SDA- Shot Data Acquisition and Analysis

Example of major applications that use the Java DAE framework

A success story and a cautionary tale….

Jean Slaughter

Controls Review

Feb 4, 2004

What is SDA?

SDA is a system for acquiring, archiving and analyzing data from "stores".

- Correlation of a defined set of information from multiple sources at specific times during a "store".
  - Information for day to day monitoring of stores
  - Specialized studies
- Two Aspects
  - Acquiring and archiving the data
  - Using the data
- Controls, Computing Division, coordinated in the Integration Department
- Java DAE framework

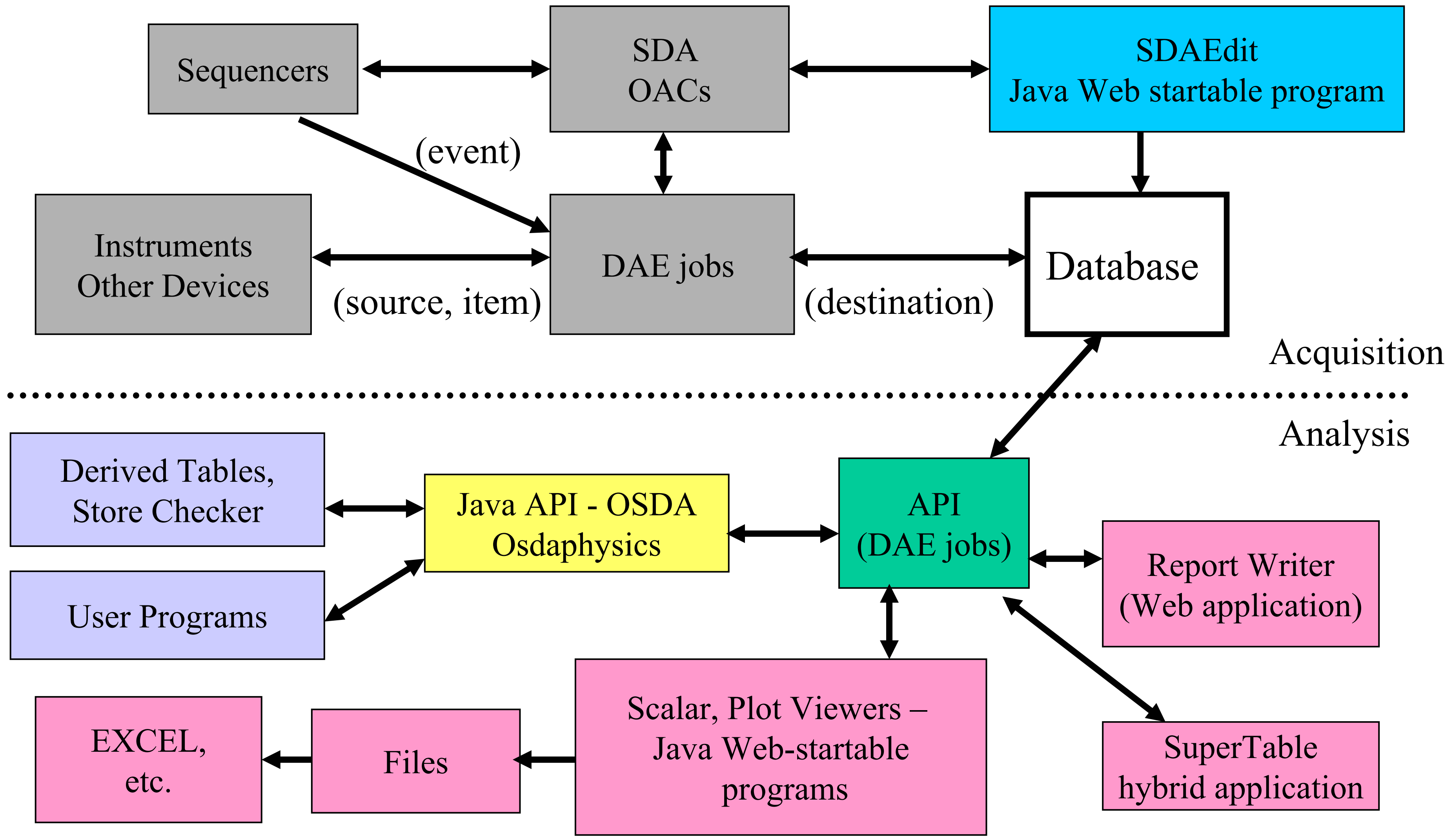
D44 versus SDA

- Lumberjack data
  - Usually fixed frequencies, can be state variable or clock event triggered.
