# Designing and developing portable large-scale JavaScript web applications within the Experiment Dashboard framework

CHEP New York 2012

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# Contents





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# Traditional Web UIs

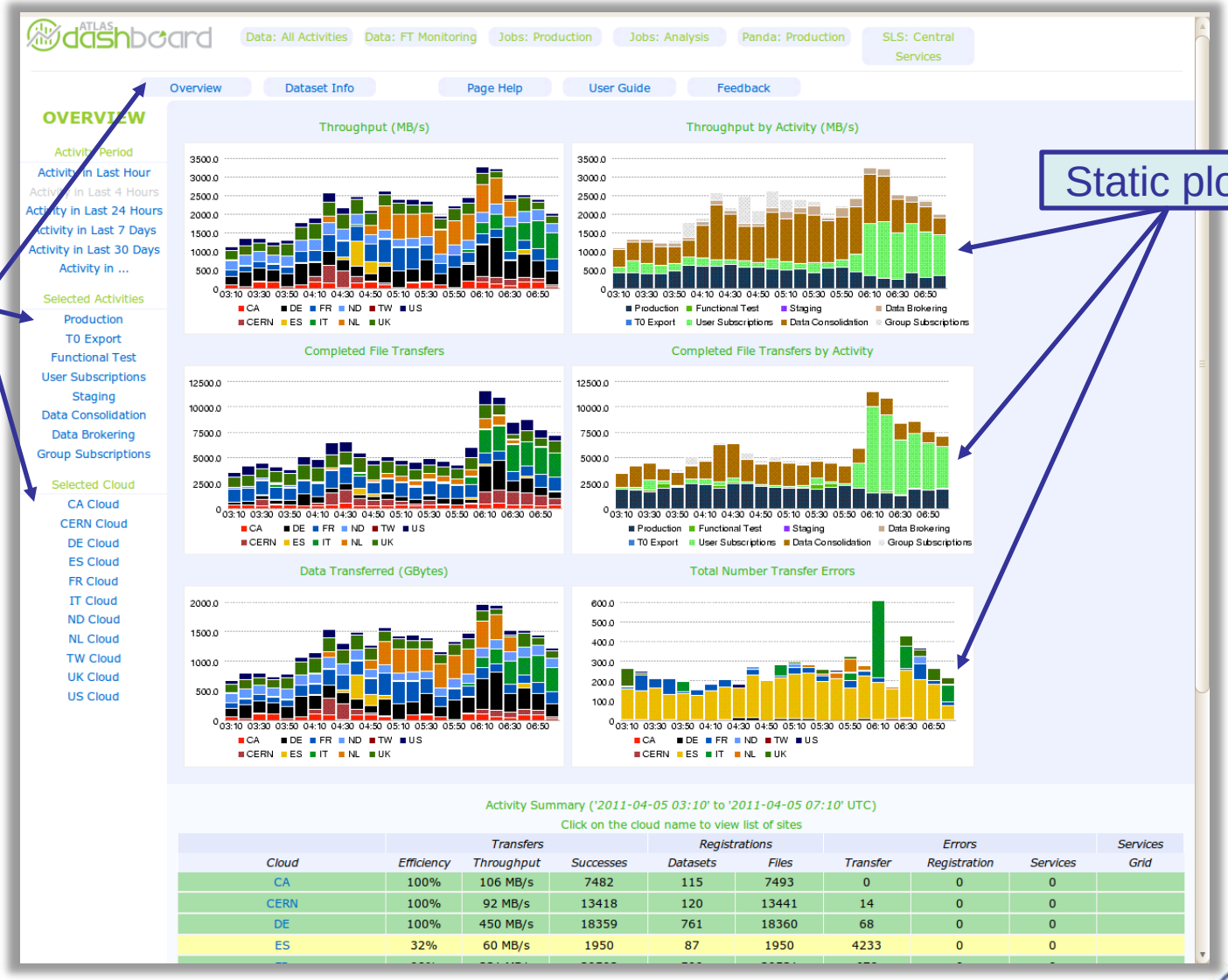


- Server-side view generation


- Multiple page interface
  - Hypertext-style
  - Full page loaded for each user interaction
- Example: ATLAS DDM Dashboard 1.0
  http://dashb-atlas-data.cern.ch/dashboard/request.py/site

# Traditional Web UIs: Example






Static plots

Links

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# Traditional Web UIs: Pros & Cons

