

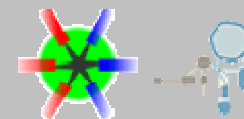
Data Acquisition Backbone Core IAFU

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GSI, Experiment Electronics: Data Processing group

MBS application as example

To do

Work supported by [EU RP6 project JRA1 FutureDAQ](#) RII3-CT-2004-506078



2004 → EU RP6 project JRA1 FutureDAQ*
 2004 → CBM FutureDAQ for FAIR

1996 → MBS future
 50 installations at GSI,
 50 external
<http://daq.gsi.de>

Intermediate
demonstrator

Use cases

- Detector tests
- FE equipment tests
- Data transport
- Time distribution
- Switched event building
- Software evaluation
- MBS event builder
- General purpose DAQ

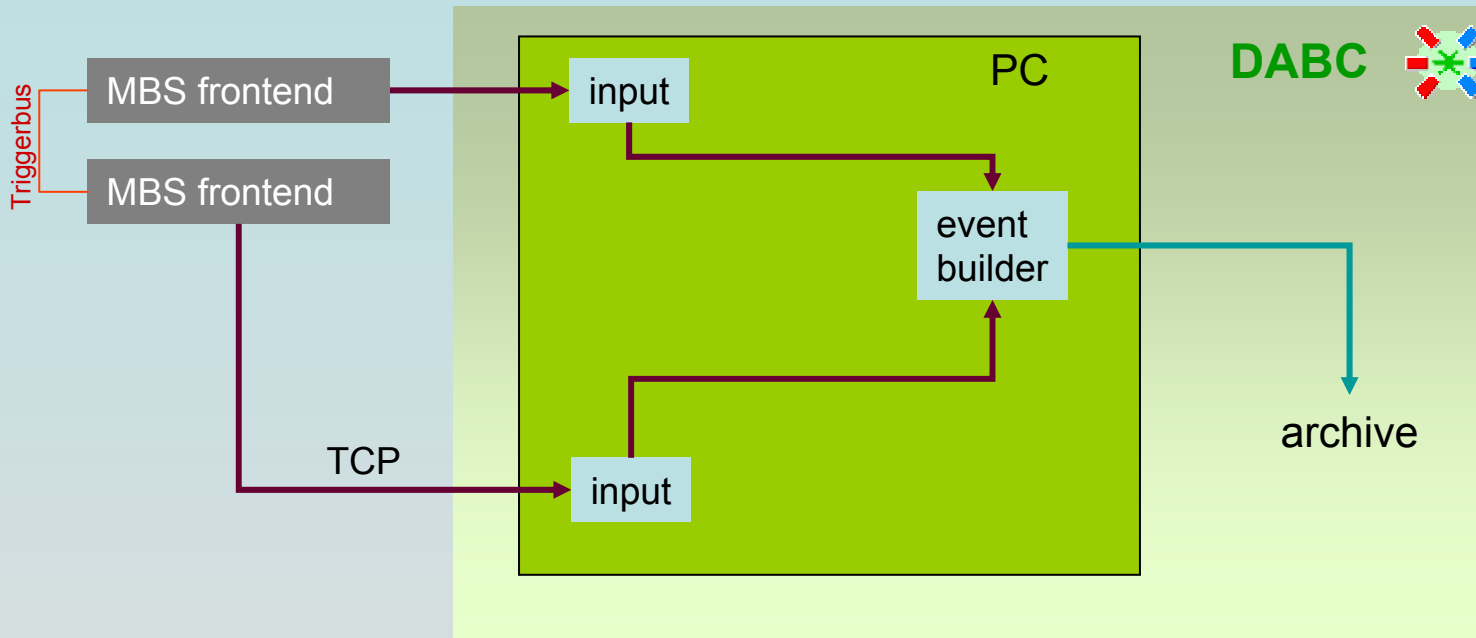
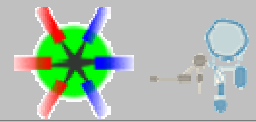
Requirements

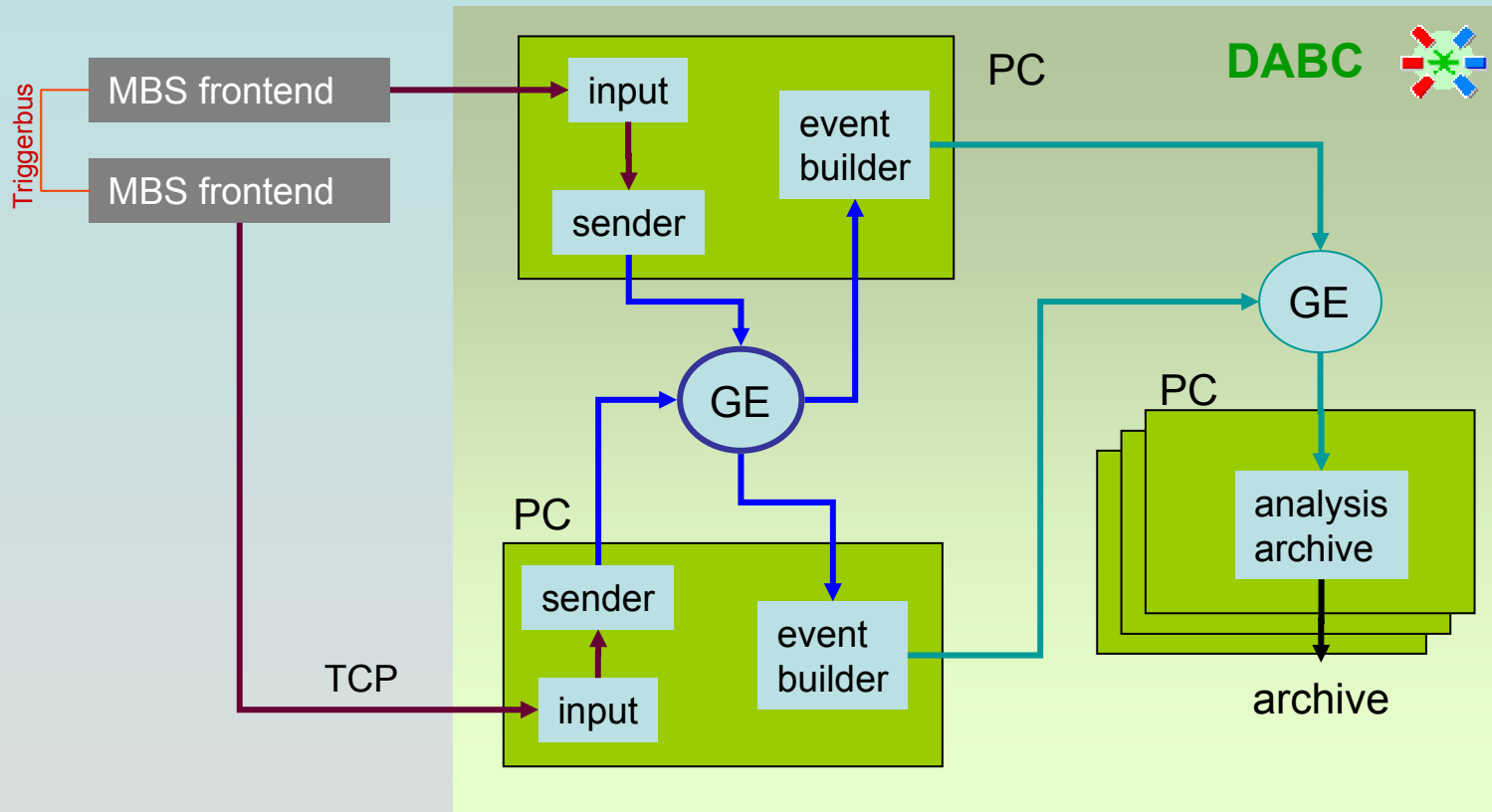
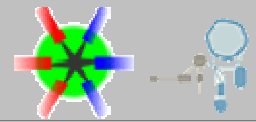
- build events over fast networks
- handle triggered or self-trigger front-ends
- process time stamped data streams
- provide data flow control (to front-ends)
- connect (nearly) any front-ends
- provide interfaces to plug in application codes
- connect MBS readout or collector nodes
- be controllable by several controls frameworks

Data
Acquisition
Backbone
Core

* RII3-CT-2004-506078

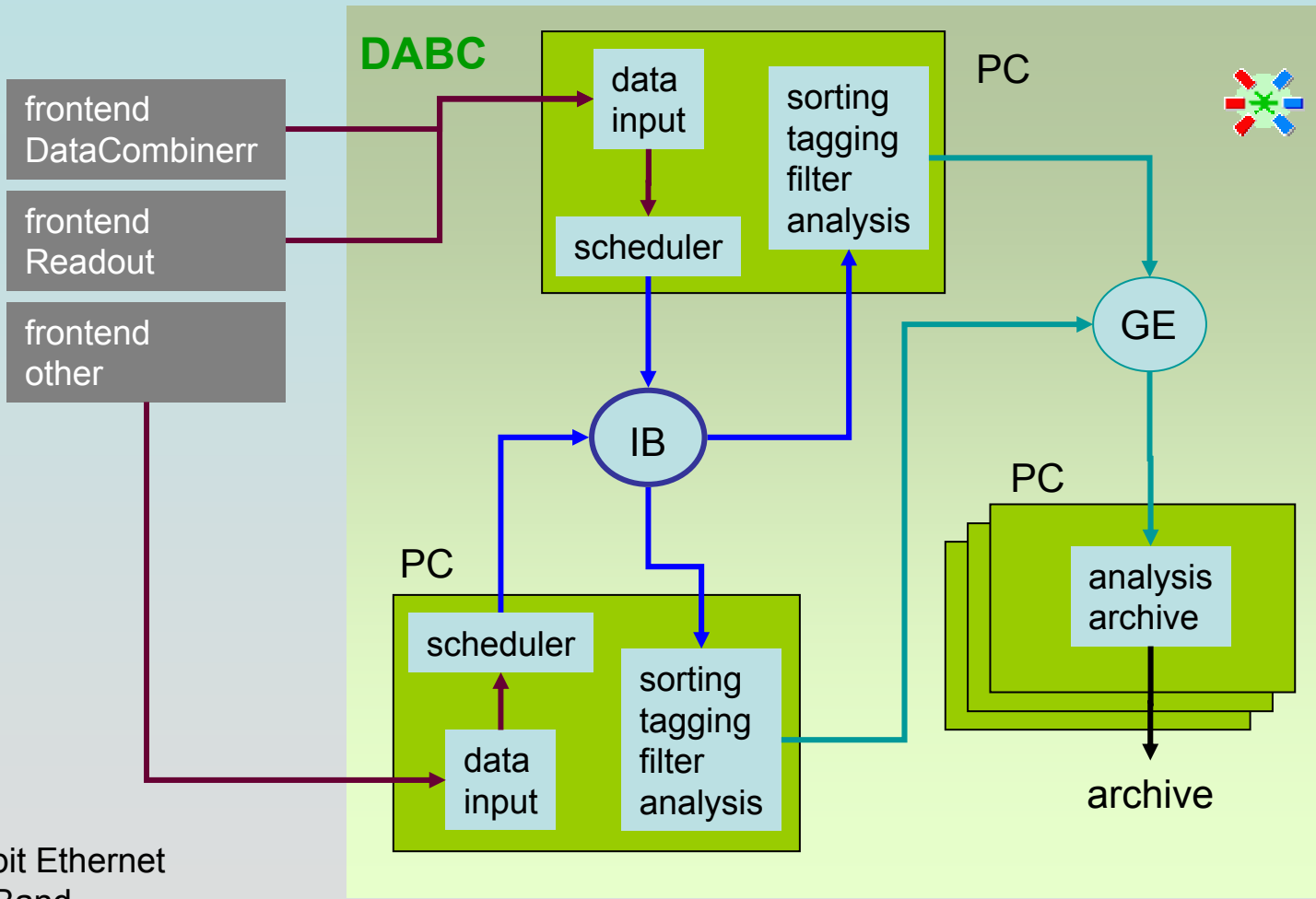
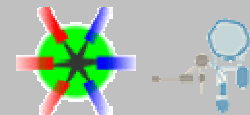
➤ Some use cases