  - Takes data continually
  - Circular buffers - data is overwritten after 1-30 days. Since last April, backed up in the backup node.
  - Any user can modify any archive configuration
- SDA data
  - Triggered at specific events
  - Only during stores*
  - Permanent archive
  - Standard content

Both types are needed to do SDA analysis

*store in a general sense.. There are recycler only and pbar only "stores".

SDA Diagram



Sequencers
SDA OACs
SDAEdit Java Web startable program
(event)
Instruments Other Devices
DAE jobs
Database
(source, item)
(destination)
Acquisition
Analysis
Derived Tables, Store Checker
Java API - OSDA Osdaphysics
API (DAE jobs)
User Programs
Report Writer (Web application)
EXCEL, etc.
Files
Scalar, Plot Viewers – Java Web-startable programs
SuperTable hybrid application

Comments on Data Acquisition in SDA - I

- Working quite well in the current configuration.
- Initially a long tail in DA times caused problems until system parameters were tuned.
- Data acquisition in certain cases/sets has been staggered.
- Because of this history, I worry about how close we are to system capacity. We should add many more devices, like magnet settings, readbacks.
- While SDA is not “real time” in the sense of real time control, in many cases we do need to know the actual physical time of the event.
- Specs on system capacity and timing are at best vague. The users have not tried to stress it.

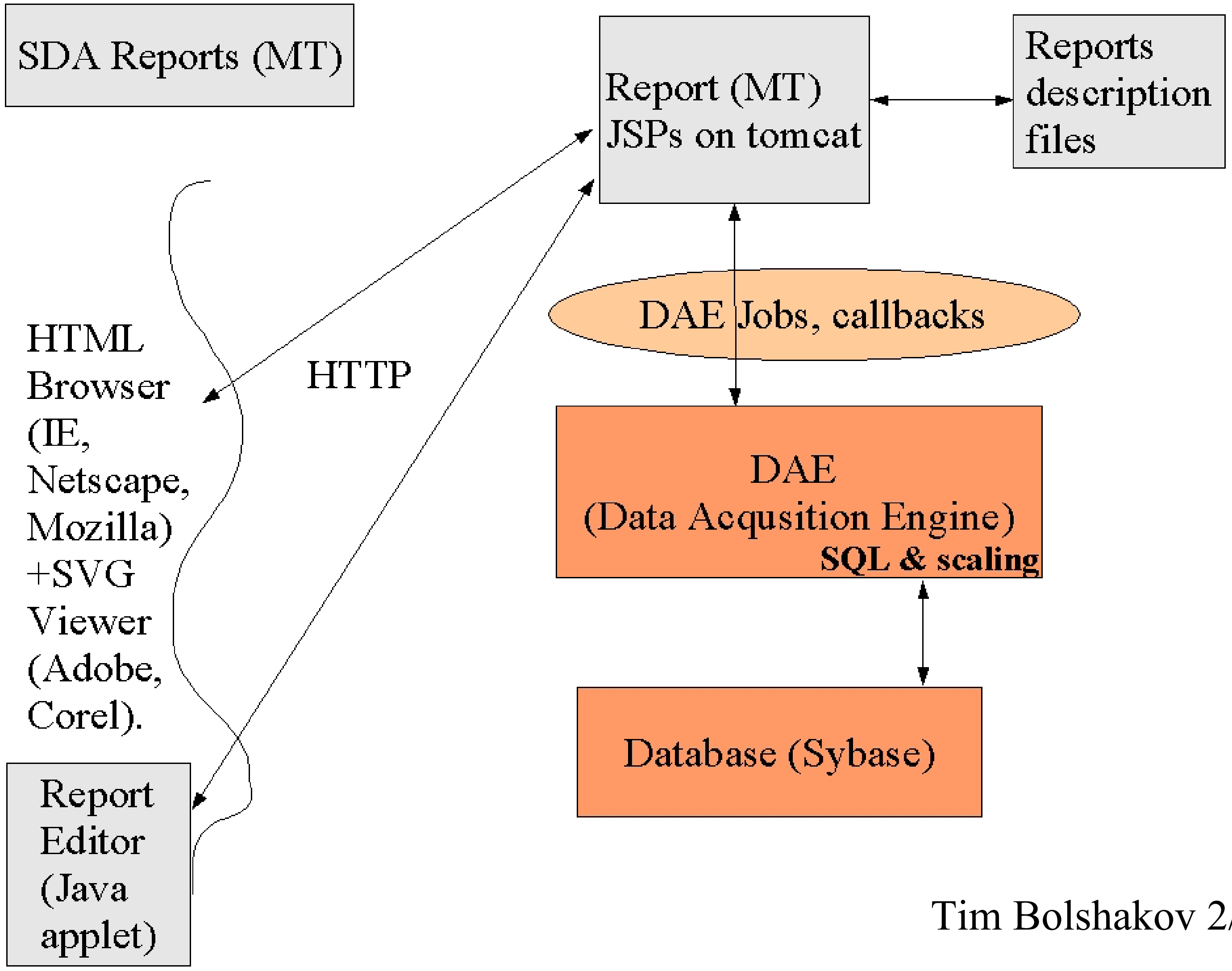
Comments on Data Acquisition in SDA - II

