

Control Software for the LBT interferometer LINC-NIRVANA

27. March 2012

Technical Seminar

DESY Zeuthen

Jan Trowitzsch [trowitzsch@mpia.de]
Florian Briegel [briegel@mpia.de]
Max-Planck-Institute for Astronomy, Heidelberg



Outline

- Introduction to LINC-NIRVANA
- MPIA common software
 - Development tools and frameworks
 - Components and features
- Control Software for LINC-NIRVANA



LINC-NIRVANA

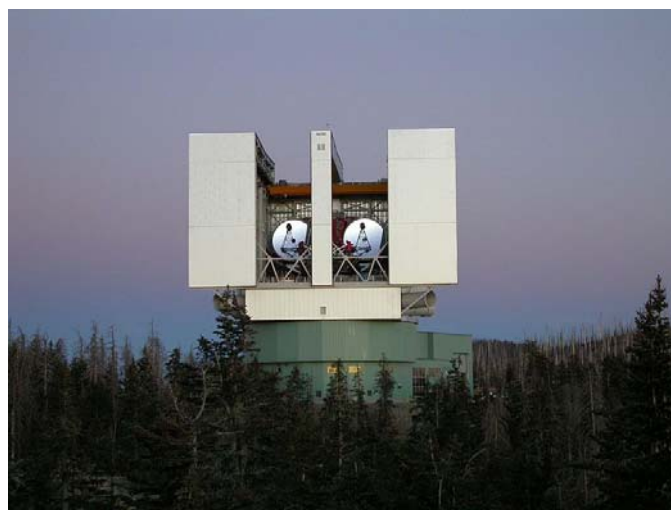
- **LBT Interferometric Camera and Near-Infrared / Visible Adaptive Interferometer for Astronomy**
 - Imaging beam combiner for the LBT
- **Multi-conjugated Adaptive Optics: MCAO**
 - High-layer and ground-layer sensing and correction using adaptive mirrors
 - Guidestars for wavefront measurement
- **Several rotating fields**