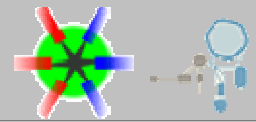
GE: Gigabit Ethernet

➤ DABC structure

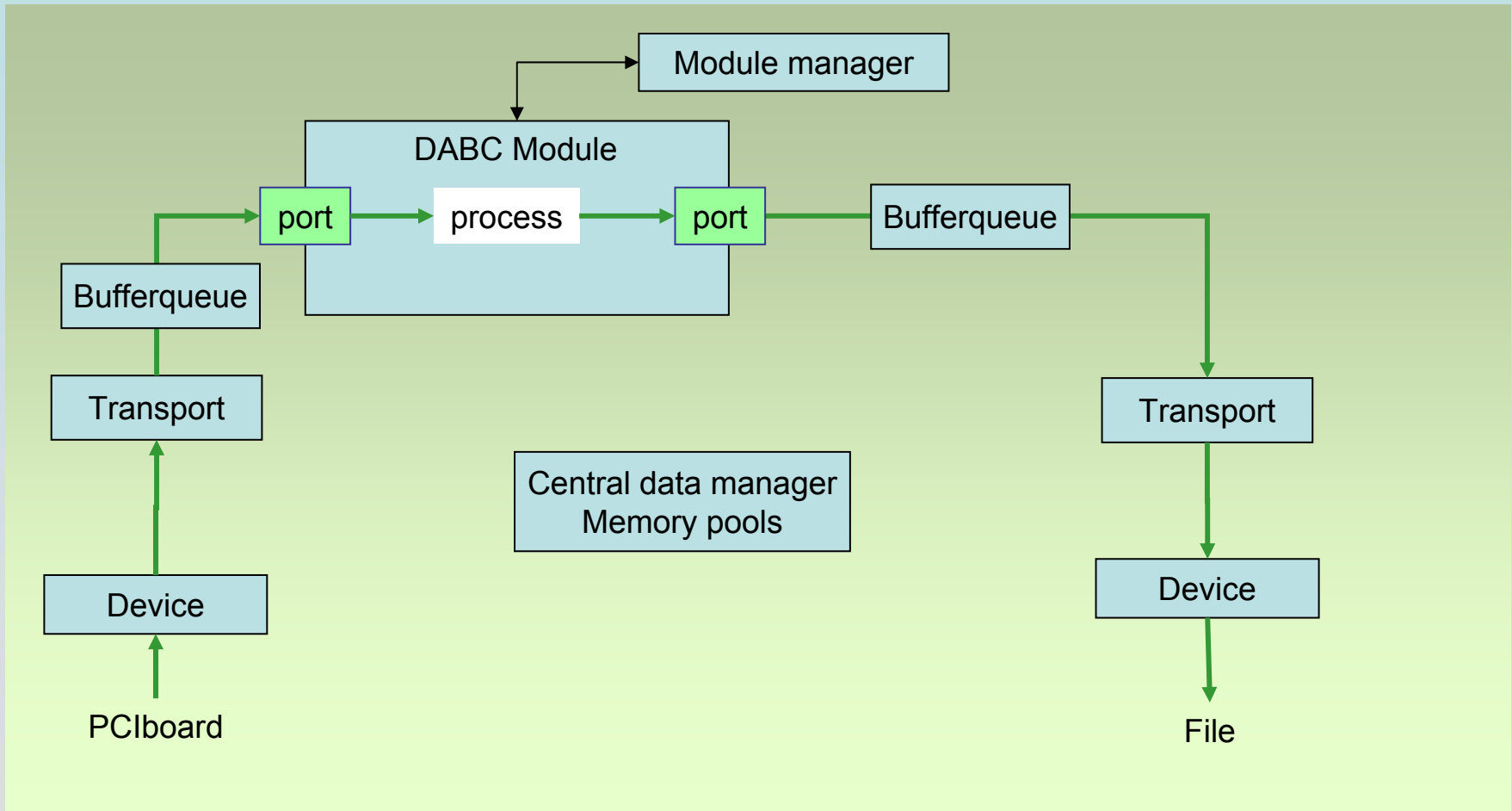


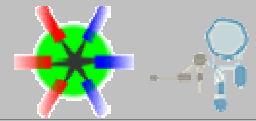
GE: Gigabit Ethernet
IB: InfiniBand

➤ DABC data flow

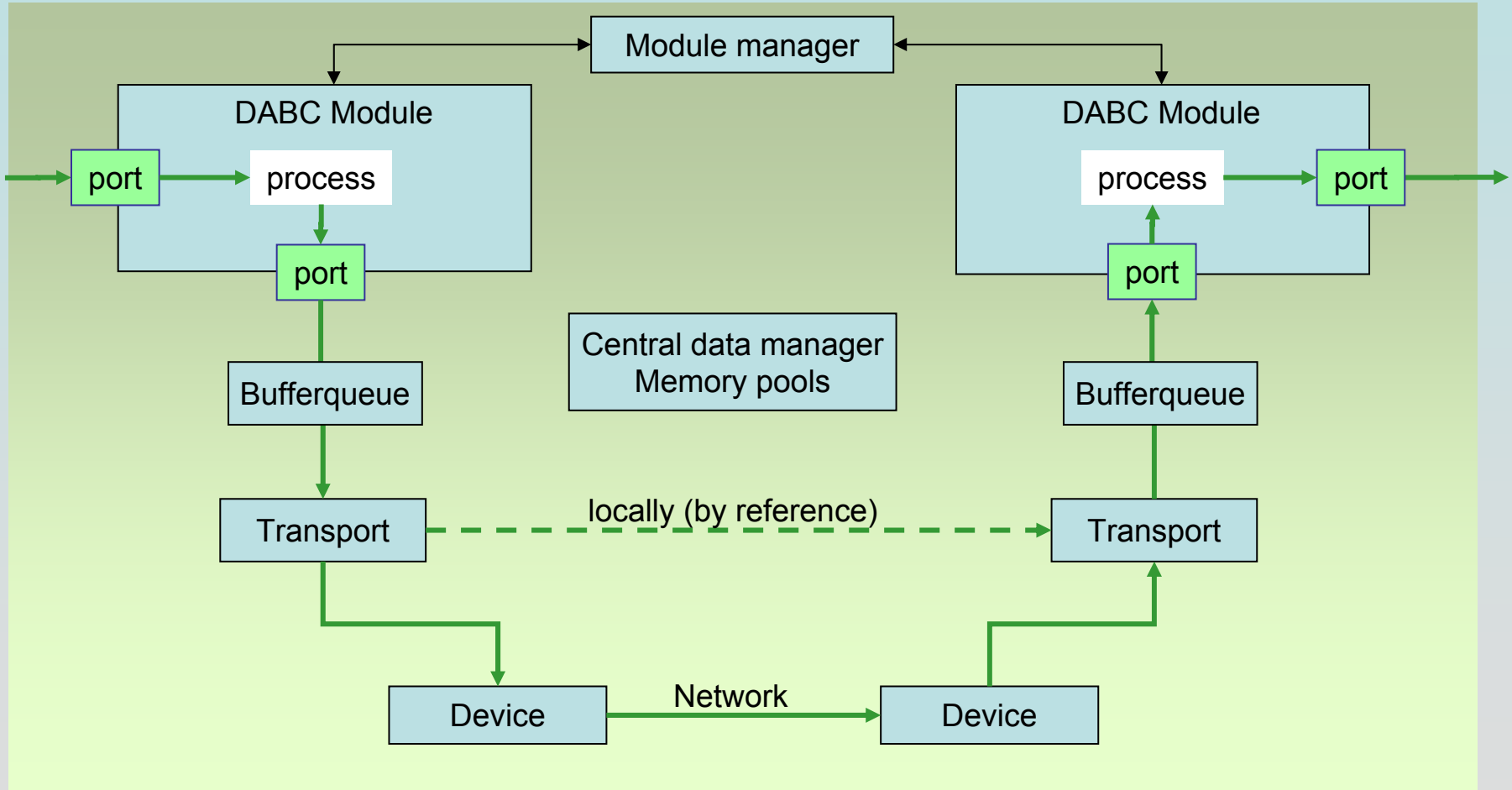


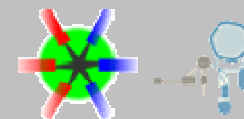
A *module* processes data of one or several data streams.
Data streams propagate through *ports*, which are connected by *transports* and *devices*



