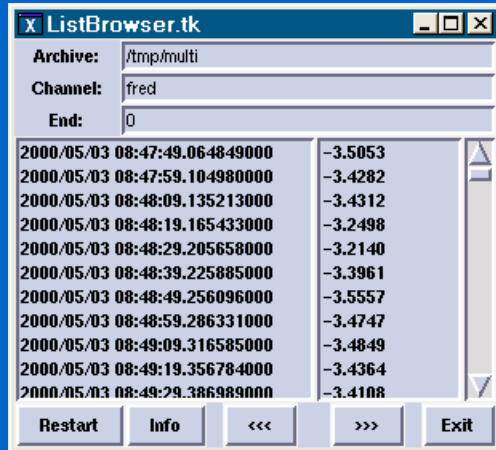
```
x emacs@bogart.ta53.lanl.gov
Buffers Files Tools Edit Search Mule Help
# Dump all values for some channel, no error checking at all
import casITools, casI, sys

archiveName, channelName("../Engine/Test/freq_directory", "fred")

archive = casI.archive()
channel = casI.channel()
value = casI.value()
archive.open (archiveName)
archive.findChannelByName (channelName, channel)
channel.getFirstValue (value)
while value.valid():
    print casITools.formatValue (value)
    value.next()

--:** 101.py (Text CVS-1.2 Abbrev Fill)--L26--44%-----
```

# Generic Examples



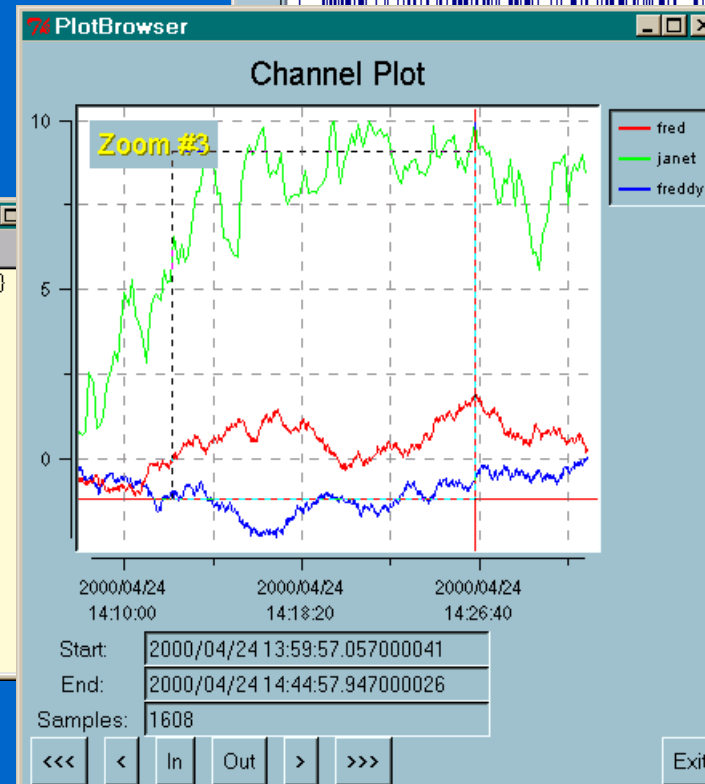
```

kvt
File Options Help
USAGE: spreadsheetExport.tcl archive startTime endTime channelName { channelName }

start/endTime as "YYYY/MM/DD hh:mm:ss" in 24h format;
startTime may be 'yesterday', endTime may be 'end'

- Dump values for given channels between start- and end time
in spreadsheet format,
filling/repeating values for missing time stamps

Example
spreadsheetExport.tcl dir "2000/03/23 10:19:09.000000000" end fred freddy
Time          fred          freddy
2000/03/23 10:19:09.000000000 0.622230947018 -0.370439261198
2000/03/23 10:19:10.460167853 0.698971152306 -0.370439261198
2000/03/23 10:19:10.570359760 0.698971152306 -0.307258069515
2000/03/23 10:19:12.463064310 0.781148672104 -0.307258069515
2000/03/23 10:19:12.573179112 0.781148672104 -0.32039347291
2000/03/23 10:19:14.465887014 0.681179642677 -0.32039347291
    
```