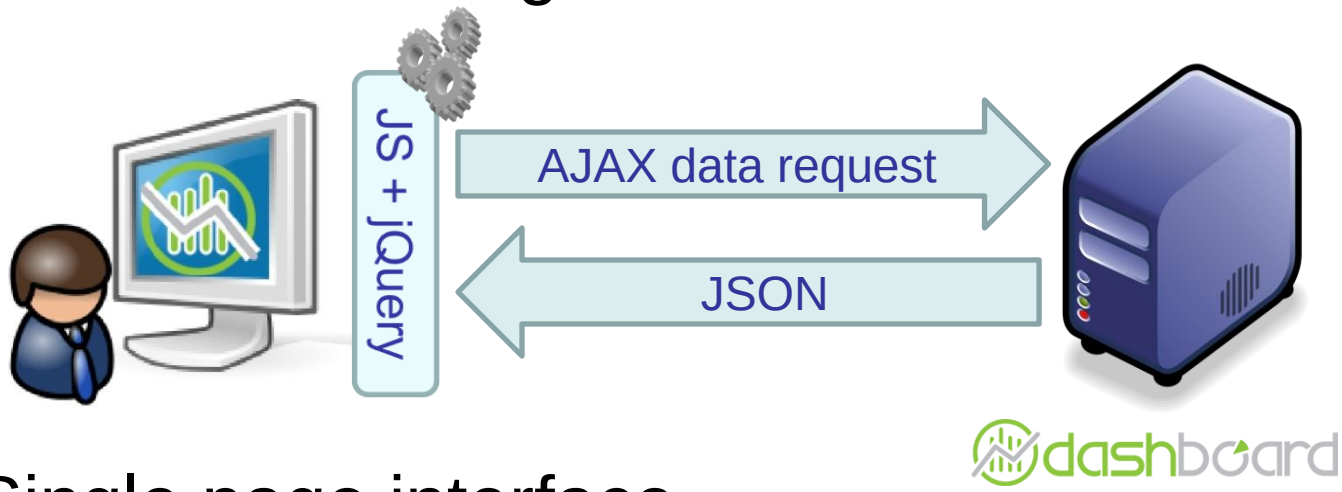


- Benefits
  - Cross-browser compatibility
  - Modularity for team-working (page per feature)
  - Bookmarkable URLs
  - Search-engine friendly
  - Accessibility friendly
  - Expertise
- Issues
  - Low interactivity
    - User cannot easily customize data visualization
  - Slow loading
    - Full page loaded for each user interaction
    - Server-side call for new view of same data
- Issues hinder novel analysis of data
- Issues cannot be fixed within the paradigm