- Consolidation is a very important part of the current implementation - multiple simultaneous requests from many sources.
- Calibration database and SDA
  - SDA stores unscaled data because of data load.
  - Causes problems when the scale factors in the database change. Information from old stores gets the new scale factor..
  - Solution 1 – Have Brian Hendricks rescale the old data.
    - Not good
  - Solution 2 – For smart front ends
    - Change database scale factors to 1.0, offsets to 0.
    - Apply the scale change in the front end.
    - Supply the current scales, offsets as ACNET variables that are data logged and stored in SDA.
  - Vulnerable to unnoticed scale factor changes.

Overview of Analysis Applications

- Viewers – interactive browsers – Web startable
- Reports – flexible, GUI driven method of asking for a subset of data – Browser, JSP, applet
- OSDA API – Java classes to allow program access to data.
- Standard analysis jobs run every store
  - Luminosity plot
  - Store checker
  - Derived tables
  - SuperTable (ntuple?), Tev subset table
  - Derived emittances table
  - Efficiency table
- Variety of access implementations as we learned.
- Firewall influenced designs.

SDA Reports

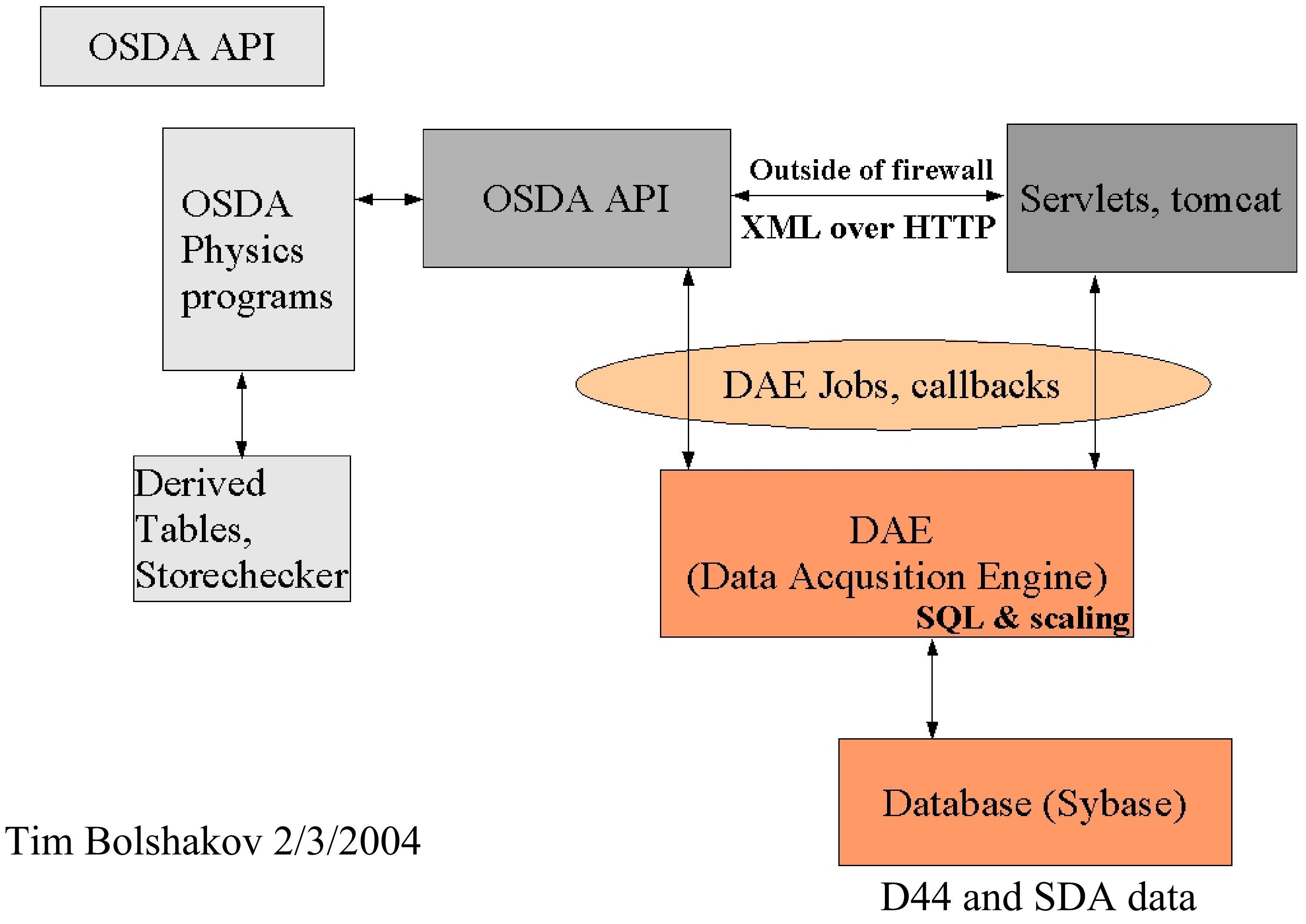

SDA Reports (MT)
Report (MT) JSPs on tomcat
Reports description files
HTML Browser (IE, Netscape, Mozilla) +SVG Viewer (Adobe, Corel).
HTTP
DAE Jobs, callbacks
DAE (Data Acqusition Engine)
SQL & scaling
Database (Sybase)
Report Editor (Java applet)