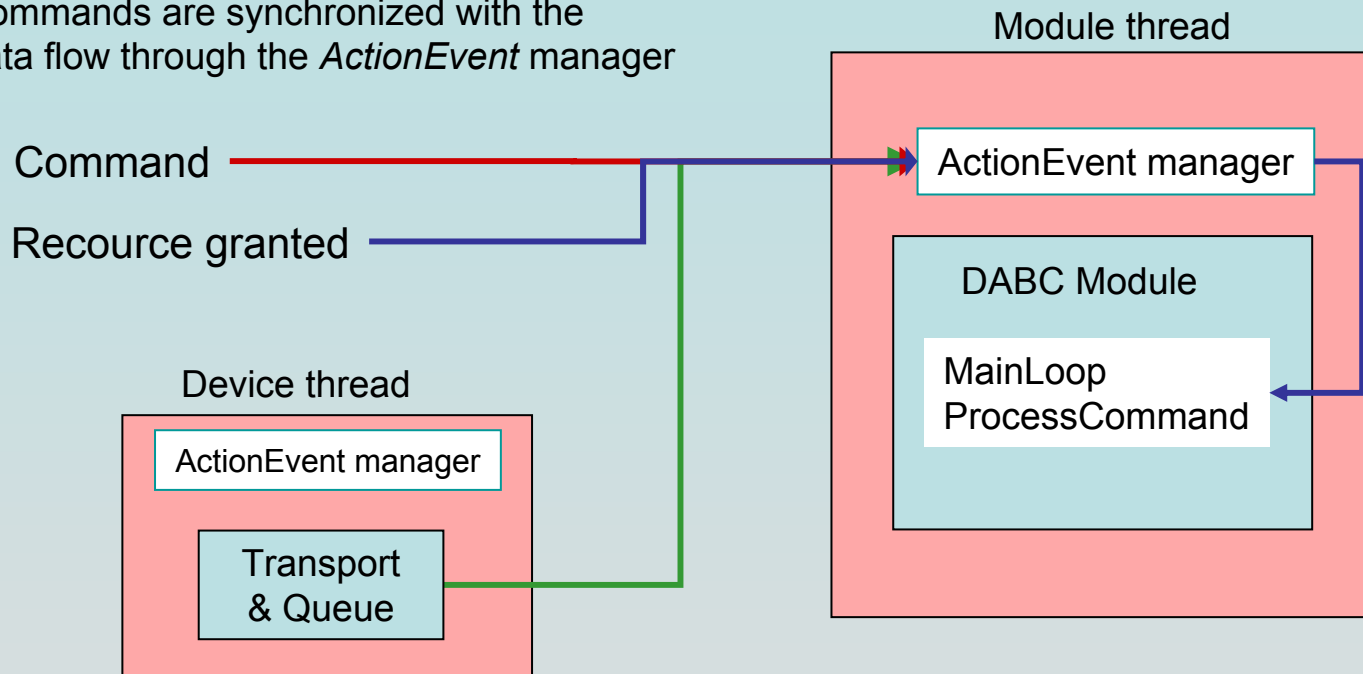


A *module* processes data of one or several data streams.
Data streams propagate through *ports*, which are connected by *transports* and *devices*

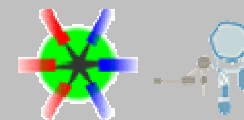




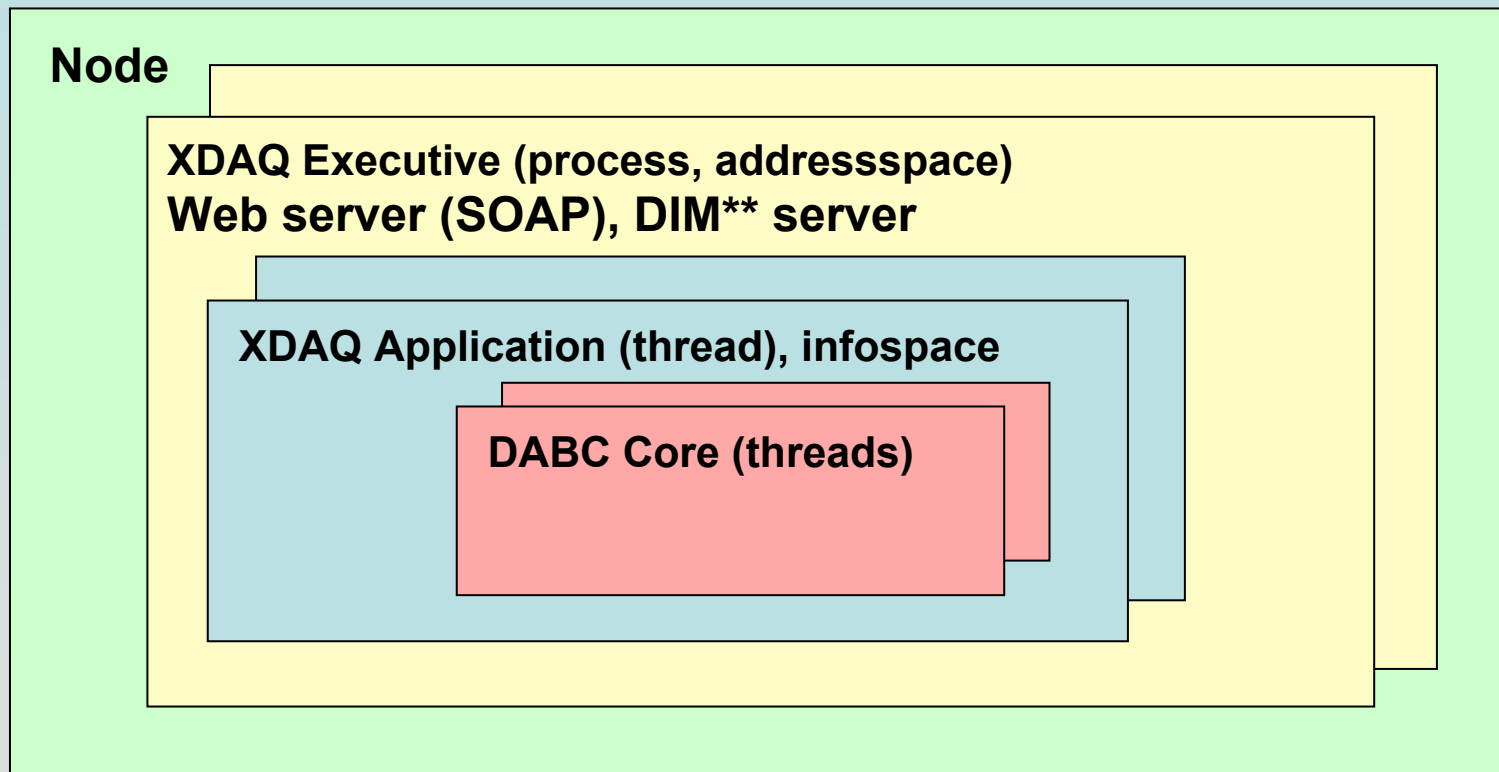
Commands are synchronized with the data flow through the *ActionEvent* manager



A device, i.e. socket device controls one port (transport).
 Once a queue buffer is filled, the transport signals the *ActionEvent* manager, which in turn calls the *MainLoop* function of the associated module, or
 If *MainLoop* was waiting for resource or buffer, it continues.

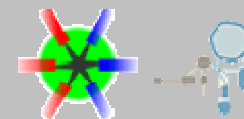


DABC core decoupled from XDAQ environment!

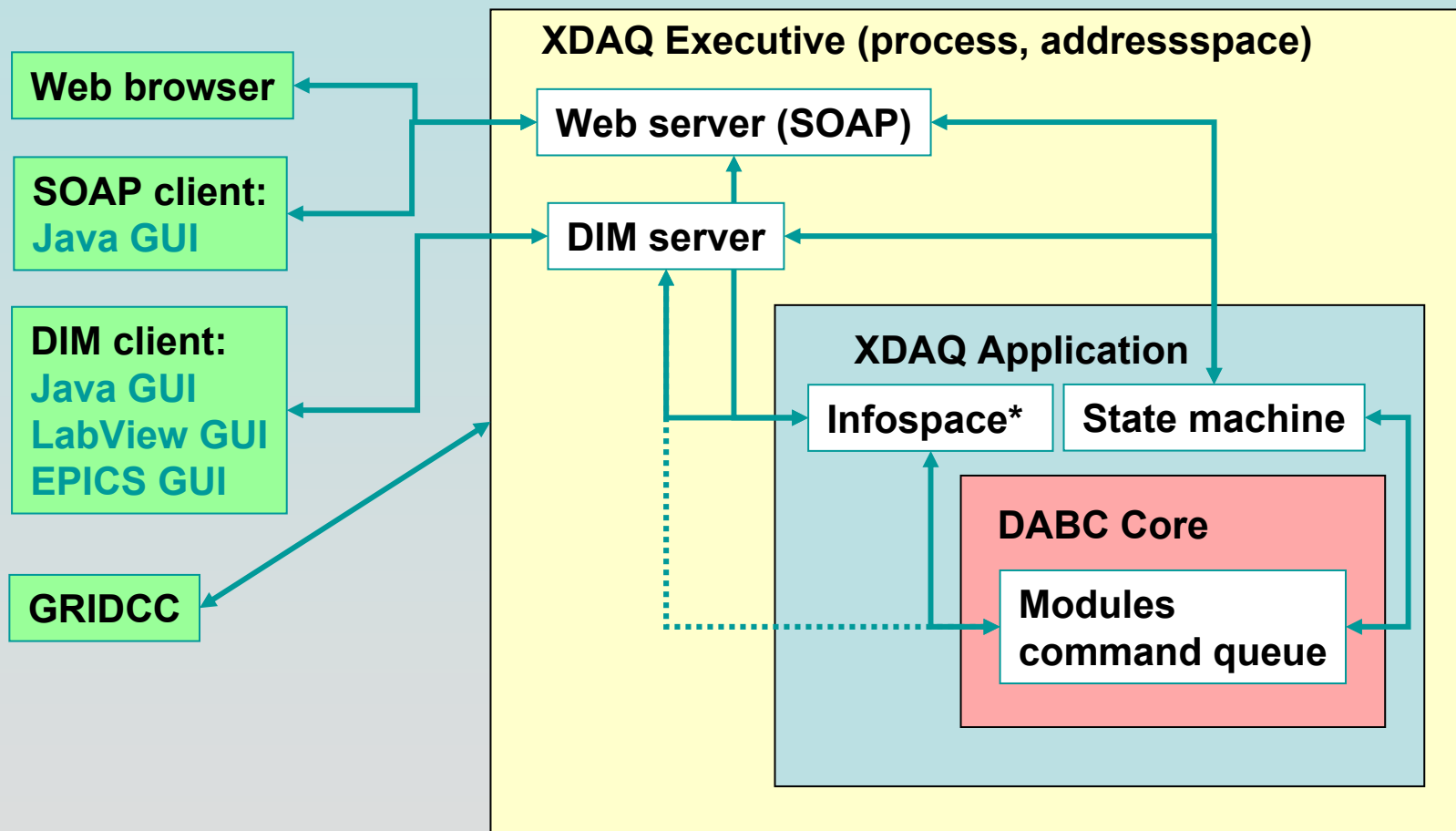


* Standard DAQ framework for LHC CMS experiment
Orsini, Gutleber <http://xdaqwiki.cern.ch>