# JavaScript Web UIs



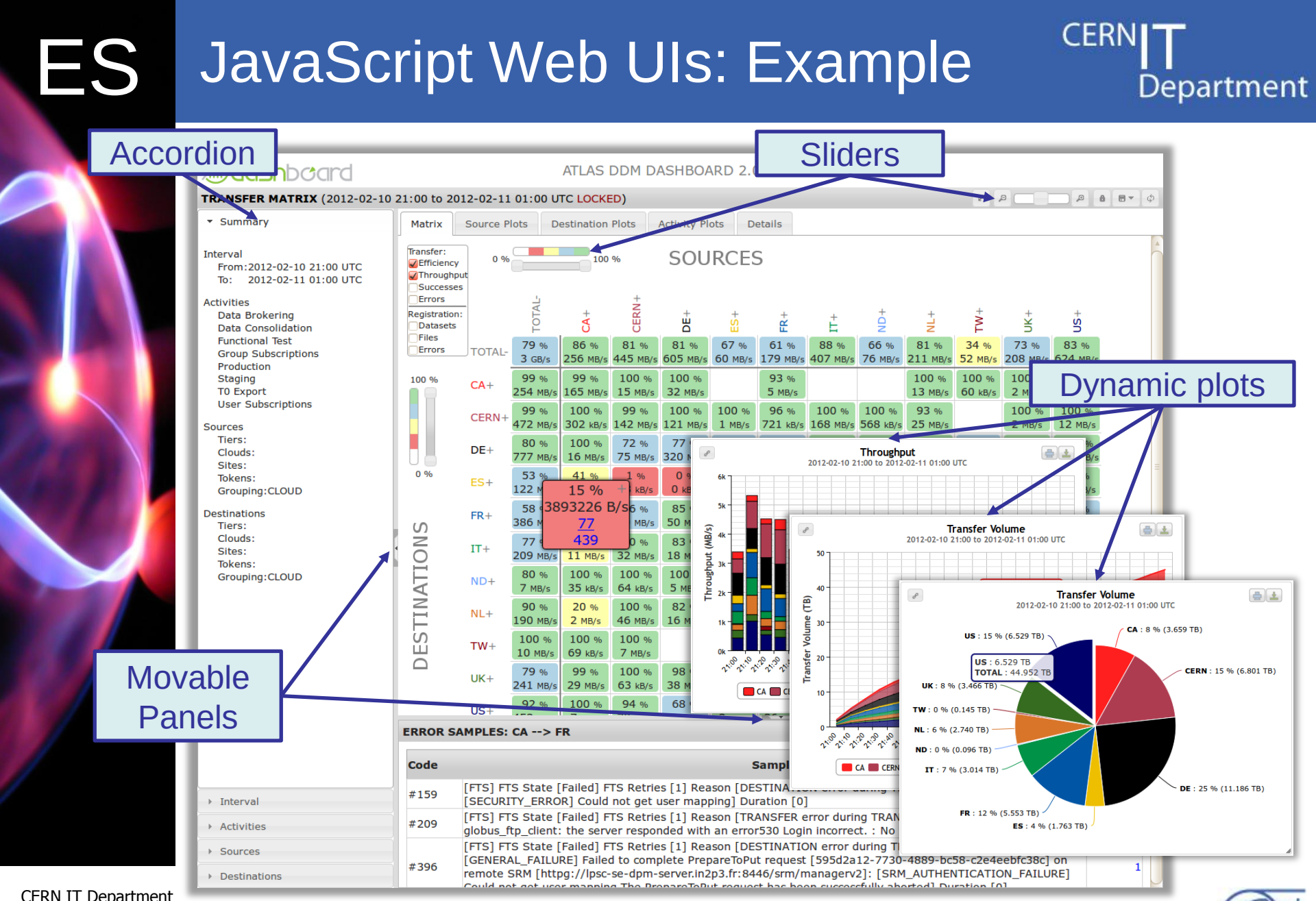
- Client-side view generation




- Single page interface
  - GUI-style
  - Data loaded on-demand
- Example: ATLAS DDM Dashboard 2.0
  http://dashb-atlas-data.cern.ch/ddm2/

# ES JavaScript Web UIs: Example



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# JavaScript Web UIs: Pros & Cons



- Benefits
  - High interactivity
    - User can easily customize data visualization
    - Leverage 3rd-party plugins
  - Fast loading
    - Data loaded on-demand
    - Client-side call for new view of same data
- Benefits facilitate novel analysis of data
- Issues
  - Browser incompatibilities
  - Slow client-side rendering
  - Lack of modularity for team-working (single-page)
  - Non-bookmarkable URLs
  - Not search-engine friendly
  - Not accessibility friendly
  - Lack of expertise
- Issues can be fixed within the paradigm

# JavaScript Web UIs: Cons Fixed



- Fixed Issues
  - Browser incompatibilities
    - Standards compliance: Acid3
    - JavaScript libraries: jQuery
  - Slow client-side rendering
    - Faster JavaScript engines
    - Faster processors
  - Lack of modularity for team-working
    - Client-side MVC frameworks
    - View object per feature
  - Non-bookmarkable URLs
    - URL hash management

```
#interval=60&dst=(ND,UK)&...
```

- Issues still in progress
  - Not search-engine friendly
  - Not accessibility friendly
  - Lack of expertise

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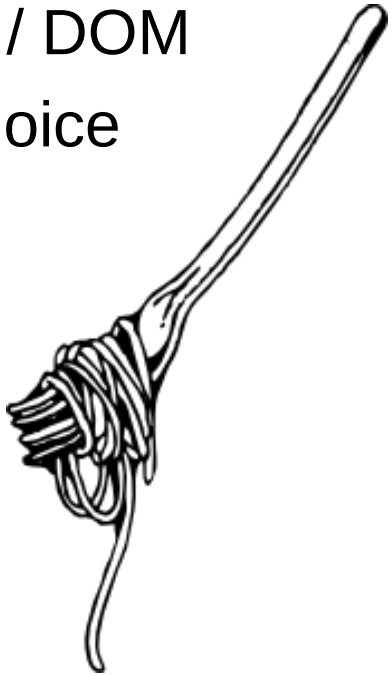
# False Start



- Our early attempts at JavaScript Web UIs
  - No client-side MVC framework
  - State / data stored in form inputs / DOM
  - No common JavaScript library choice
  - Limited use of 3rd-party plugins
  - Non-modular, highly-coupled "spaghetti" code