Tim Bolshakov 2/3/2004

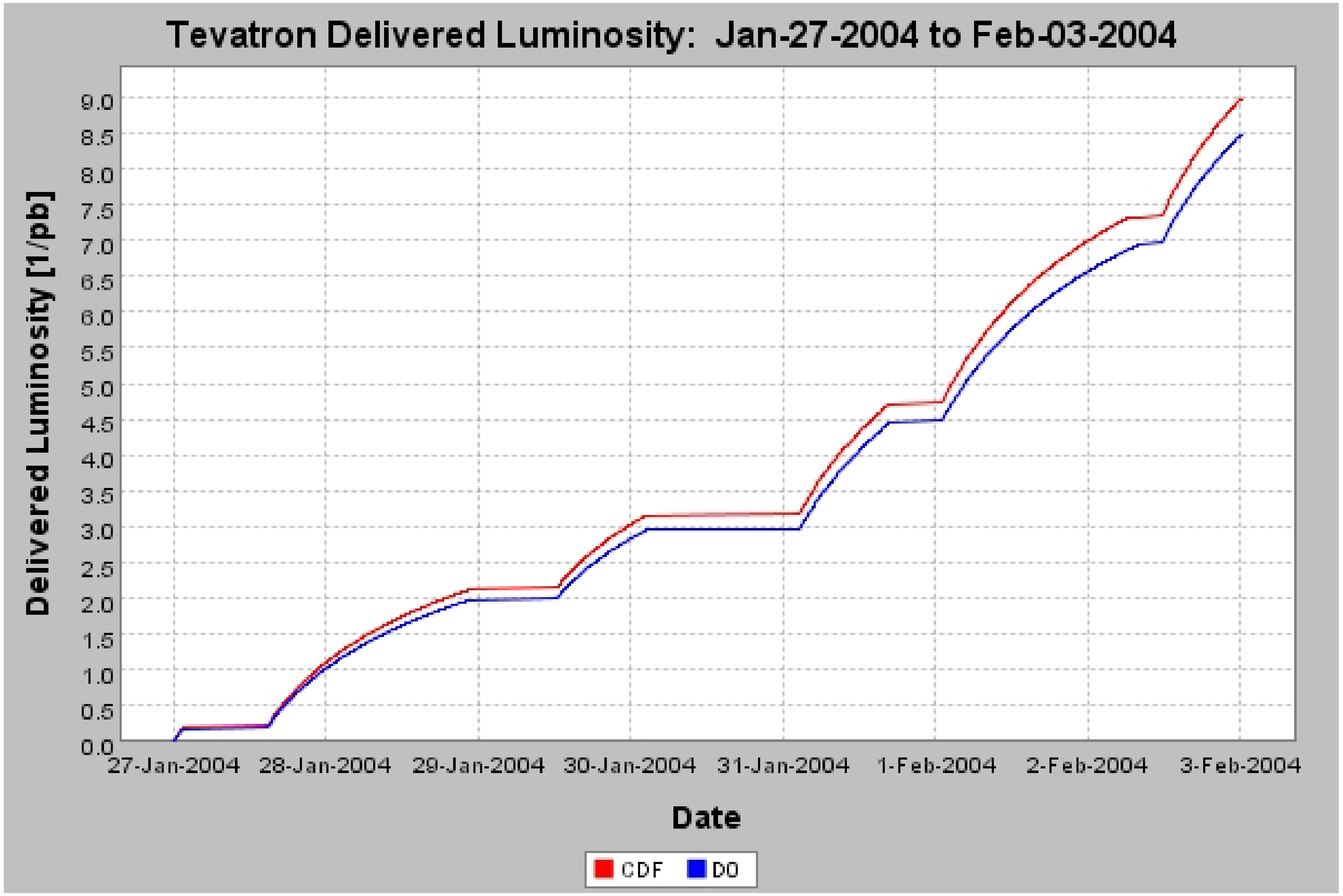
OSDA (Offline SDA) and Osdaphysics

- Original Conception of SDA
  - Data Acquisition via Java DAEs
  - SDA Edit for specifying what devices to read and when.
  - Viewers, Reports make files for input to EXCEL, etc.
  - Data from front ends can be used as is.
- Experience led to OSDA, Osdaphysics
  - Data from front ends needs massaging. Want a single source for algorithms, including OACs.
  - Complex questions need direct program access to SDA data and D44 data.
- Current status OSDA, Osdaphysics
  - Evolved from special purpose analyses where flexibility was the prime consideration. Very slow.
  - Now used for operations - being upgraded for speed and maintainability (clarity).