3/27/2012 Technical Seminar DESY Zeuthen

3

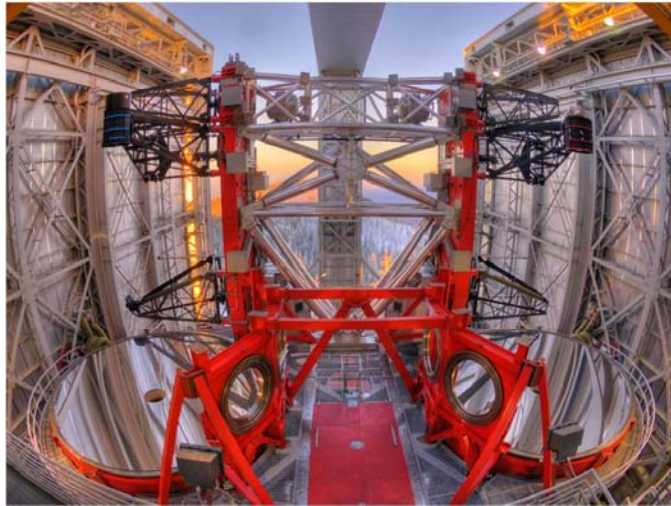
Large Binocular Telescope



3/27/2012 Technical Seminar DESY Zeuthen

4

Large Binocular Telescope

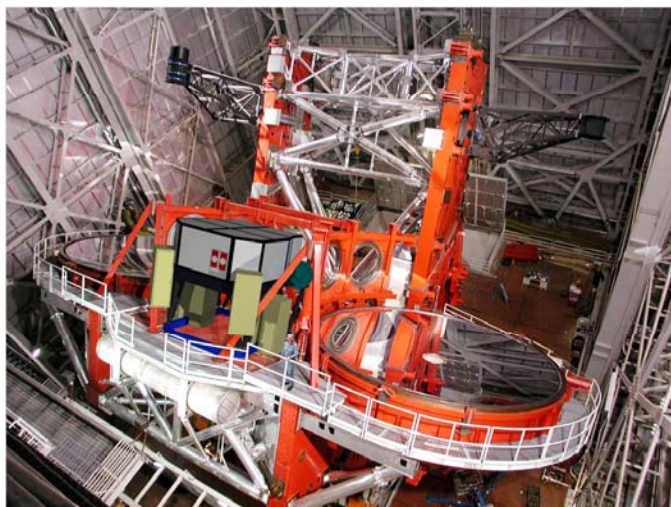


3/27/2012 Technical Seminar DESY Zeuthen

5



LINC-NIRVANA

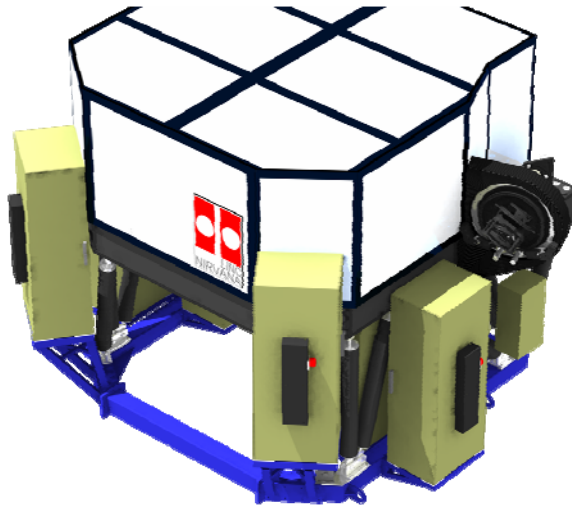


3/27/2012 Technical Seminar DESY Zeuthen

6



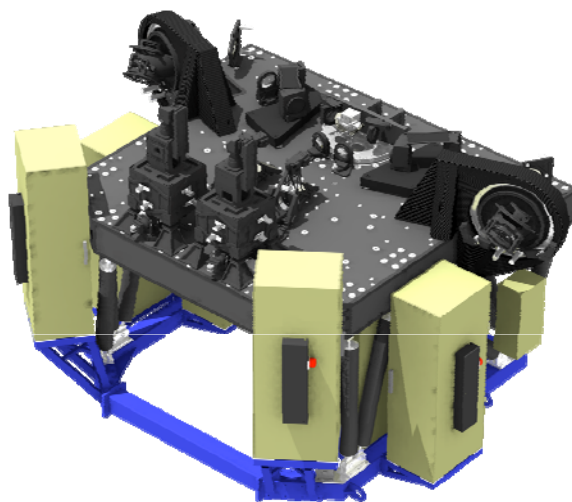
LINC-NIRVANA



3/27/2012 Technical Seminar DESY Zeuthen

7

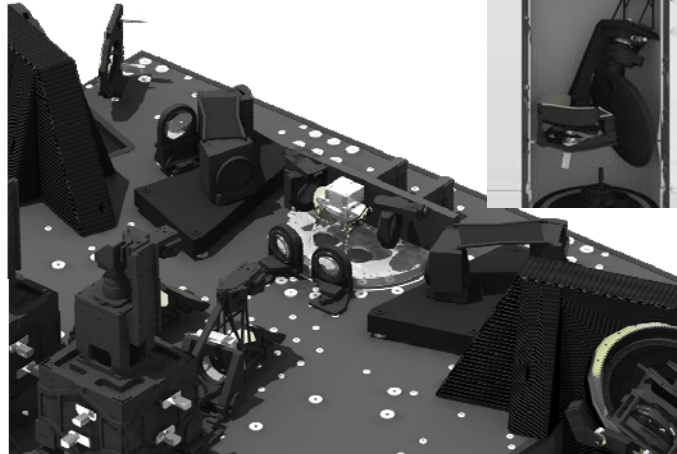
LINC-NIRVANA



3/27/2012 Technical Seminar DESY Zeuthen

8

LINC-NIRVANA



3/27/2012 Technical Seminar DESY Zeuthen

9

What needs to be controlled?

- 4 Wavefront sensors → AO Loops
- 6 De-rotating elements
- Detector positioning and readout
- Many movable elements on motorized stages (ca. 120)
- Interaction with the telescope
- We will have multiple services running on 8 different computers



3/27/2012 Technical Seminar DESY Zeuthen

10

MPIA Common Software

- **TwiceAsNice**
 - Framework for developing service oriented architectures – SOA
 - Linux only
 - Based on Ice and Qt
- 1. **Neubau**
- 2. **Nice**
- 3. **Basda**
 - Mocca, Tempo, Vino, IO, Misda...