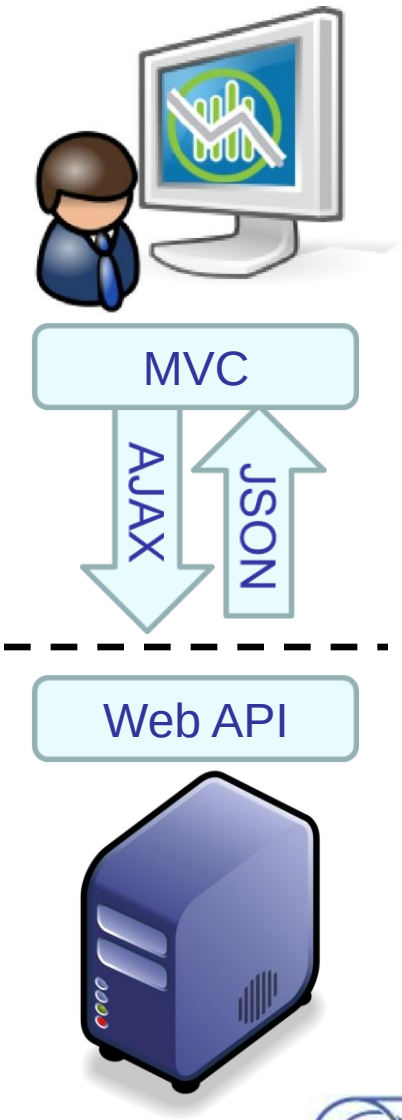


- Difficult to extend or maintain

# Our Approach



- Client-side MVC
  - Model
    - state – user selected filters
    - data – application data from server
  - Views
    - update / reflect state
    - request data from web API
    - update / reflect data
  - Controller
    - initialize model and views
    - synchronize state with URL
- Web API
  - AJAX requests
  - JSON responses
  - Data source decoupling
- Client-side MVC + Web API
  → Configurable UIs

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# Technology Cocktail



- jQuery Core & UI
  - DOM manipulation
  - UI widgets
  - Popular! →
- Plugins
  - URL hash: BBQ
  - MVC events: Backbone
  - Templating: Handlebars
  - Plotting: Highcharts
  - Tables: DataTables
  - Utilities: Underscore
  - …