** DIM: Distributed Information Management System, CERN

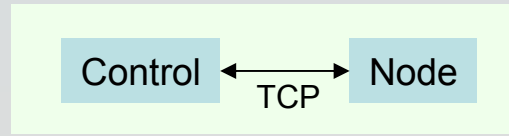
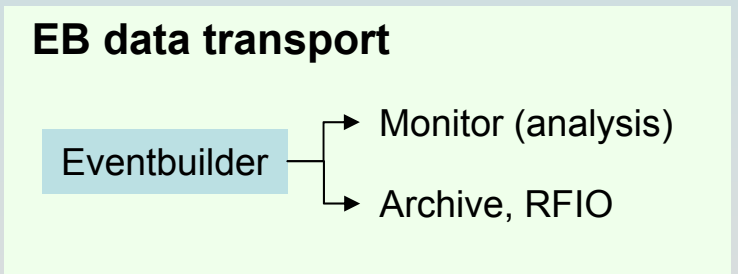
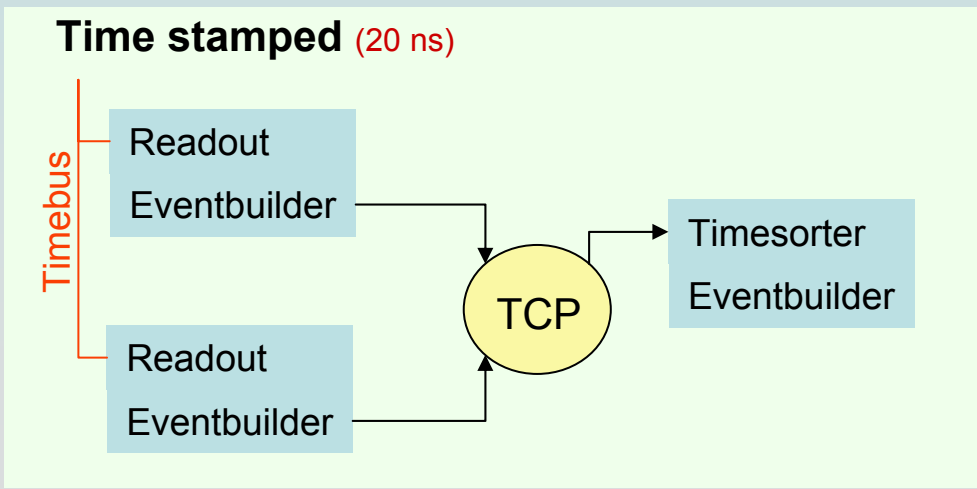
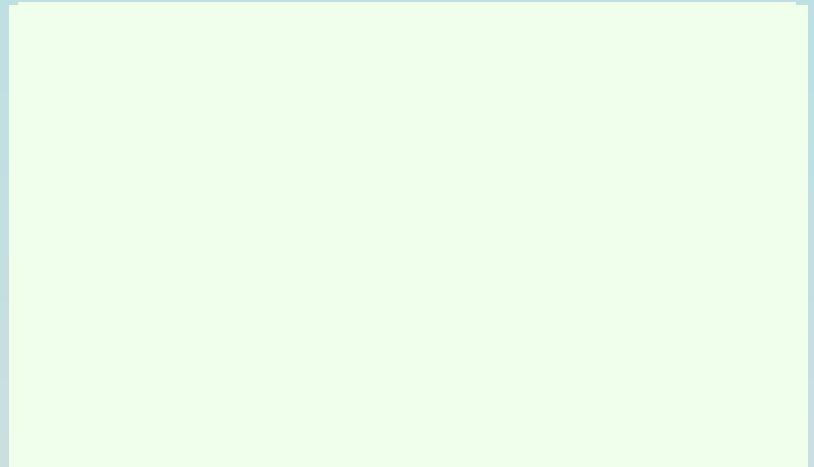
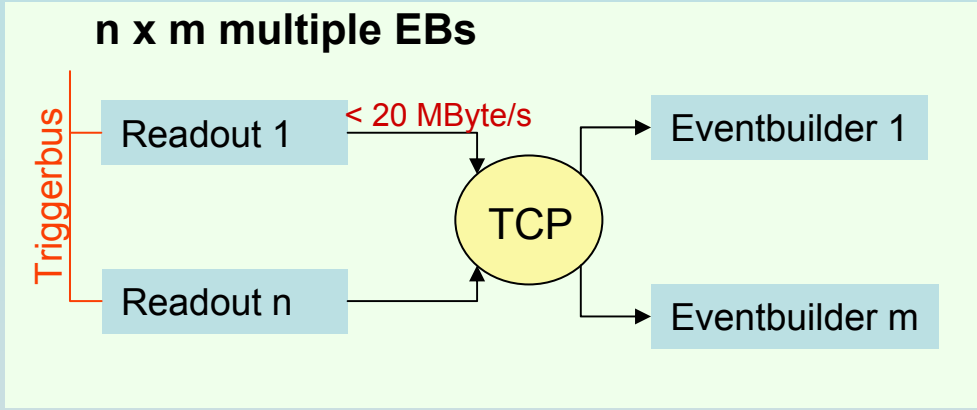
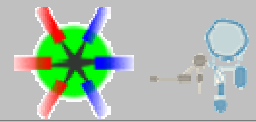


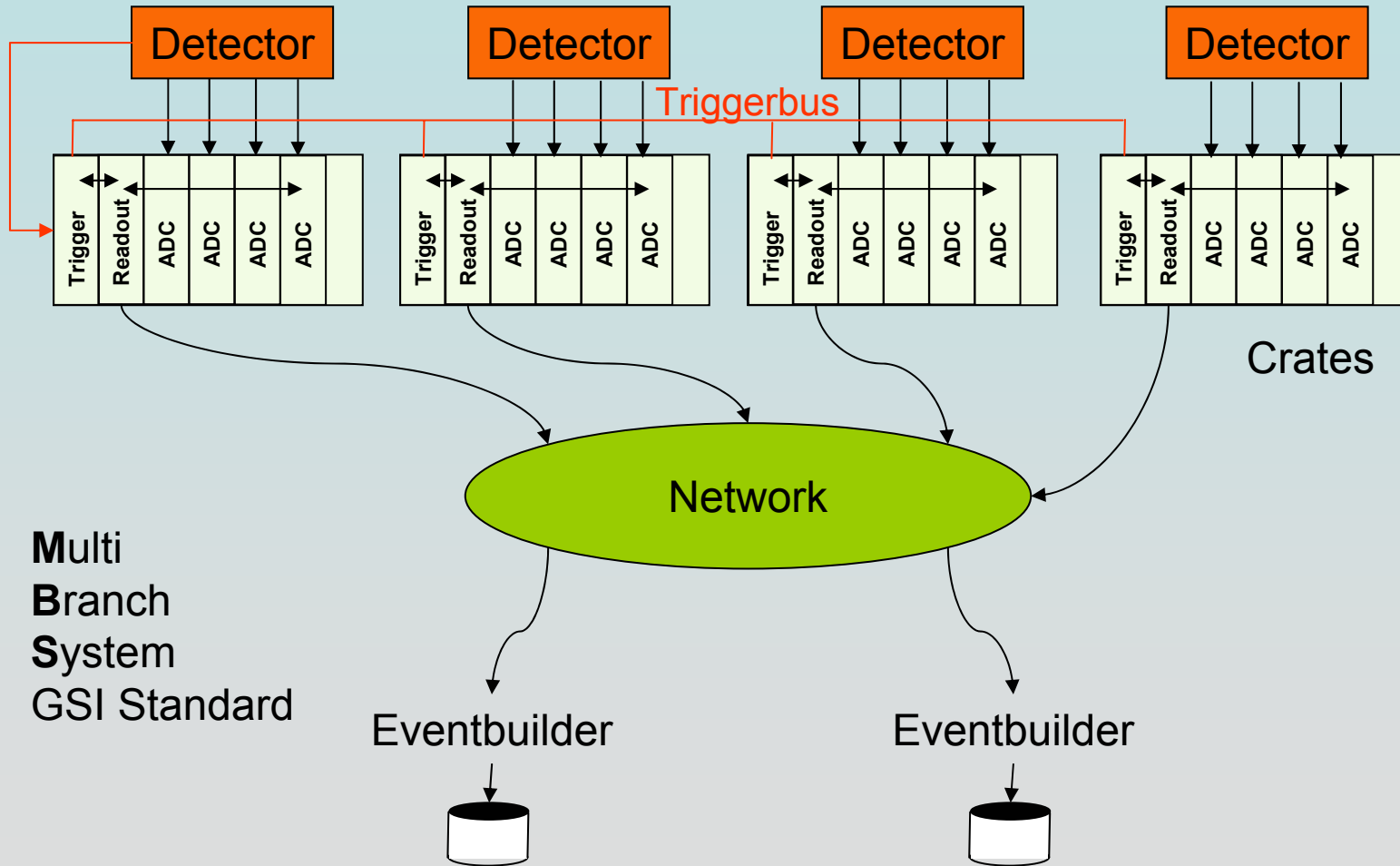
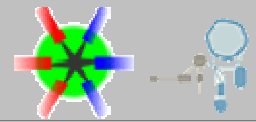
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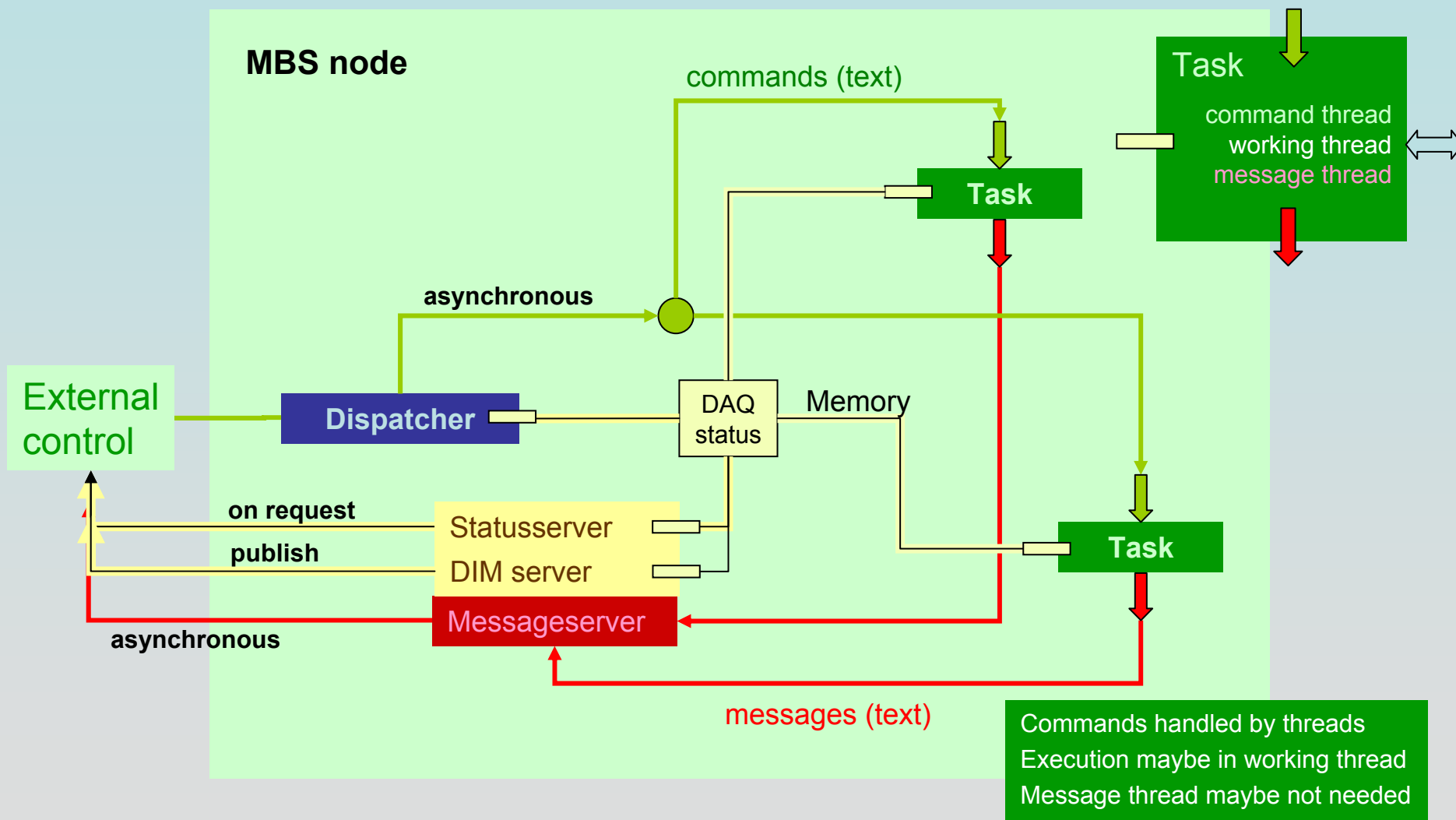
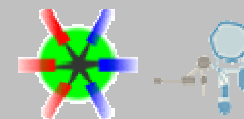