3/27/2012 Technical Seminar DESY Zeuthen

11

Third party software

- **Internet Communications Engine (Ice)**
from ZeroC – www.zeroc.com
 - Distributed computing platform
 - Provides powerful network infrastructure
 - Supports many languages: C++, Java, Python, Ruby...
- **Qt and Qwt** – qt.nokia.com
 - Crossplatform application and UI framework
 - Widgets for technical applications
- **Boost** – www.boost.org
 - Widely useful C++ source libraries



3/27/2012 Technical Seminar DESY Zeuthen

12

Development Organization

- Version control using subversion – SVN
- Using TRAC on top of SVN
 - Web-based software project management
 - Issue tracking system – Tickets
 - Enhanced wiki system (documentation)
 - Allows linking of sources or tickets to wiki pages
 - Plugins and enhancements:
 - Blog, Discussion, Roadmap based on tickets, Source browser ... extendable
 - trac.edgewall.org



3/27/2012 Technical Seminar DESY Zeuthen

13

Development Organization



Welcome to Twice as Nice

TwiceasNice is a new and flexible developer framework for high performance SOA based systems, using the middleware ICE by ZeroC Inc. for interprocess communication and Trolltechs Qt Platform Rich Client Development Framework Qt. The framework was developed at the Max Planck Institute for Astronomy in Heidelberg Germany within the scope of the LBT interferometer LINC NIRVANA control software, but may also be used, in respect of its flexibility, for other astronomical instruments. The systems architecture was designed to decrease the development time of large SOA based systems like astronomical instrument control software. The advantages of this new framework is the combination of online instrument data handling, validation and the ability to integrate user defined data manipulation, which can be executed during instrument operation. This way the development time may include just in-time data pipelining functionalities into the system.

Enjoy! The Ten Team



News

TwiceasNice Crashcourse 17 Februar 2011 in Heidelberg
TwiceasNice Crashcourse 26/29 Januar 2009 in Heidelberg
Nice & Basia crashcourse over TwiceasNice
Presentation 15.09.2008 — First online presentation!

Status Overview

Basia — Developers guide for the Basia Applications Services Devices Architecture

User Manual

Getting Started — Let's go!
Ranger — Engineering user interface for management and distributed service control.
Sapi — Standalone application to start dedicated user interfaces and python based procedures.
Basia — Lets start to move a motor. An introduction of a site wide World Wide Web application.

Programmers Manual

Jumbie — General Documentation, Scripting Software and more.
Touba — User guide for the build system Touba
Nice — Developers guide for the Common Software Base Instrument Control Environment
Basia — Developers guide for the Basia Applications Services Devices Architecture

For a complete list of local wiki pages, see [Twinixes](#).



3/27/2012 Technical Seminar DESY Zeuthen

14

Development Organization

- Continuous integration testing using:
 - *Bitten:*
 - continuous integration plugin for Trac
 - Python-based framework for collecting various software metrics via continuous integration
 - *Jenkins:*
 - Extendable open source continuous integration server
 - Several plugins available
- bitten.edgewall.org
- jenkins-ci.org



3/27/2012 Technical Seminar DESY Zeuthen

15

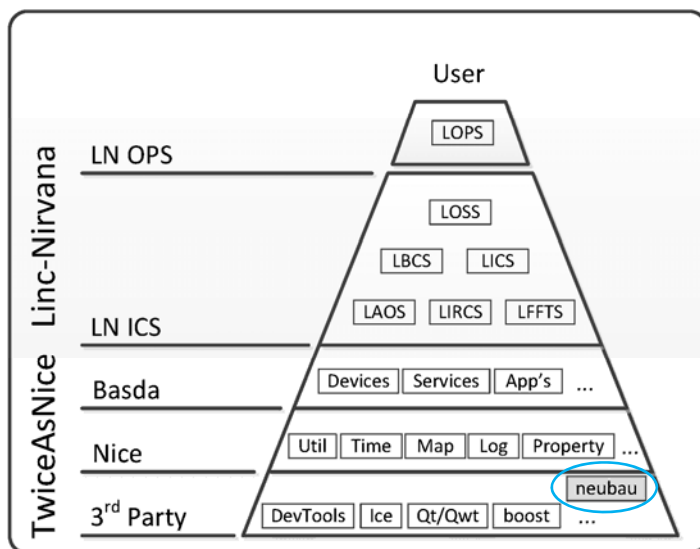
Continuous Integration



3/27/2012 Technical Seminar DESY Zeuthen

16

Software Overview



3/27/2012 Technical Seminar DESY Zeuthen

17

Neubau

- Perl script for creating auto tools based projects
 - Helps to manage projects
 - Adding subdirectories
 - Keeping the *subdir* tree of *configure.in* in an *Makefile.am* synchronized
 - Code template support, for creating pieces of code
 - *Autoconf* macros for finding various software packages (boost, qt4, ice, ...)
- gnu.org/software/autoconf