# Configurable UIs

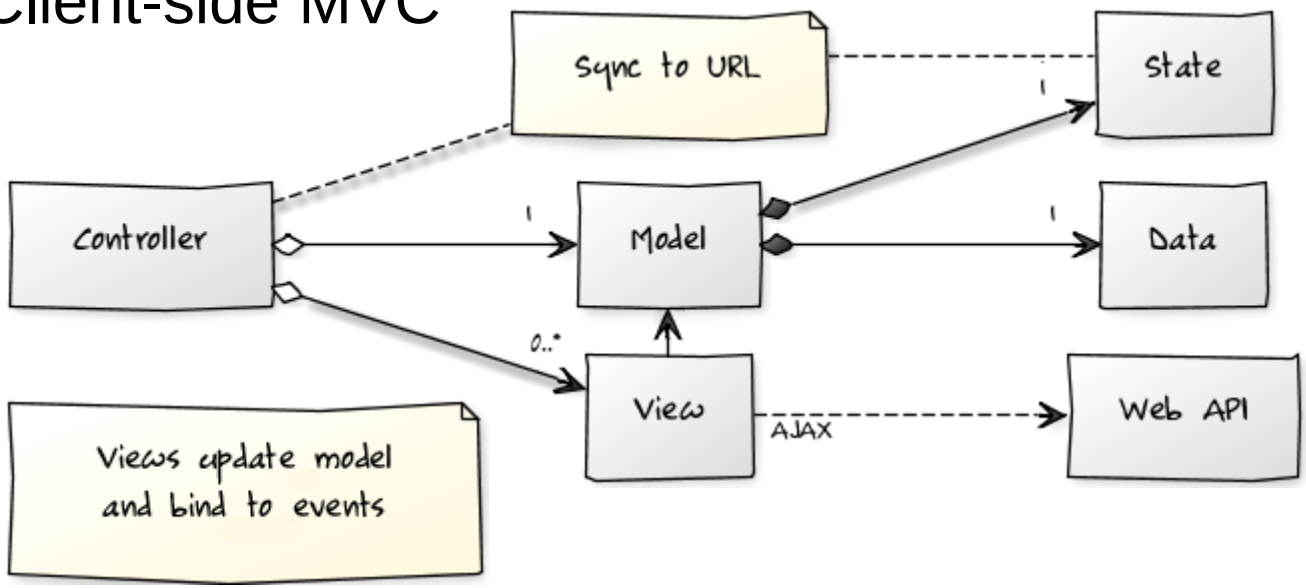


- Skeleton UIs adaptable to many use cases
- Design features
  - Client-side MVC
    - Configurable model
    - Pluggable views
  - Pre-defined views
  - Server interaction via web API
    - UI treated as external application
    - Data source decoupling
- Building new applications for new use cases
  - Define model state default values
  - Combine / adapt pre-defined views
  - Few dozen lines of code
- 2 configurable UIs
  - Hbrowse for hierarchical data
  - Xbrowse for matrix data (in more detail next)

# Xbrowse: Overview



- Xbrowse configurable UI
- Client-side MVC




- Pre-defined view objects
  - sidebar, controls, tabs, matrix, plots, toolbars, ...
  - particularly suited to matrix data
- Brief documentation: http://tinyurl.com/xbrowse

ES

# Xbrowse: Pre-defined Views

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Titlebar

Plots

Toolbar

ATLAS DDM DASHBOARD 2.0 M3.2

**TRANSFER MATRIX** (2012-02-10 21:00 to 2012-02-11 01:00 UTC LOCKED)

Matrix | Source Plots | Destination Plots | Activity Plots | Details

Summary

Interval
From: 2012-02-10 21:00 UTC
To: 2012-02-11 01:00 UTC

Activities
Data Brokering
Data Consolidation
Functional Test
Group Subscriptions
Production
Staging
T0 Export
User Subscriptions

Sources
Tiers:
Clouds:
Sites:
Tokens:
Grouping: CLOUD

Destinations
Tiers:
Clouds:
Sites:
Tokens:
Grouping: CLOUD

Transfer:
Efficiency
Throughput
Successes
Errors

Registration:
Datasets
Files
Errors

0 % — 100 %

SOURCES

| DESTINATIONS | TOTAL- | CA+ | CERN+ | DE+ | ES+ | FR+ | IT+ | ND+ | NL+ | TW+ | UK+ | US+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL- | 79 % 3 GB/s | 86 % 256 MB/s | 81 % 445 MB/s | 81 % 605 MB/s | 67 % 60 MB/s | 61 % 179 MB/s | 88 % 407 MB/s | 66 % 76 MB/s | 81 % 211 MB/s | 34 % 52 MB/s | 73 % 208 MB/s | 83 % 624 MB/s |
| CA+ | 99 % 254 MB/s | 99 % 165 MB/s | 100 % 15 MB/s | 100 % 32 MB/s | | 93 % 5 MB/s | | | 100 % 13 MB/s | 100 % 60 kB/s | 100 % 2 MB/s | 96 % 22 MB/s |
| CERN+ | 99 % 472 MB/s | 100 % 302 kB/s | 99 % 142 MB/s | 100 % 121 MB/s | 100 % 1 MB/s | 96 % 721 kB/s | 100 % 168 MB/s | 100 % 568 kB/s | 93 % 25 MB/s | | 100 % 2 MB/s | 100 % 12 MB/s |
| DE+ | 80 % 777 MB/s | 100 % 16 MB/s | 72 % 75 MB/s | 77 % 320 MB/s | 78 % 27 MB/s | 79 % 20 MB/s | 98 % 94 MB/s | 100 % 413 kB/s | 92 % 11 MB/s | 70 % 49 MB/s | 92 % 24 MB/s | 100 % 141 MB/s |
| ES+ | 53 % 122 M | 41 % | 1 % kB/s | 0 % 0 kB/s | 100 % 3 MB/s | 8 % 911 kB/s | 38 % 10 MB/s | 0 % 0 kB/s | 27 % 4 MB/s | 100 % 152 kB/s | 54 % 17 MB/s | 91 % 66 MB/s |
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| US+ | 92 % | 100 % | 94 % | 68 % | 100 % | 87 % | 89 % | 100 % | 86 % | | 84 % | 96 % |