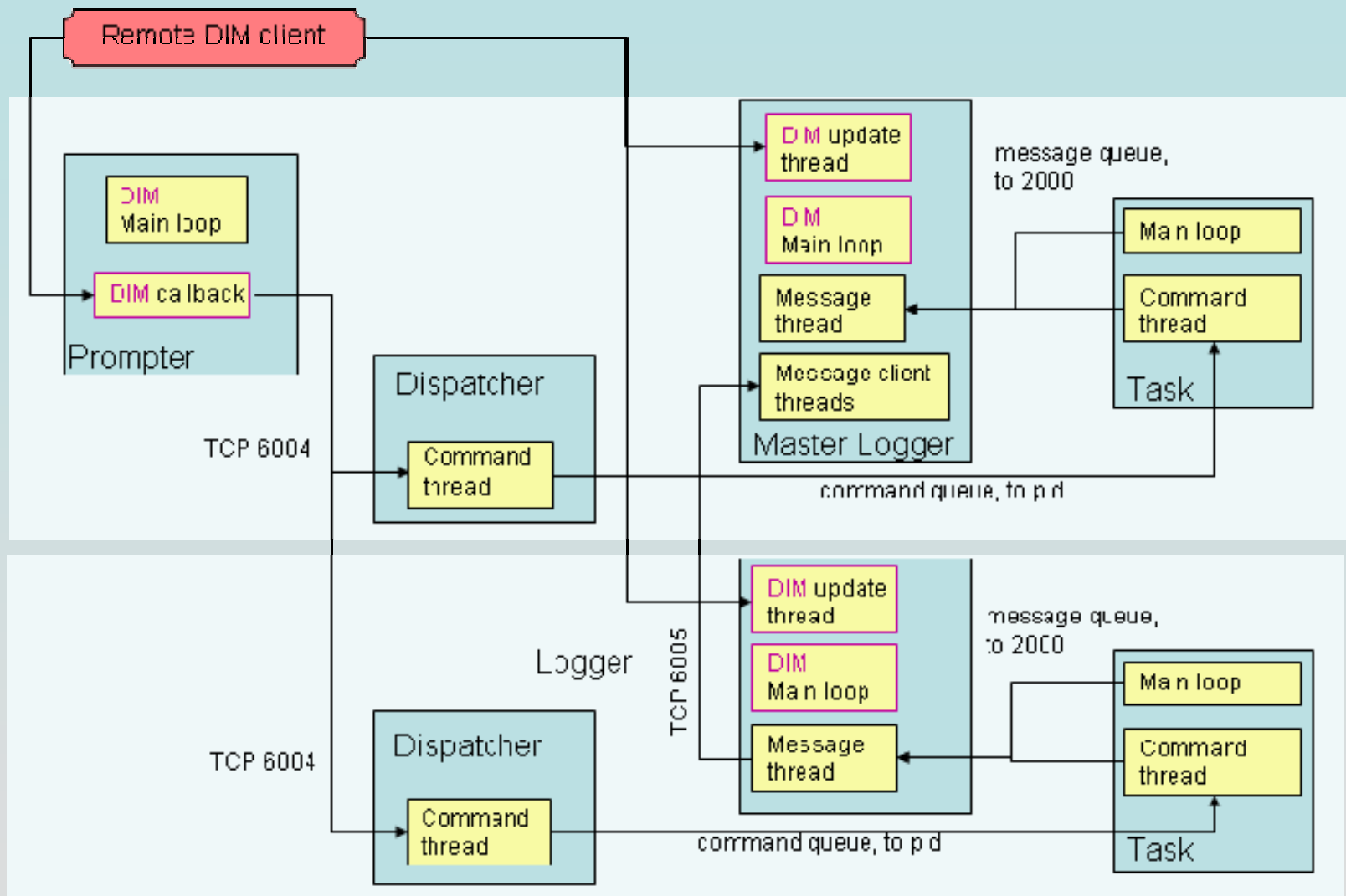
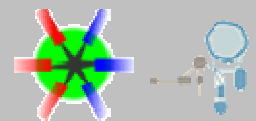
* Infospace: remotely accessible parameters

➤ MBS connection

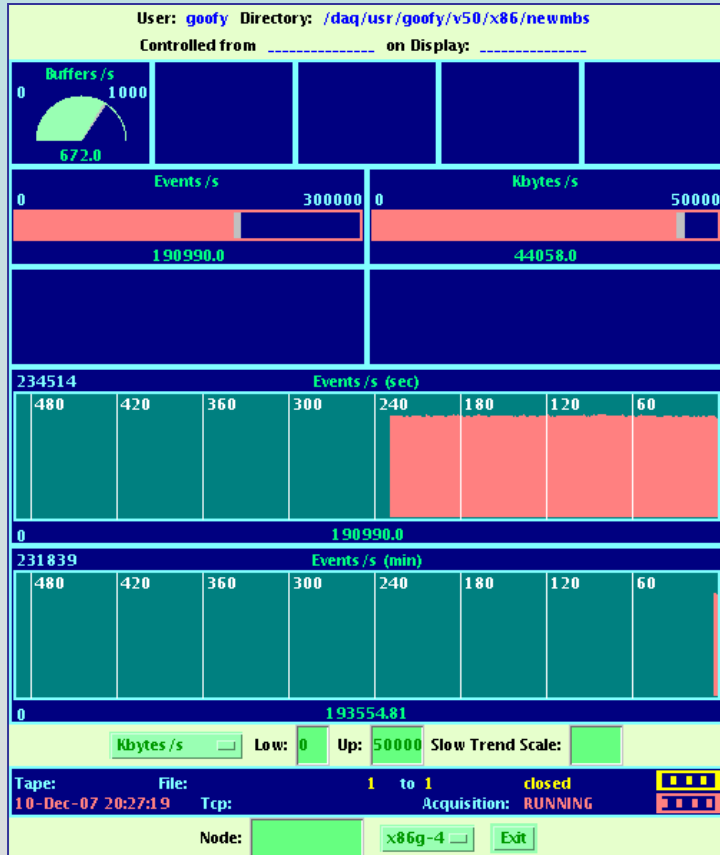
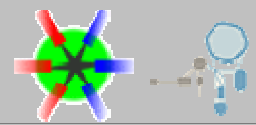








Multi node MBS, controlled by DIM client (red)

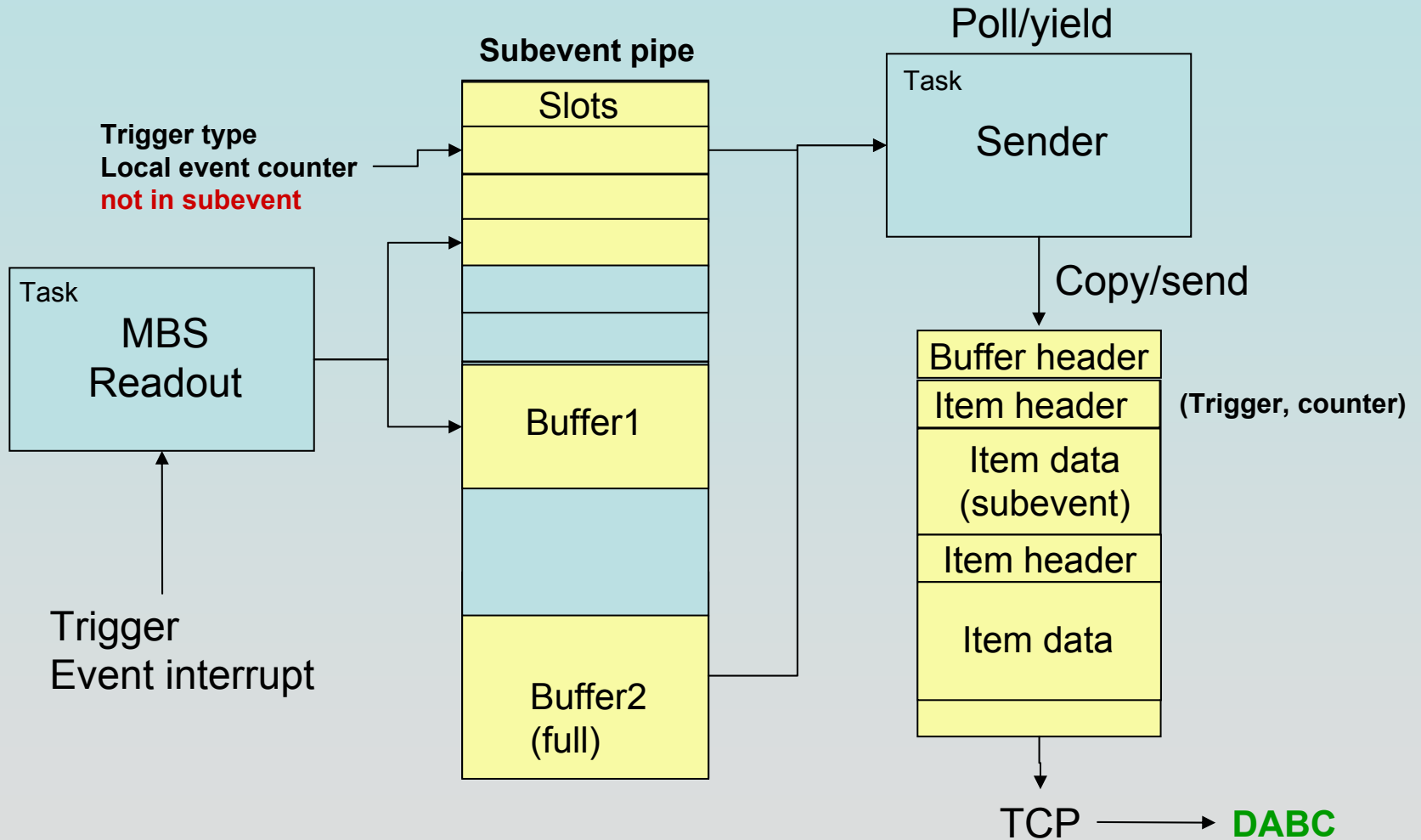
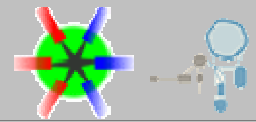