3/27/2012 Technical Seminar DESY Zeuthen

18

Neubau

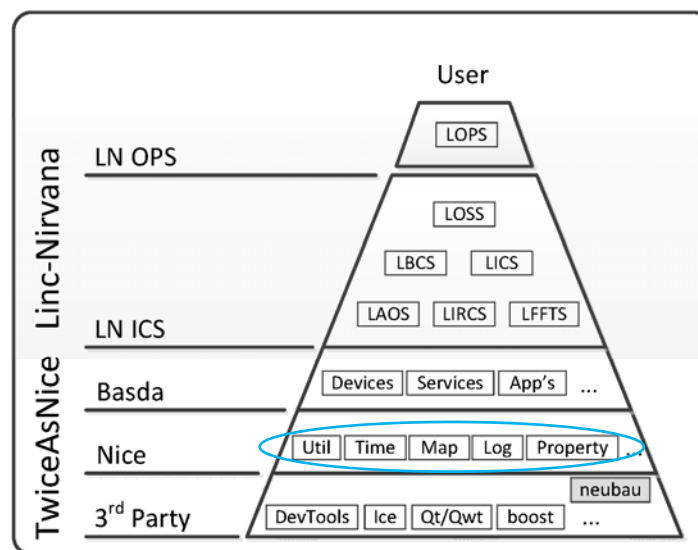
- Automake build rules for administration
 - Automatic subversion add
 - Building of rpm packages
 - Doxygen documentation ...
- Automake build rules for compiling not supported meta languages and formats
 - Qt, ice, png, nice, ...
- gnu.org/software/automake



3/27/2012 Technical Seminar DESY Zeuthen

19

Nice

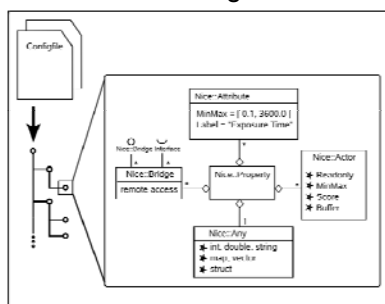


3/27/2012 Technical Seminar DESY Zeuthen

20

Heart and Soul - Properties

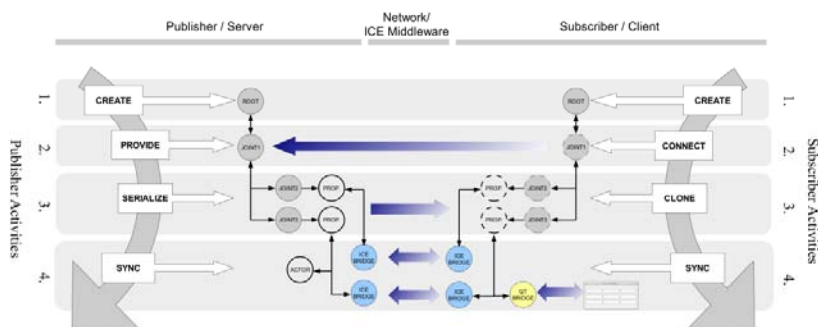
- Property:
 - Weak typed data container attached to a Joint
 - All supported data types of our framework can be placed here
 - May contain a set of bridges to communicate with outside world
 - May contain a set of actors to trigger actions whenever the internal value is about to change