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# Channel Archiver LibIO

- Portable C++ code (handling e.g. byte swapping)
- Based on generic “Iterator” interface:
  - Archive: list channels
  - ChannelIterator/Channel:  
first/last time available, find value before/after/near time
  - ValueIterator/Value:  
get time, status, value both as string and “raw”
- Supported: BinArchive, MultiArchive

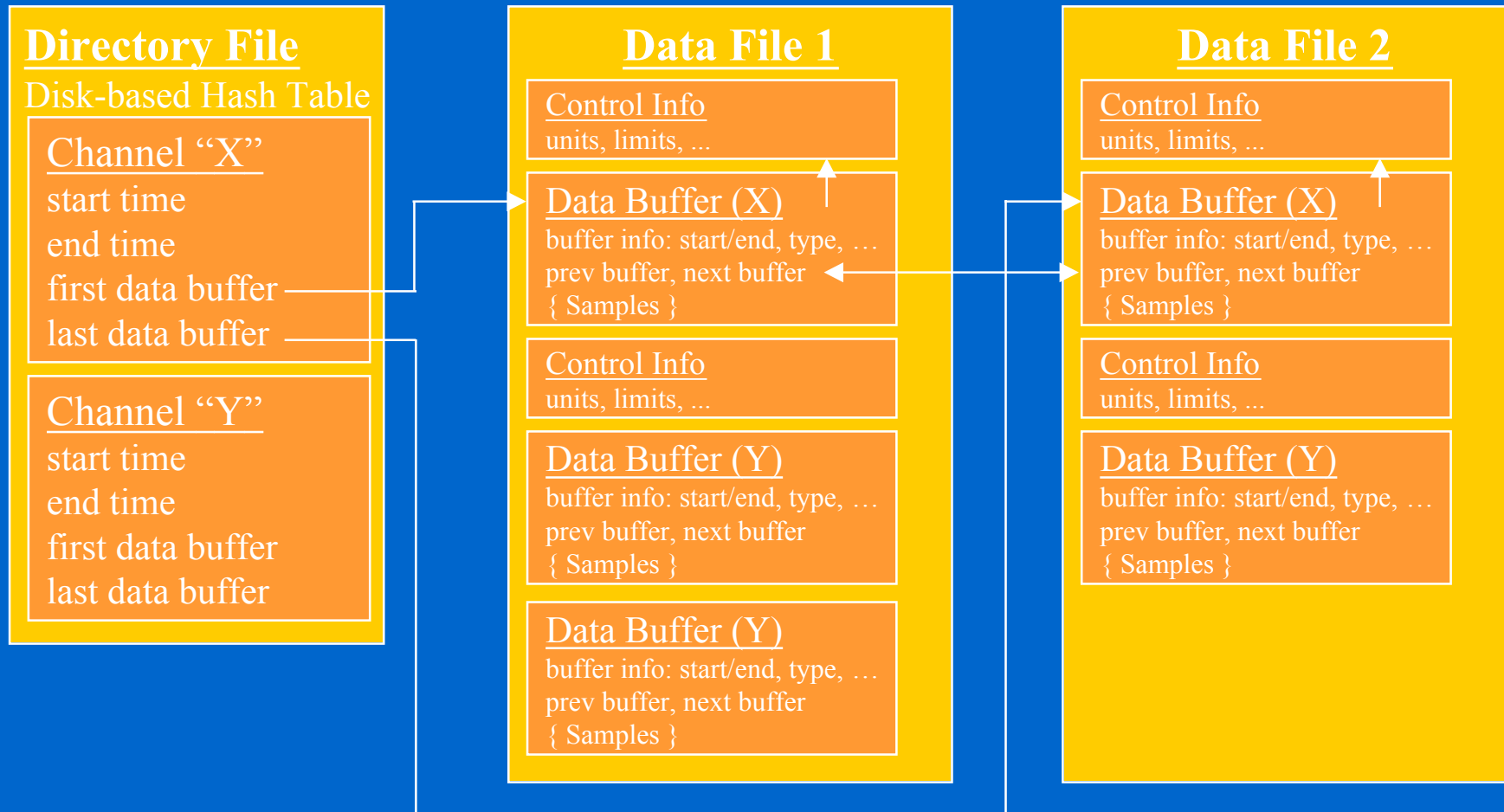
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# LibIO: Example

```
#define ARCHIVE_TYPE BinArchive
```

```
void list_values  
    (const stdString &archive_name, const stdString &channel_name, const osiTime &start, const osiTime &end)  
{  
    Archive    archive (new ARCHIVE_TYPE (archive_name));  
    Channellterator channel(archive);  
    ValueIterator value(archive);  
  
    if (! archive.findChannelByName (channel_name, channel))  
        return;  
    channel->getValueAfterTime (start, value);  
    while (value && value->getTime() < end)  
    {  
        cout << *value << endl;  
        ++ value;  
    }  
}
```