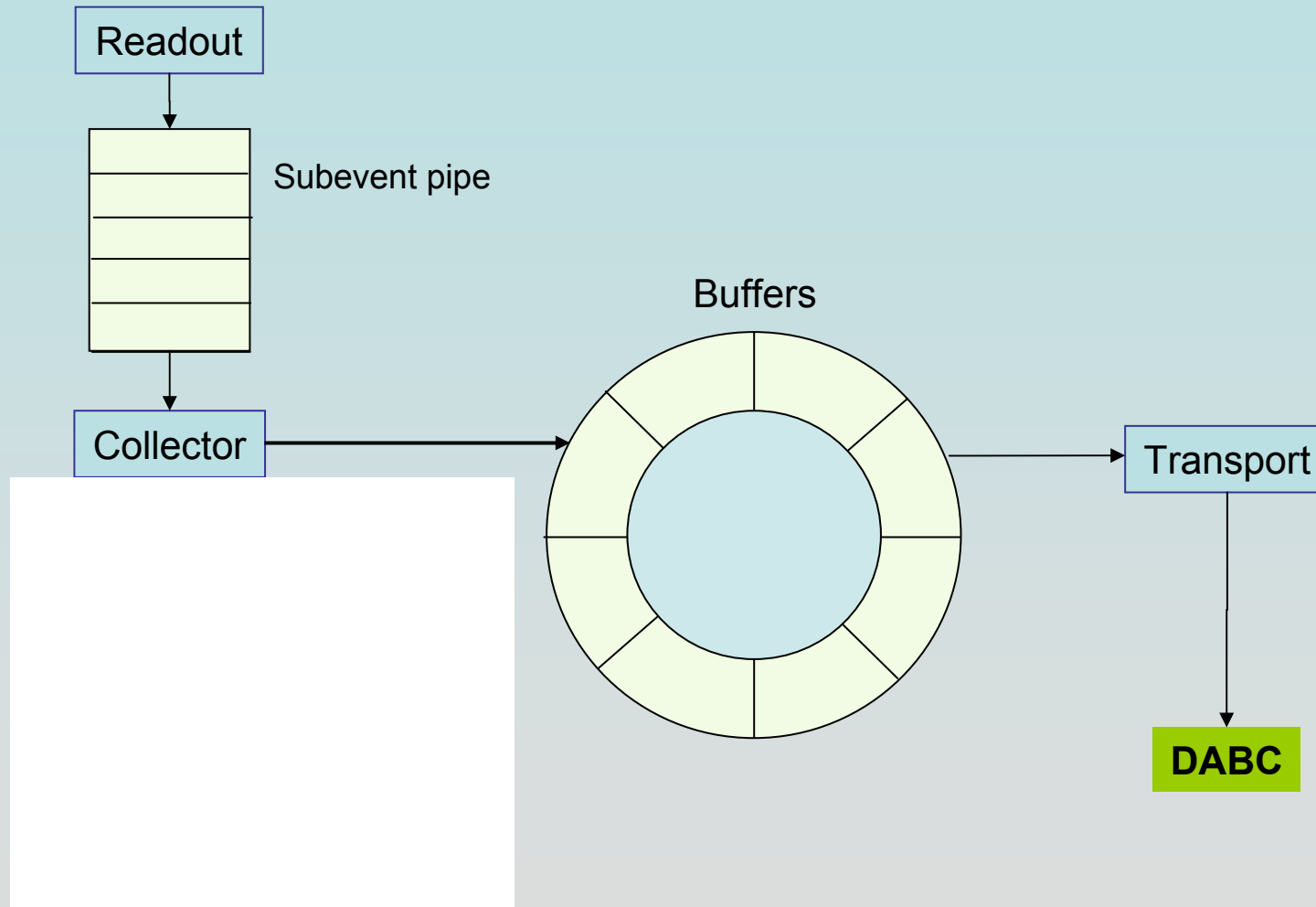
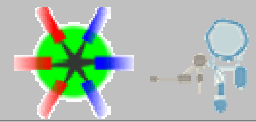
Counters		Rates/sec	
Events	67748699	Events	191850
Buffers	238551	Buffers	675
Streams	238551	Streams	675
Kbytes	15267264	Kbytes	44274
File Kb	0	File Kb	0
Tape Kb	0	Tape Kb	0
EventServ evt	0	EventServ evt	0
EventServ Kb	0	EventServ Kb	0
StreamServ buf	0	StreamServ buf	0
StreamServ Kb	0	StreamServ Kb	0

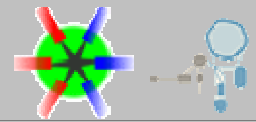
Task Table

Prompter	Not running
Dispatcher	Not running
Message Logger	
Utilities	none
Transport	/daq/usr/goofy/mbs work/v51/bin_PCx86/m_util
Collector	Not running
Rate Meter	/daq/usr/goofy/mbs work/v51/bin_PCx86/m_msg_log
Read Camac	Not running
Read Meb	Not running
Event Server	Not running
Stream Server	Not running
Esome Server	Not running
Histogram Server	Not running
Fastbus SMI	Not running
SE sender	Not running
SE receiver	Not running
SE async receiver	Not running
Rising receiver	
Time sort receiver	Not running
Setup Table	Not loaded
MultiLayer Setup	Not loaded
Readout Table	Not loaded

Stop node survey:

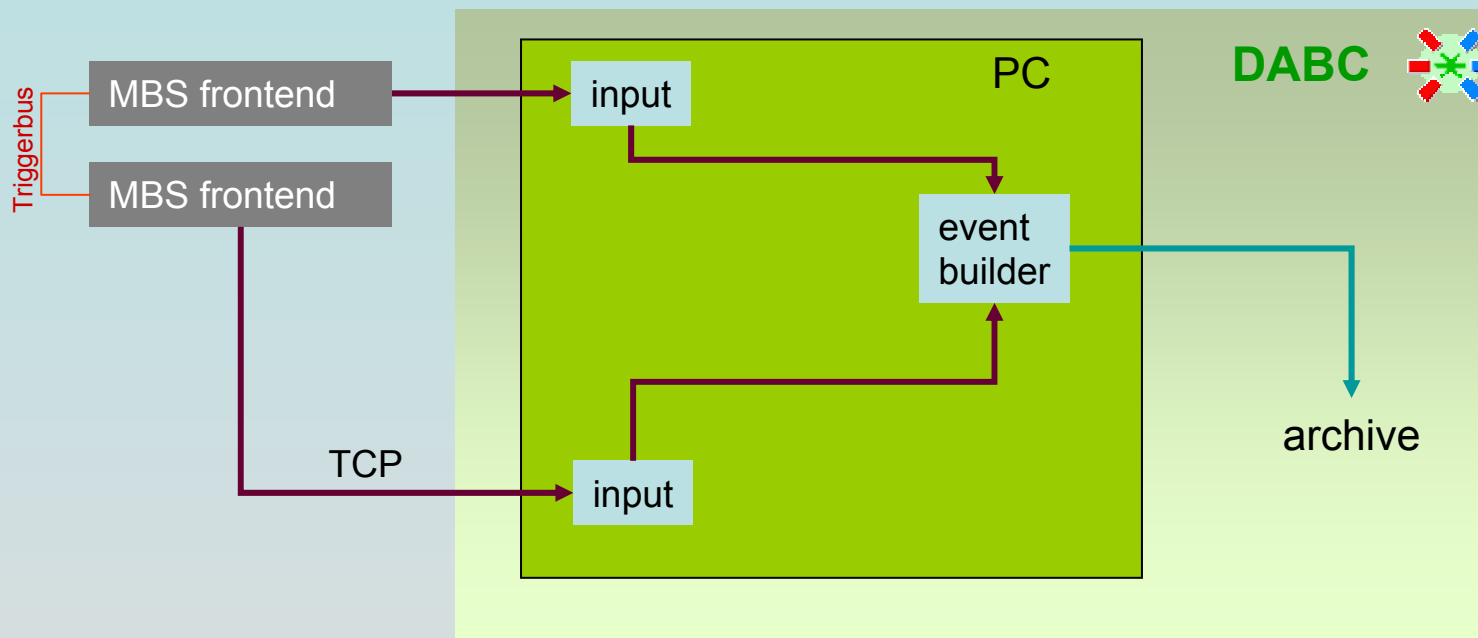
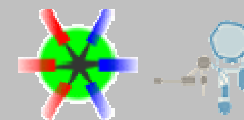


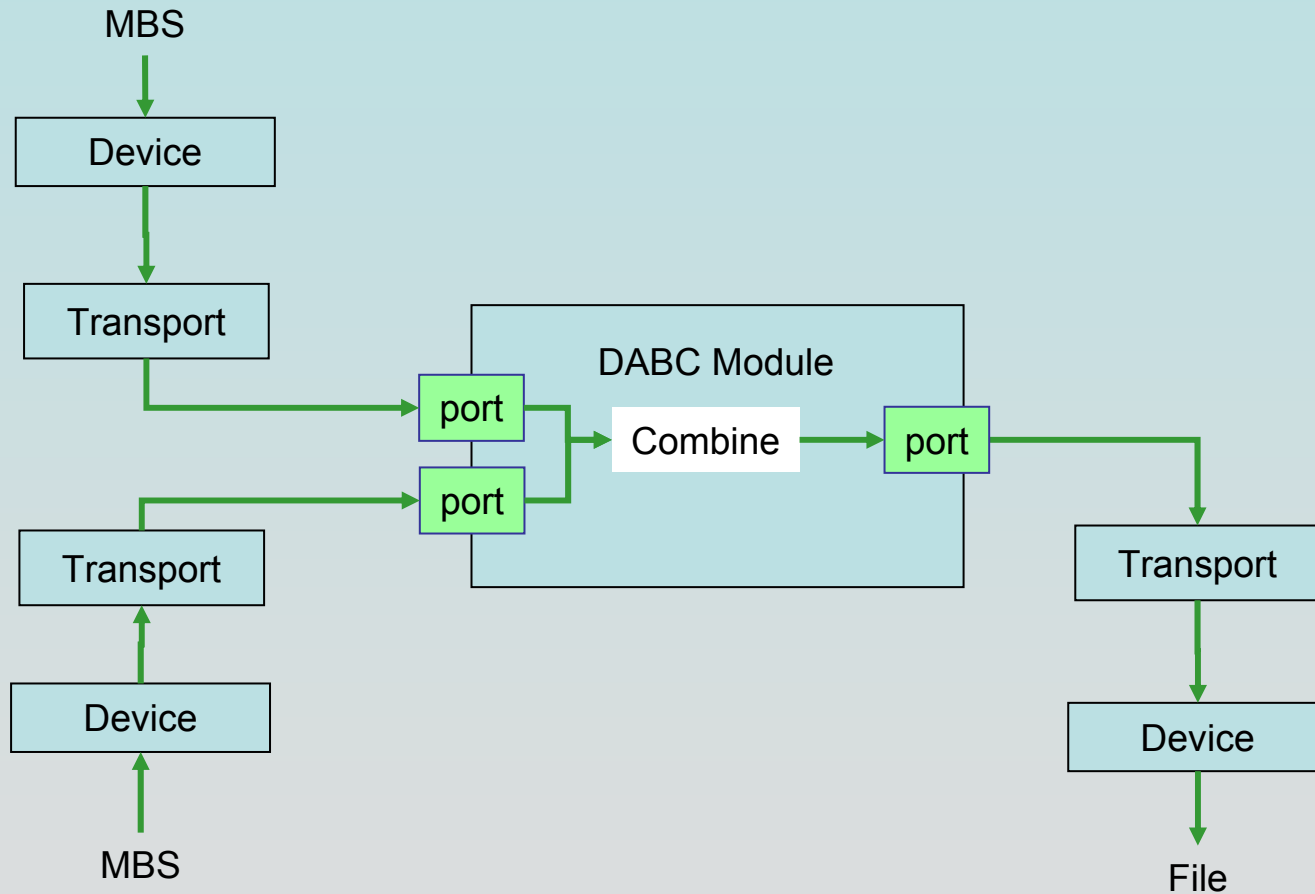
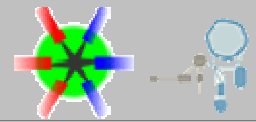