3/27/2012 Technical Seminar DESY Zeuthen

23

Service – Client Connections

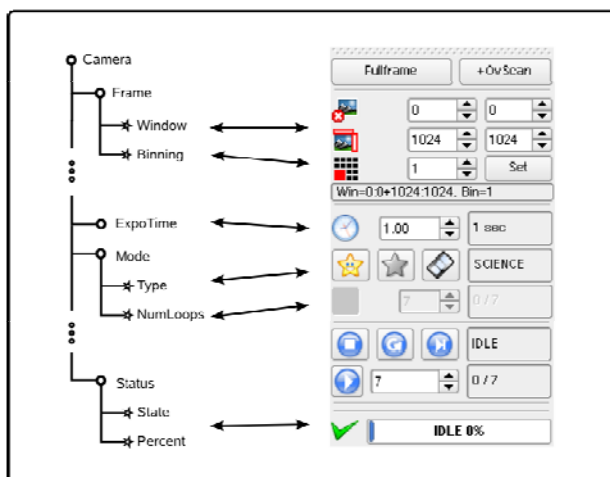


1. Server & Client create a Joint root node
2. Client connects to publisher's Joint node
3. Server sub-tree is cloned at client side and an Ice bridge is attached to each property
4. Property value changes are distributed via attached Ice bridges to all subscribers