OSDA (Offline SDA) API- Access SDA and D44 Data



Integrated Luminosity Table



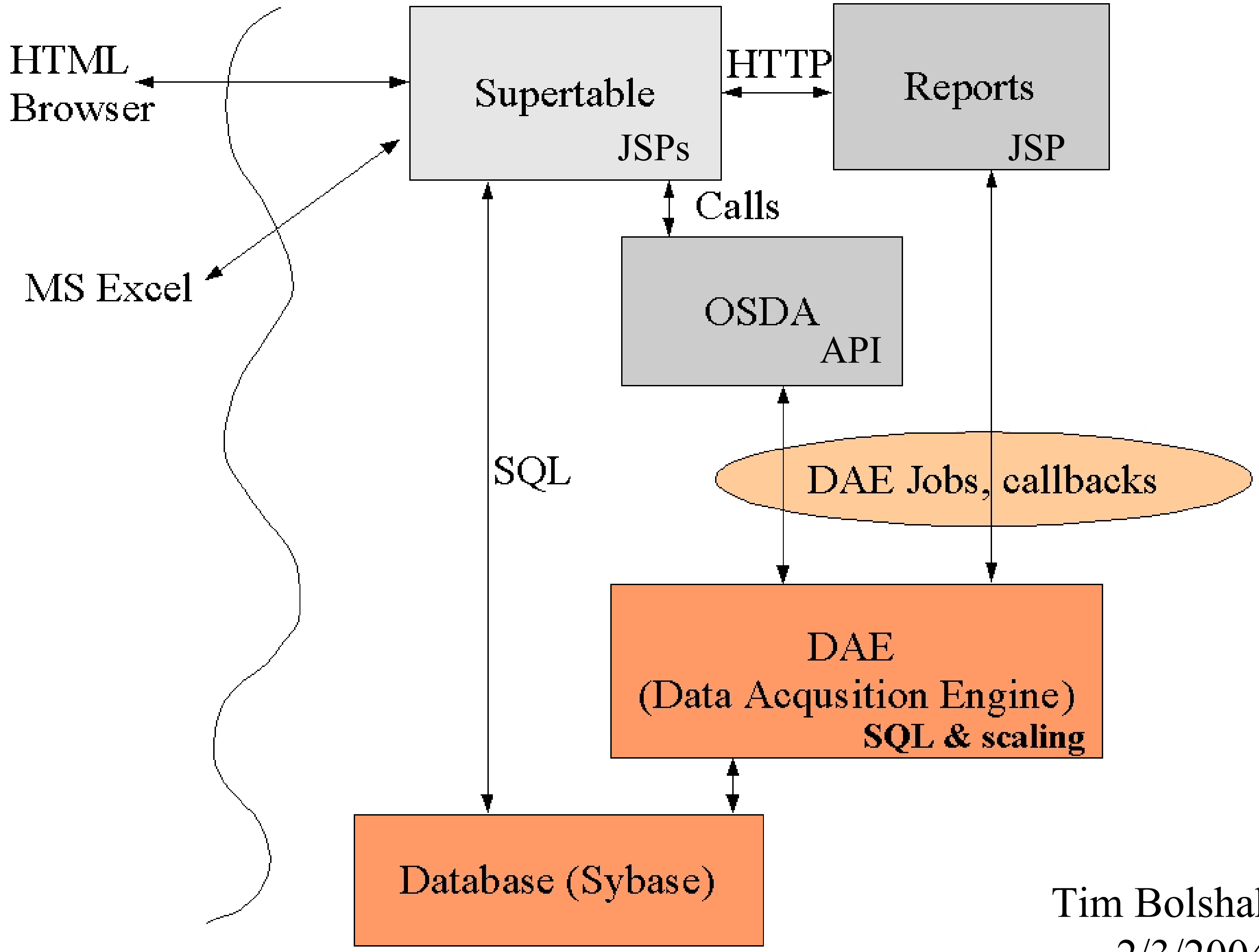
Derived Tables- Detailed Information on each Store