# BinArchive File Layout





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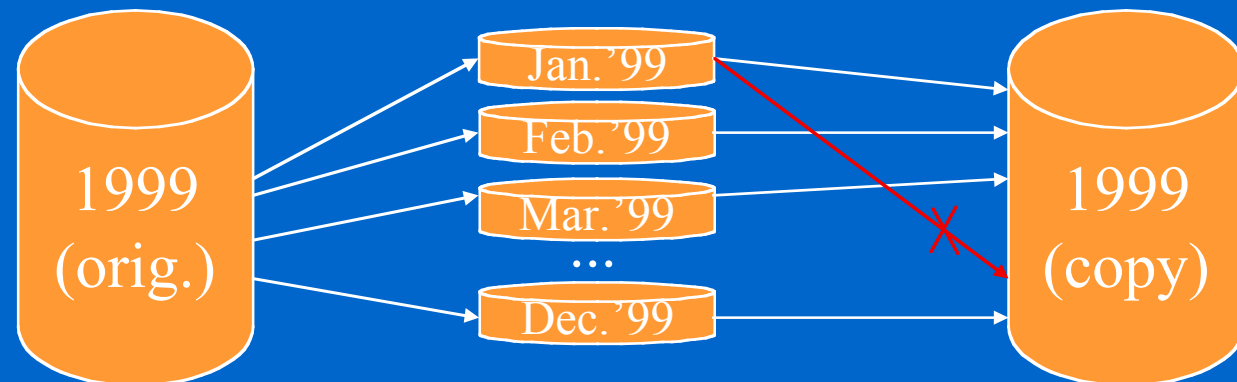
# BinArchive Features

- Hash Table
  - + fastest lookup by name
  - less suited for sorted listing or wildcard lookup
- Binary Data File, Multiple Channels per File
  - + minimized open/close calls, fastest read/write access
  - byte swapping required, harder to maintain
- Double-Linked Data Blocks
  - + fastest access to most recent values
  - links must not be broken

# ArchiveManager Program

- Extraction of channels and time range into new archive
  - attempt is made to skip/repair “broken” values while copying
- Channels/time ranges can be appended to existing archive
  - no “insert” nor “prepend”!
- Possible Approach:
  - Create extracts of reasonable size for backup (e.g. monthly CD-ROM)
  - Original archive can be recreated from extracts, starting with the oldest one,

not going  
back in  
time



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# MultiArchive

- Allows read-access to list of archives
  - compile-time option for CGIExport, Tcl extension, WinBrowser
  - first archive that holds requested data is used
  - when iteration meets end of data, archive list is searched again
  - no sophisticated merging, i.e. archives should not overlap in time
  - for now each individual archive has to be a BinArchive
- Format:

```
# ChannelArchiver master file
master_version=1
# Order in which archives are checked for data:
/archives/fast/dir
/archives/main/SinceJan2000/freq_directory
/archives/main/Jul99-Dec99/freq_directory
/archives/main/Jan99-Jun99/freq_directory
/home/fred/xyzarchive/dir
```

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## More Information

- “ChannelArchiver” under  
<http://mesa53.lanl.gov/lansce8/epics/PC>
- Documentation is part of sources:  
ChannelArchiver/doc
- Bob Dalesio: [ldalesio@lanl.gov](mailto:ldalesio@lanl.gov)  
Kay-Uwe Kasemir: [kasemir@lanl.gov](mailto:kasemir@lanl.gov)