15 %
3893226 B/s
77
439

**ERROR SAMPLES: CA --> FR**

| Code | Sample | Total /439 |
|---|---|---|
| #159 | [FTS] FTS State [Failed] FTS Retries [1] Reason [DESTINATION error during TRANSFER_PREPARATION phase: [SECURITY_ERROR] Could not get user mapping] Duration [0] | |
| #209 | [FTS] FTS State [Failed] FTS Retries [1] Reason [TRANSFER error during TRANSFER phase: [GRIDFTP_ERROR] globus_ftp_client: the server responded with an error530 Login incorrect. : No local mapping] Duration [0] | |
| #396 | [FTS] FTS State [Failed] FTS Retries [1] Reason [DESTINATION error during TRANSFER_FINALIZATION phase: [GENERAL_FAILURE] Failed to complete PrepareToPut request [595d2a12-7730-4889-bc58-c2e4eebfc38c] on remote SRM [httpg://lpsc-se-dpm-server.in2p3.fr:8446/srm/managerv2]: [SRM_AUTHENTICATION_FAILURE] | 1 |

Interval
Activities
Sources
Destinations

Sidebar

Matrix

Samples

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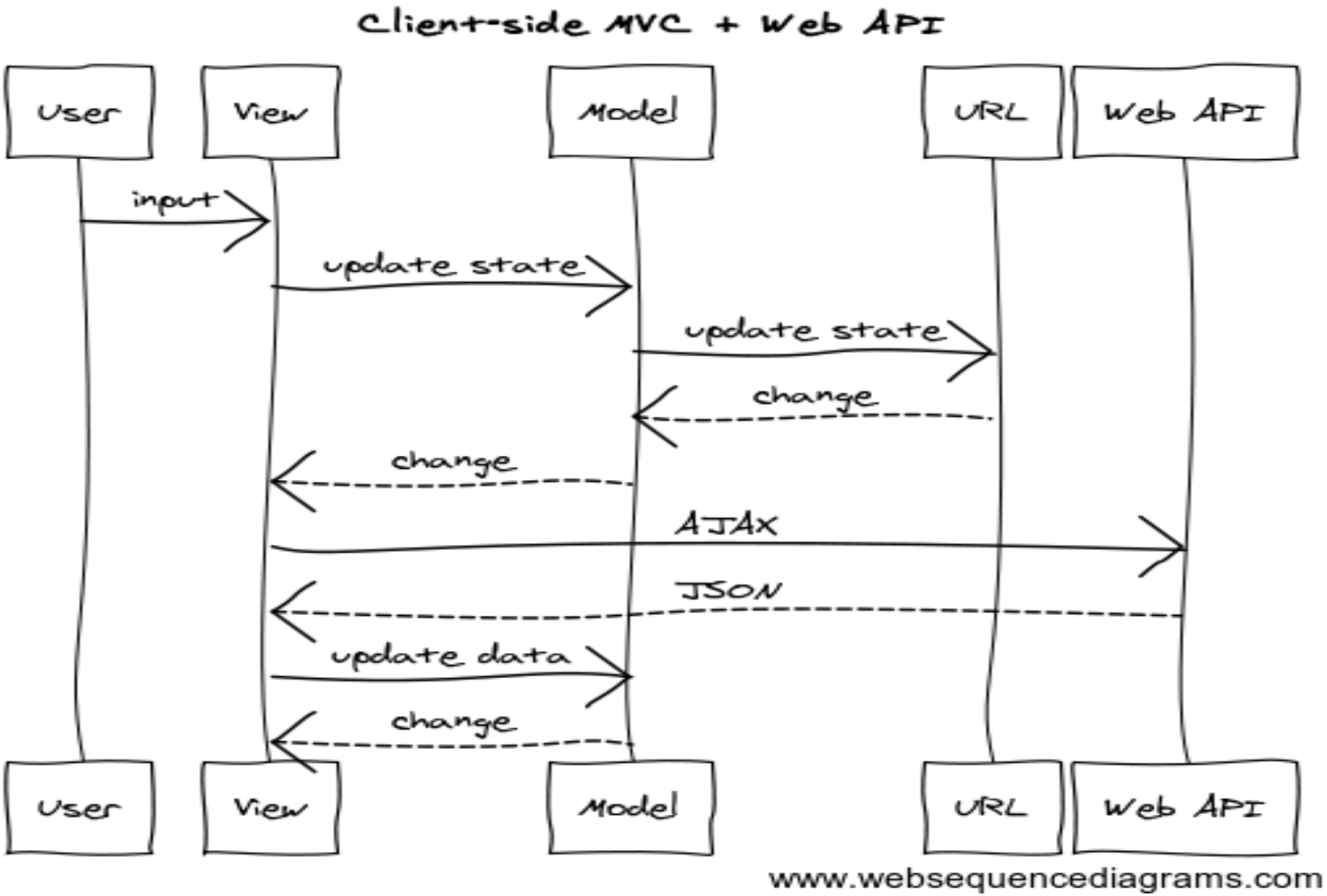
# Xbrowse: Data Flow