3/27/2012 Technical Seminar DESY Zeuthen

24

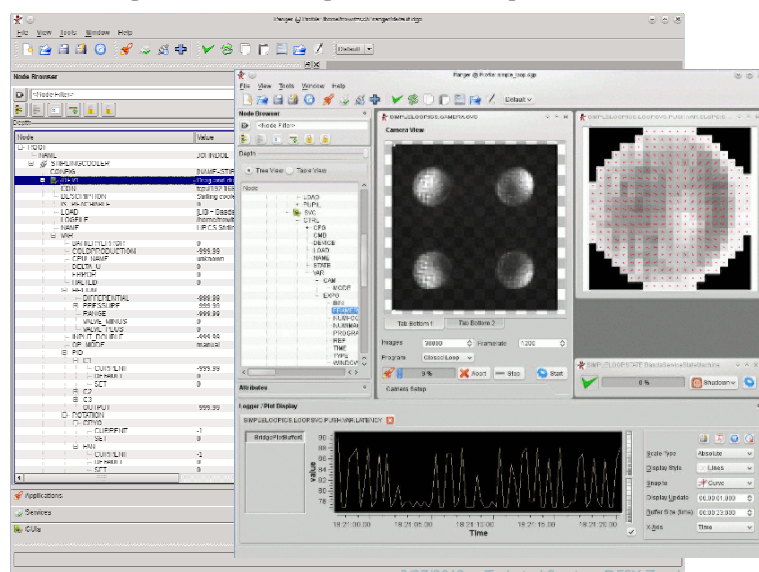
More Heart and Soul



3/27/2012 Technical Seminar DESY Zeuthen

25

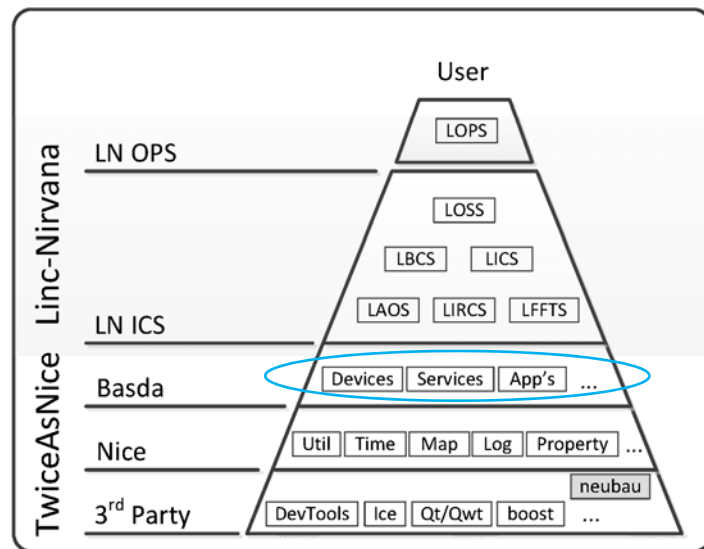
Ranger – Engineering Interface



3/27/2012 Technical Seminar DESY Zeuthen

26

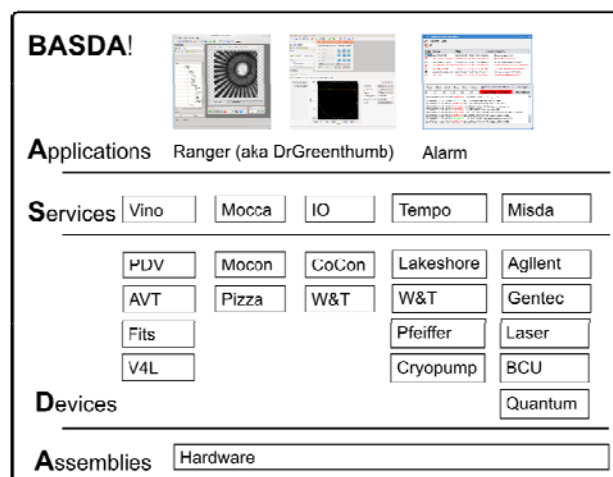
Basda



3/27/2012 Technical Seminar DESY Zeuthen

27

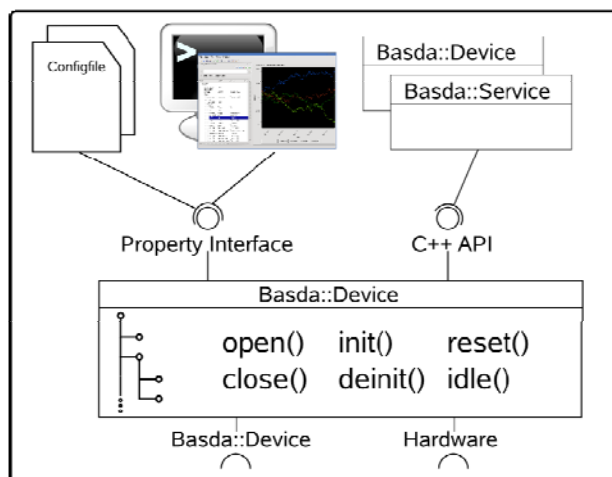
Basda - Overview



3/27/2012 Technical Seminar DESY Zeuthen

28

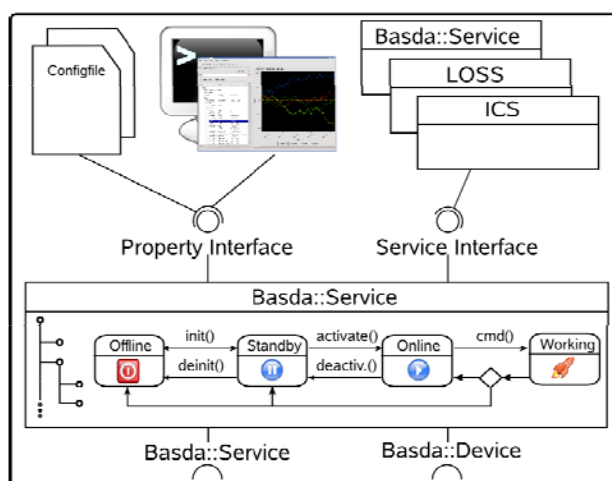
Basda - Device



3/27/2012 Technical Seminar DESY Zeuthen

29

Basda - Service



3/27/2012 Technical Seminar DESY Zeuthen

30

Basda – Interface Def. Language

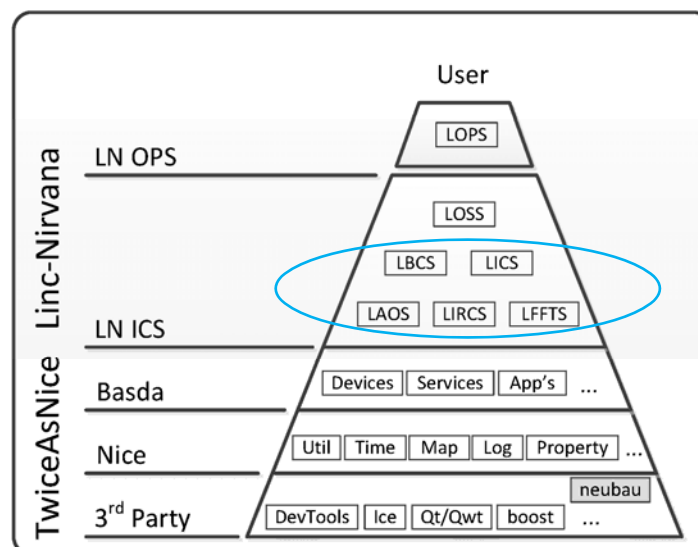
- Asynchronous communication via bridge member functions
- What about synchronous stuff?
- General programming language independent interface
 - Similar to Corba or Sun RPC → *.basda
- Basda2xx
 - Automatic generation of skeleton and stub code for the target programming language
 - Special property sub-tree *CMD* for synchronous invocations