- Table per store – built automatically
  - All 6 emittances
  - Intensities
- Average and bunch by bunch information
- Use best algorithms to get physics quantities
  - Not always available directly from front-end.
- Uses OSDA, Osdaphysics
- Interactive plotting interface

Supertable

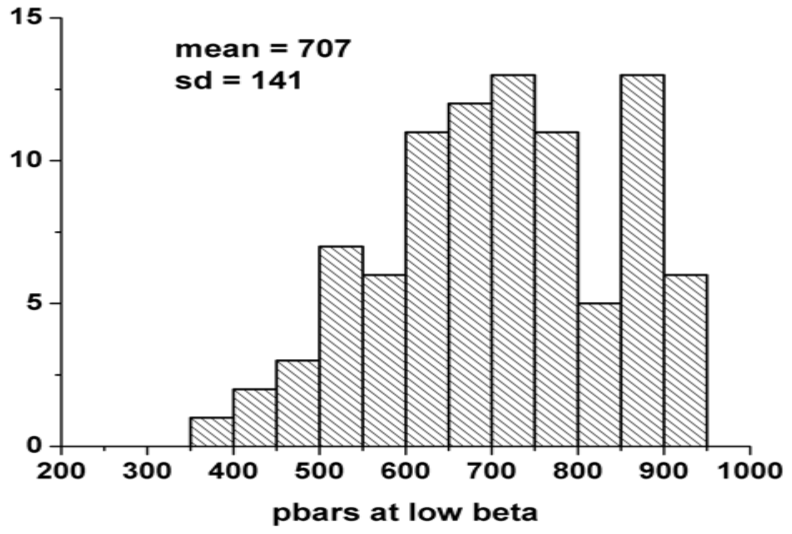
- One line per store
- Built automatically every store
- 130+ quantities of general interest
  - Dates, time on helix, length of store
  - How store ended
  - Luminosities, intensities, lifetimes
  - Efficiencies at each stage from p, pbar sources to HEP
  - Emittances at each stage
- Web Accessible – HTML, EXCEL
  - Used by all the bigwigs….
- Hybrid implementation
  - Complex computations
  - Rebuilt as understanding changes
  - Adapt to broken devices