ES

# Xbrowse: Model Adaptor

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```
/* Model Adaptor */
xmvc.adaptor = $.extend(true, xmvc.adaptor, {
  model: {
    post_init: function(model) {
      // define state defaults
      model.state.opts.defaults = {
        date:{interval:240, from:'', to:''},
        vo:['atlas', 'cms', 'lhcb'],
        ...
      };
      // define state types for automatic coercion
      model.state.opts.types = {
        date:{interval:'number', from:'date', to:'date'},
        ...
      };
      // define state change side-effects
      model.state.on('change:date', function(e) {
        this.set({plot:{bin:null}}); //reset plot.bin
      });
    }
  }
});
```

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# Xbrowse: View Adaptor



```
/* View Adaptor */
xmvc.adaptor = $.extend(true, xmvc.adaptor, {
  view:{
    create: function() { // define view plugins
      return [
        new ViewDates(), view_matrix, ...
      ];
    }
  }
});
var view_matrix = new ViewMatrix({
    ctx:'#t_tab_matrix', // DOM ID
    ajax:{
      url:'/dashboard/request.py/transfer-matrix', // AJAX URL
      params:function(state, data, opts) { // AJAX parameters
        return {
          from_date:state.date.from,
          to_date:state.date.to,
          vo:state.vo,
          ...
      };
    },
    template: ... // template (optional)
  }
});
(new xmvc.Controller()).init(); // initialize controller
```

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# Xbrowse: Matrix View



ATLAS dashboard — ATLAS DDM DASHBOARD 2.0 M3.2

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Staging
T0 Export
User Subscriptions

Sources
Tiers:
Clouds:
Sites:
Tokens:
Grouping: CLOUD

Destinations
Tiers:
Clouds:
Sites:
Tokens:
Grouping: CLOUD

Transfer: Efficiency, Throughput, Successes, Errors
Registration: Datasets, Files, Errors

0 % — 100 %

SOURCES

| DESTINATIONS | TOTAL- | CA+ | CERN+ | DE+ | ES+ | FR+ | IT+ | ND+ | NL+ | TW+ | UK+ | US+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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15 % 3893226 B/s 77 439

Matrix