3/27/2012 Technical Seminar DESY Zeuthen

31

LN Instrument Control Software



3/27/2012 Technical Seminar DESY Zeuthen

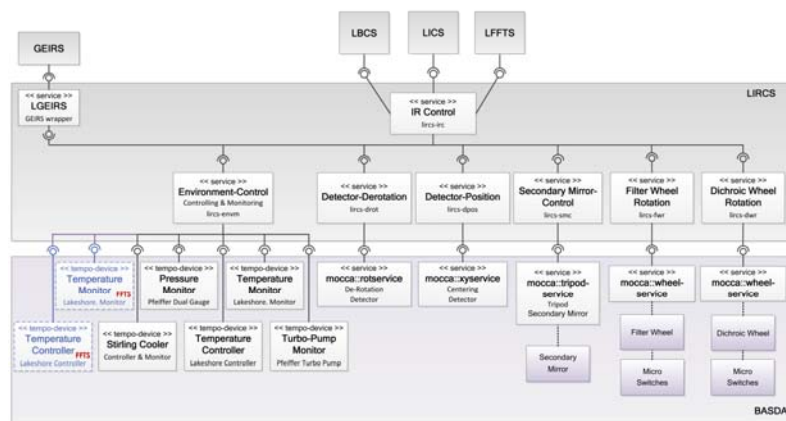
32



LAOS Sub-System



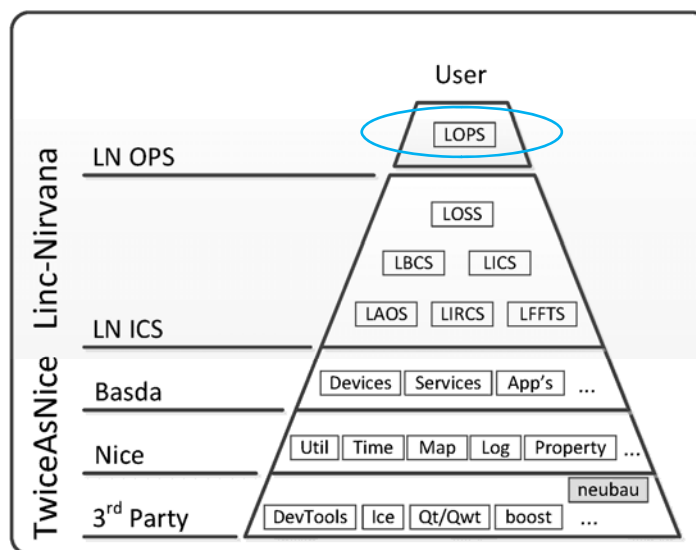
LIRCS Sub-System



3/27/2012 Technical Seminar DESY Zeuthen

35

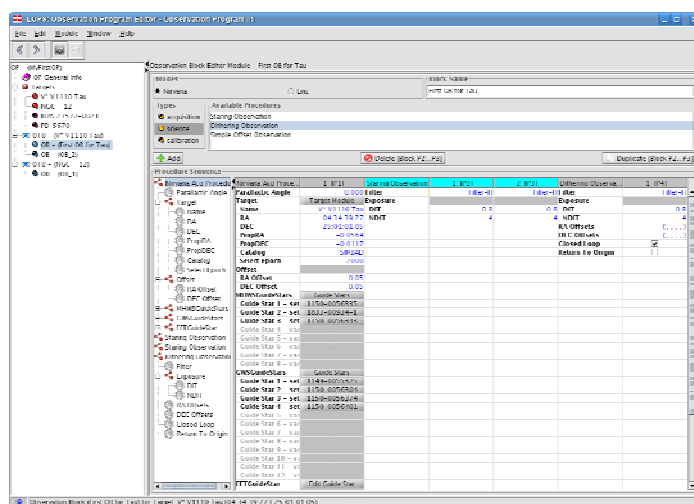
Observation Preparation Software



3/27/2012 Technical Seminar DESY Zeuthen

36

Observation Preparation Software



3/27/2012 Technical Seminar DESY Zeuthen

37



38