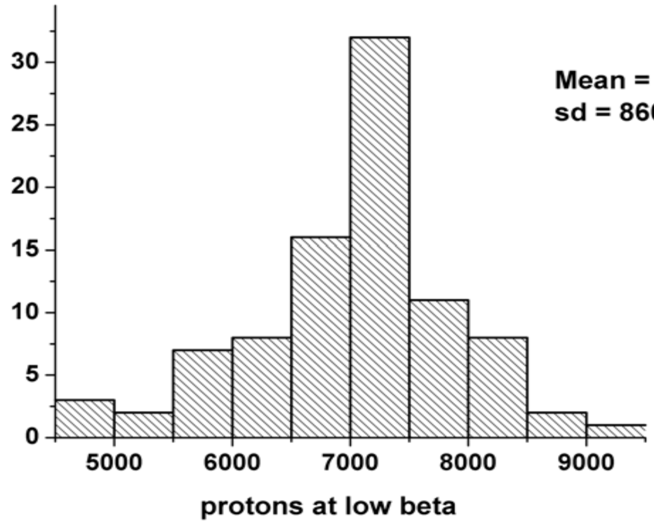
SuperTable

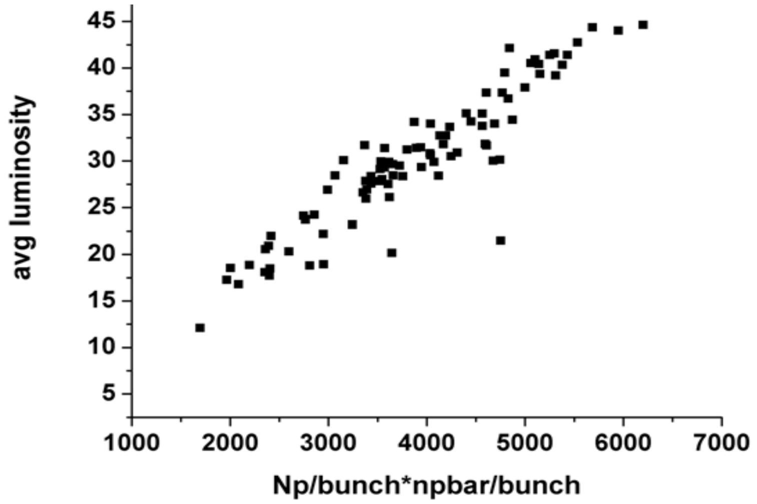


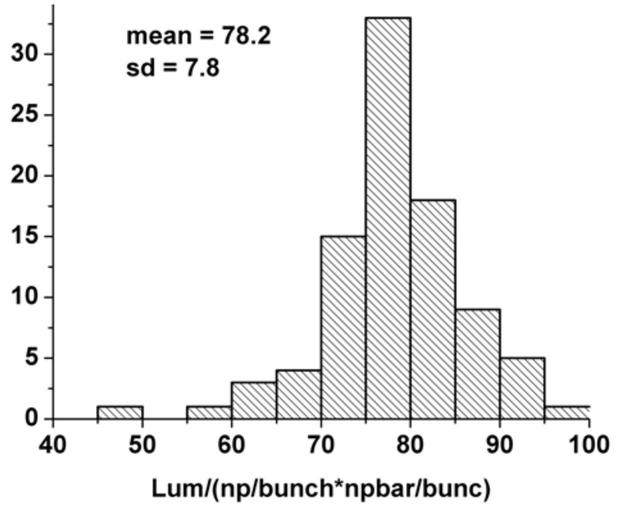
Tim Bolshakov
2/3/2004

Plots From Supertable - Elements of Luminosity









Monitoring SDA itself

- Complex system – lots of places for things to wrong
  - Front ends – instrumentation, MADCs, break
  - DAQ process itself
    - Node down
    - Hung process
    - Sequencer mistakes
    - etc.
  - Problems in the analysis code
- Needs constant monitoring
  - Error logs from SDA OACs
  - Store checker
  - User complaints

Store Checker

- Purpose
  - Monitor instrumentation and DAQ
  - Monitor accelerator performance
- Checks SDA data for specified cases/sets
  - Min < device value < max
  - Min < (difference in time of 2 devices) < max
  - Min < (difference in value of 2 devices) < max
- Jobs run automatically every store
- "Standard" and "private" lists
- Results on WWW for "standard" list
- Lists on WWW
- Used to give email notification of initial luminosities

Java is a Good Thing

- Easy to learn – and all the school kids learn it. No memory management headaches.
- Java Web Start programs make maintaining and deploying code much easier.
- Platform independent, so moving to new faster machines is easy.
- Easy WWW integration – really important for access given firewalls.
- Lots of tools for human interfaces
- Division into client side and server side code makes it easy to spread the load, but you can lose this advantage in communications overhead if not careful.

Java is a Bad Thing

- Speed – particularly if you don't think about it in advance.
- Poor tools for interactive scientific graphing and fitting.
- Packages like Origin7 and Mathematica don't have suitable Java interfaces.
- There is a learning curve, even if it is relatively short.

Access to Front End Data

- All of the intelligent front ends like SBD, flying wires, FBI, synclite, need access to the raw data for detailed study to develop and understand the algorithms. This means ways of getting and storing the raw data. (Eugene Lorman's talk.)
- This is really important!

Lessons

- SDA is a success, but the system is very complicated. It is very time consuming to keep on top of things.
- Java is a good thing.
- Our understanding of needs change – need flexibility and extensibility .
- More data and more compute capability is (almost always) useful in ways we never anticipated.
- Still lacking information in SDA and analysis tools
  - Tunes, chromaticities
  - More magnet settings, readbacks
  - BPM and orbit analysis tools