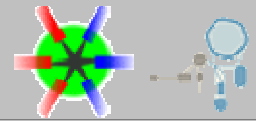


- **General upgrades**
 - ☑ Large buffers (up to now 32K limit) in MBS.
 - ☑ Large buffers in LMD files.
 - ☑ Remote control of MBS via DIM by DABC Java GUI
- **DABC specific mode**
 - ☑ MBS transport in DABC mode blocks, if no DABC is connected.
 - ☑ MBS transport sends variable sized buffers.
 - ☑ Using large buffers and one buffer per stream: no event spanning.
- **New LMD file format**
 - ☑ No buffer structure.
 - ☑ File header, data elements, index table (random access).
 - ☑ No size limit (> 2 GB).
 - ☑ Supported by event API.
- **To do**
 - Event server in DABC

➤ MBS application in DABC







DABC Device

MbsFrontend

MbsFrontend ()

Create commands
Register parameters

CreateTransport (port)

Create MbsRead

DABC Transport

MbsRead

MbsRead (port)

Connect MBS transport
Register port

GetBufferSize ()

Return buffer size

Read (buffer)

Read header
Read data
Return

~MbsRead ()

Disconnect MBS

Thread

DABC Module

MbsCombiner

MbsCombiner ()

Create commands
Register parameters
Create ports (n x input, 1x output)

MainLoop ()

Wait input port 1...n
Get empty buffer
Loop: Add subevent ref. to buffer
Size > max? Put buffer to port
Return

EndLoop

~MbsCombiner ()

Thread

DABC Device

MbsFile

MbsFile ()

Create commands
Register parameters

CreateTransport (port)

Create MbsStore

DABC Transport

MbsStore

MbsStore (port)

Register port

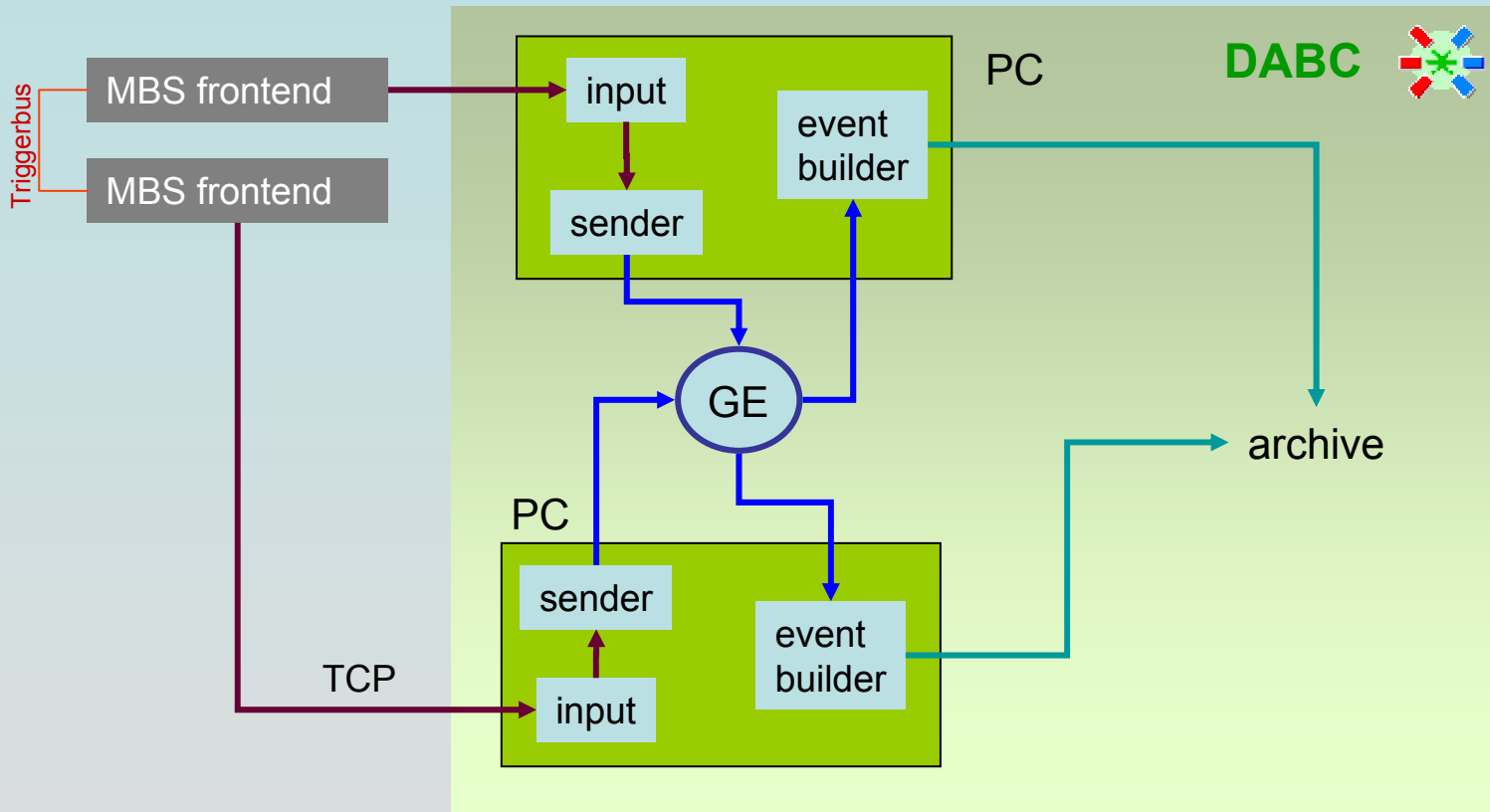
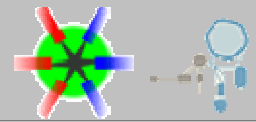
Write (buffer)

Filesize > max?
close/open
Write fragments to file

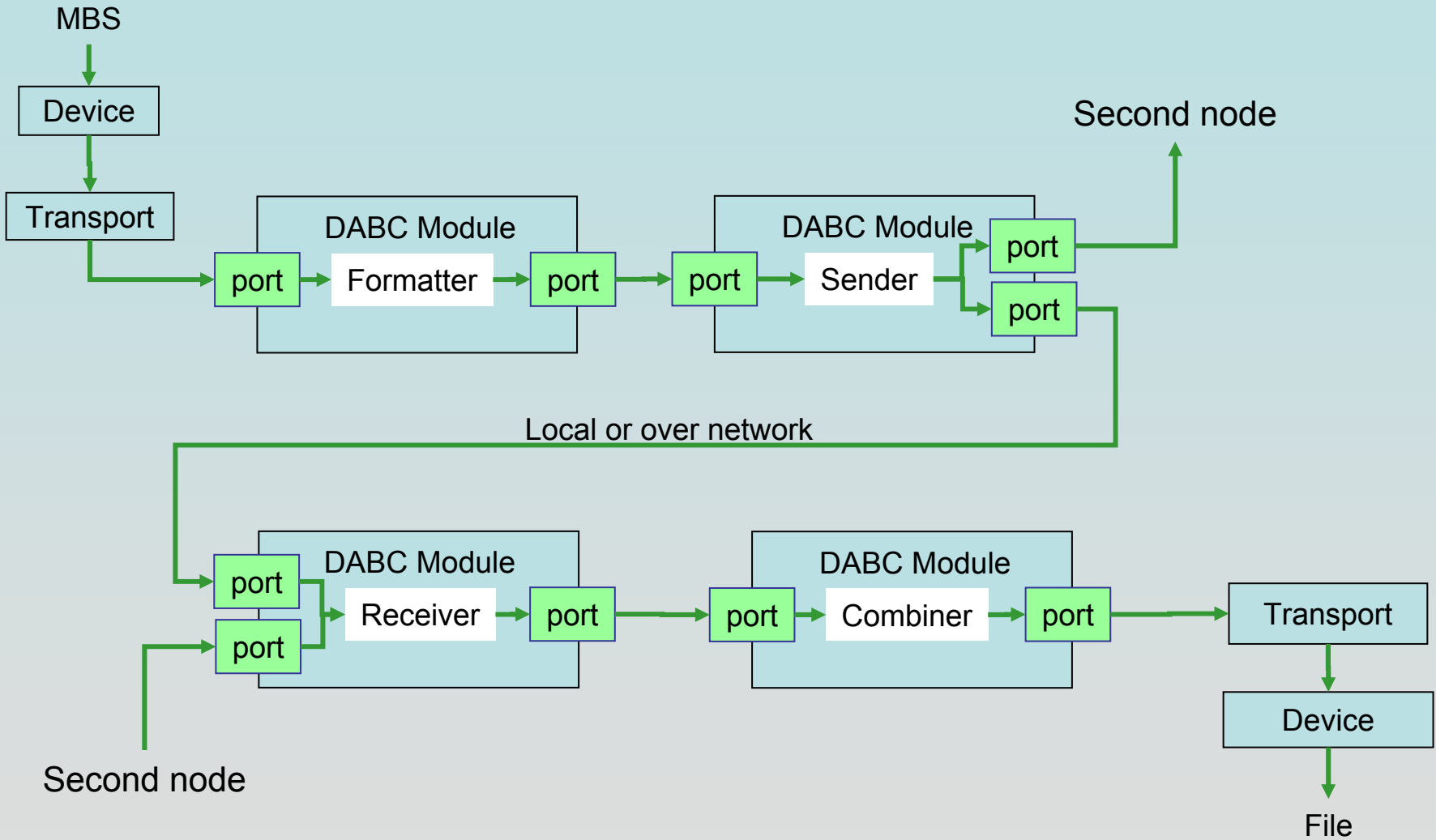
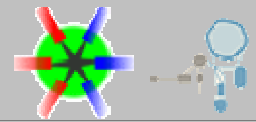
~MbsStore ()

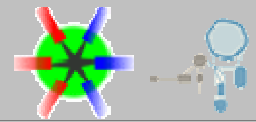
Close last file

Thread



GE: Gigabit Ethernet





DABC Module

MbsCombiner

MbsCombiner ()

Create commands
 Register parameters
 Create ports (1 x input, 1x output)

MainLoop ()

Wait input port 1
 Get empty buffer
 Loop: Add data ref. to buffer
 Size > max? Put buffer to port
 Return

EndLoop

~MbsCombiner ()

Input as before

Thread

DABC Module

BNetSender

BNetSender ()

Create commands
 Register parameters
 Create ports (1 x input, n x output)

MainLoop ()

Wait input port 1
 Put buffer to next output port

~BNetSender ()

Provided by DABC

Thread

DABC Device

BNetNetworkDevice

BNetNetworkDevice ()

Create commands
 Register parameters

CreateTransport (port) ()

Create BNetNetworkTransport

DABC Transport

BNetNetworkTransport

NetNetworkTransport (port)

Register port

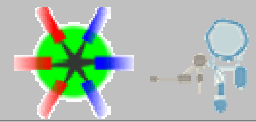
Write (buffer)

Send fragments

~BNetNetworkTransport ()

Provided by DABC

Thread



DABC Device

BNetNetworkDevice

BNetNetworkDevice ()

Create commands
Register parameters

CreateTransport (port)

Create BNetNetworkTransport

DABC Transport

BNetNetworkTransport

BNetNetworkTransport (port)

Register port

Read (buffer)

Receive fragments

~BNetNetworkTransport ()

Provided by DABC

Thread

DABC Module

BNetReceiver

BNetReceiver ()

Create commands
Register parameters
Create ports (n x input, 1 x output)

MainLoop ()

Wait for all input ports
Add input buffers to output list
Put list to output port

~BNetReceiver ()

Provided by DABC

Thread

DABC Module

MbsEventBuilder

MbsEventBuilder ()

Create commands
Register parameters
Create ports (1 x input, 1x output)

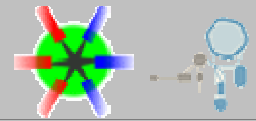
MainLoop ()

Wait input port 1
Get empty buffer
Build event from input list
Put event to buffer
Put buffer to port (file store)

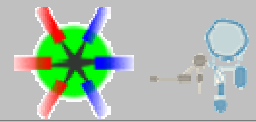
~MbsEventBuilder ()

Thread

➤ DABC setup



- **Configuration via XML files**
- ***ApplicationPlugins* (entry point to application libraries)**
 - Call application factories
- **Application factory classes**
 - CreateDevice
 - CreateModule
 - Device->CreateTransport (Module->GetPort)
 - ConnectPorts (Module1->GetPort, Module2->GetPort)
 - CreateMemoryPool
- **State commands**
 - Startup
 - Initialize
 - Run / Stop
 - Hold / Resume
 - Shutdown



- **Commands**

Objects with command description (XML) and *ProcessCommand* function.

Name string: / **server** / **node** / **application** / **type.thread.name**

- **server**: DIM namespace
- **node**: name:ID (port)
- **application**: namespace::name:ID
- **type**: DEV, MOD, POOL, PLUG
- **thread**: name of module or device or...
- **name**: command (description by related parameter record)

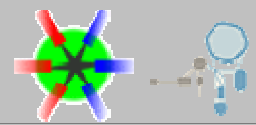
- **Parameters**

Same name structure as above

- **Parameter records**

Recognized by GUI, graphical presentation

- Status
- Rate
- Histogram
- Command description
- and more



DABC Controls

Launcher

Node: Master
 Username: Pluto
 Password: *****
 Directory: working/test

Commands
 Parameters
 Logger
 Status
 RateMeters
 Histograms

Status

Columns

- Ixg05 17:RunStatus S:Enabled
- Ixg05 17:RunStatus S:Enabled
- Ixi002:RunStatus S:Enabled
- Ixi004:RunStatus S:Enabled
- Ixi011:RunStatus S:Enabled
- Ixi006:RunStatus S:Enabled

Histograms

Columns

- Ixg05 17:LatencyHist Int=5921
- Ixi002:LatencyHist Int=5891
- Ixi004:LatencyHist Int=5887
- Ixi006:LatencyHist Int=5920
- Ixi011:LatencyHist Int=5863
- Ixg05 17:LatencyHist Int=0

Commands

Resume

- DABCNetExampleController: 41
 - xg05 17: 1968
- DABCNetExampleWorker: 42
 - xg05 17: 1972
 - xi002: 1972
- SetCombiner
- SetOutput
 - TestRecords: 42
 - xi002: 1972
 - SetParameter

Arguments of command SetOutput, scope public

Queues (L , R) : 8
 Size (L , R) : 4096
 Sync (C , O) : yes

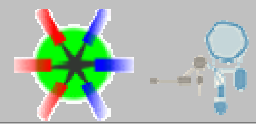
RateMeters

Columns

- Ixg05 17:Bandwidth 12,9
- Ixi011:Bandwidth 12,5
- Ixi002:Bandwidth 12,9
- Ixi004:Bandwidth 13,0
- Ixi006:Bandwidth 12,6

Parameters

ID	Node	Application	Parameter	Current	Set...	Sh...
00000	Ixg05 17: 1968	BNetExampleController: 41	Bandwidth	0.0	-	<input checked="" type="checkbox"/>
00001	Ixg05 17: 1968	BNetExampleController: 41	DABCVersion	DABC Control v0.2(Aug 22...	-	<input type="checkbox"/>
00002	Ixg05 17: 1968	BNetExampleController: 41	Latency	0.0	-	<input checked="" type="checkbox"/>
00003	Ixg05 17: 1968	BNetExampleController: 41	LatencyHist	Histogram	-	<input checked="" type="checkbox"/>
00004	Ixg05 17: 1968	BNetExampleController: 41	PacketRate	0.0	-	<input checked="" type="checkbox"/>
00005	Ixg05 17: 1968	BNetExampleController: 41	RunStatus	Enabled	-	<input checked="" type="checkbox"/>
00006	Ixg05 17: 1968	BNetExampleController: 41	State	Enabled	-	<input type="checkbox"/>
00007	Ixg05 17: 1968	BNetExampleController: 41	TestDouble	3.14159	-	<input type="checkbox"/>
00008	Ixg05 17: 1968	BNetExampleController: 41	TestInteger	1	-	<input type="checkbox"/>
00009	Ixg05 17: 1968	BNetExampleController: 41	TestString	Dies ist ein Text zum Test...	-	<input type="checkbox"/>
00010	Ixg05 17: 1968	BNetExampleController: 41	controllerIP	Ixg05 17	-	<input type="checkbox"/>



DABC Controls

MbsLauncher

Login

Node: x86g-4
 Username: goofy
 Password:
 Userpath: v50/x86/newmbs
 Systempath: /daq/usr/goofy/mbswork/v51/
 Script: script/remote_exe.sc
 Command: lm_rising v50/x86/newmbs . x86g-4

Commands

Arguments of command MbsShoAcq, scope Common

Argument (C) :

Parameters

ID	Node	Application	Parameter	Current	Set value	Show
000...	X86-7:0	MBS:0	Acquisition	Running	-	<input checked="" type="checkbox"/>
000...	X86-7:0	MBS:0	BufferSize	65536	-	<input type="checkbox"/>
000...	X86-7:0	MBS:0	Buffers	849394	-	<input type="checkbox"/>
000...	X86-7:0	MBS:0	DataRate	48146.0	-	<input checked="" type="checkbox"/>
000...	X86-7:0	MBS:0	DataRateT	48146.0	-	<input checked="" type="checkbox"/>
000...	X86-7:0	MBS:0	Date	06-Feb-08 13:28:41	-	<input type="checkbox"/>
000...	X86-7:0	MBS:0	EventRate	208794.0	-	<input checked="" type="checkbox"/>
000...	X86-7:0	MBS:0	EventRateT	208794.0	-	<input checked="" type="checkbox"/>
000...	X86-7:0	MBS:0	Events	241228029	-	<input type="checkbox"/>
000...	X86-7:0	MBS:0	Experiment		-	<input type="checkbox"/>
000...	X86-7:0	MBS:0	GuiNode		-	<input type="checkbox"/>
000...	X86-7:0	MBS:0	MBytes	54361	-	<input type="checkbox"/>
000...	X86-7:0	MBS:0	Run		-	<input type="checkbox"/>
000...	X86-7:0	MBS:0	User	goofy	-	<input type="checkbox"/>

States

Columns

- X86-7: Stopped collector
- X86-7: Stopped readout
- X86-7: Running rising emulator
- X86-7: Loaded ml setup set_mo_x86-7.usf
- X86-7: Running transport
- X86-7: Running utility
- Current node: X86-7
- X86G-4, X86-7
- X86G-4: Stopped collector
- X86G-4: Stopped readout
- X86G-4: Running rising emulator
- X86G-4: Loaded ml setup set_mo.usf
- X86G-4: Running transport
- X86G-4: Running utility

RateMeters

Columns

- X86-7: DataRate 48146,0
- X86-7: EventRate 208794,0
- X86G-4: DataRate 45031,0
- X86G-4: EventRate 195281,0

Logger

Logging

```
-X86-7 :util :SB setup NOT LOADED. MO setup LOADED from set_mo_x86-7.usf.
-X86-7 :util :Readout table NOT LOADED, acquisition RUNNING.
-X86-7 :util :There are 10 streams with 1 buffers a 65536 [b] each.
-X86-7 :util :-----
-X86-7 :util :Name of output device =
-X86-7 :util :Tape label = , Dismounted, file CLOSED
-X86-7 :util : 0.000 [MB] written to tape, 0.000 to file
-X86-7 :util :-----
-X86-7 :util :Collected: 51957.9238 MB, 792815 Buffers, 225159519 Events.
-X86-7 :util :Rate : 48012 KB/s, 733 Buffers/s, 208052 Events/s
-X86-7 :util :-----
```

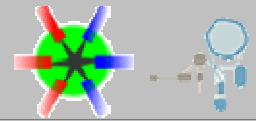
Status

Columns

- X86-7: Acquisition W:Running
- X86G-4: Acquisition W:Running

Control MBS

Everything generated from MBS DIM servers except MBS Launcher

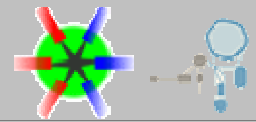


Achieved

- Infrastructure
- Data flow engine
- Very first (0.1) Java GUI
- PCI support
- MBS event building
- Final Programming Interface definitions

Todo

- Controls, GUI
- Data formats
- Combiner/Time sort
- Event building
- Final Programming Interface implementation
- Final packaging
- MBS GUI
- Documentation



- People of data processing group
 - H.G.Essel
 - J.Adamczewski
 - N.Kurz
 - S.Linev
- People of controls group
maybe one FTE
- People from CBM
hopefully
- **CBM requires in 2008 a data taking system**
Start with small system, grow on demand
Preliminary controls
- **NUSTAR ?**
In discussion
- **MBS** a first test bed