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| #209 | [FTS] FTS State [Failed] FTS Retries [1] Reason [TRANSFER error during TRANSFER phase: [GRIDFTP_ERROR] globus_ftp_client: the server responded with an error530 Login incorrect. : No local mapping] Duration [0] | 2 |
| #396 | [FTS] FTS State [Failed] FTS Retries [1] Reason [DESTINATION error during TRANSFER_FINALIZATION phase: [GENERAL_FAILURE] Failed to complete PrepareToPut request [595d2a12-7730-4889-bc58-c2e4eebfc38c] on remote SRM [httpg://lpsc-se-dpm-server.in2p3.fr:8446/srm/managerv2]: [SRM_AUTHENTICATION_FAILURE] Could not get user mapping The PrepareToPut request has been successfully aborted] Duration [0] | 1 |

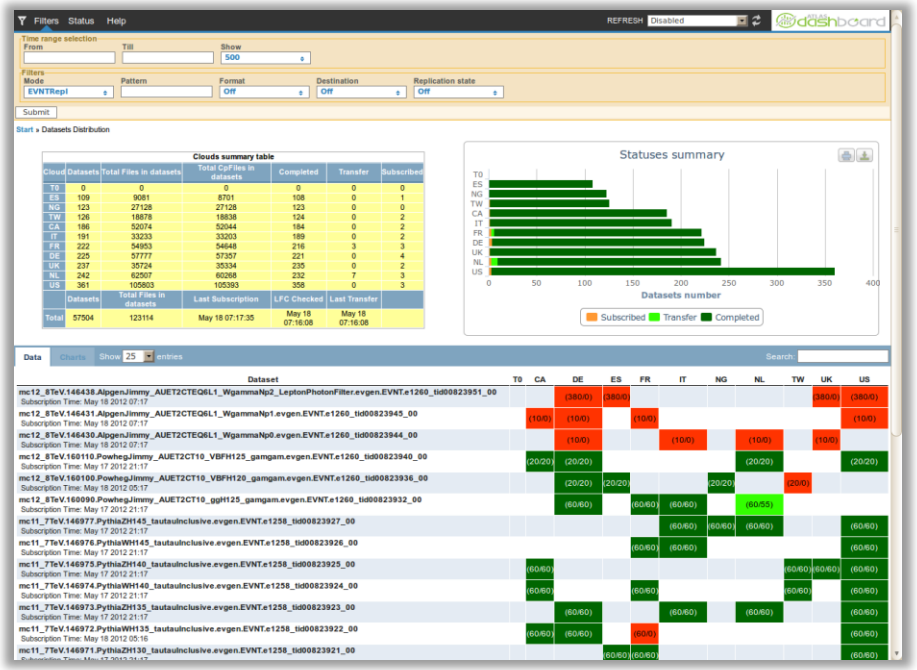
Interval | Activities | Sources | Destinations

# Hbrowse Overview



Hbrowse Framework

- Hbrowse configurable UI
  - JavaScript client framework for hierarchical data visualization
  - Highly configurable environment
  - Bookmarking support
  - Highcharts and Google charts support
  - Server-side independent
  - Infinite number of data levels
- Full documentation: [http://www.hbrowse.net/](http://www.hbrowse.net/)
- See poster: *[152] Hbrowse framework*

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# Example Applications



- Hbrowse for hierarchical data
  - ATLAS Task Analysis
    https://dashb-atlas-prodsys-prototype.cern.ch/templates/task-analysis/#timerange=lastMonth&demo=on
  - CMS Interactive View
    http://dashb-cms-job.cern.ch/dashboard/templates/web-job2/
  - ATLAS Dataset distribution
    http://dashb-atlas-task.cern.ch/templates/pandadatasetdist/
  - …
- Xbrowse for matrix data
  - ATLAS DDM Dashboard
    http://dashb-atlas-data.cern.ch/ddm2/
  - WLCG Transfers Dashboard
    http://dashb-wlcg-transfers.cern.ch/ui/
    (See poster: *[289] Providing WLCG Global Transfer Monitoring)*
  - …

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# Site Status Board Overview

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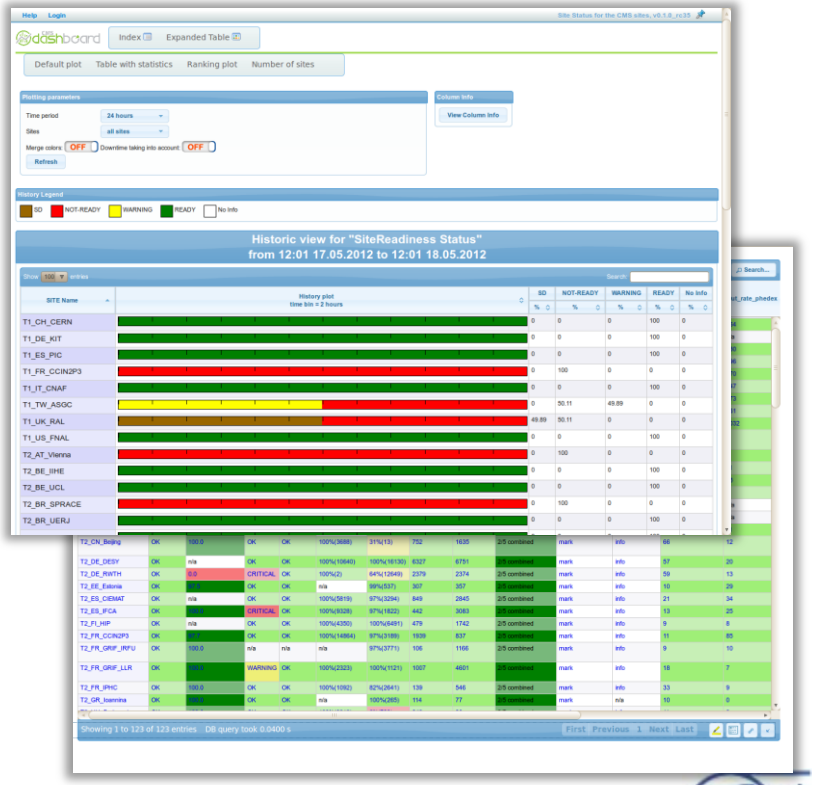
- Site Status Board
  - Monitoring of site and service status
  - Deployed for four main LHC experiments
  - Heavily used by CMS and ATLAS
    http://dashb-ssb.cern.ch
    http://dashb-atlas-ssb.cern.ch
- Developed using common approach
  - Client-side MVC + Web API
  - jQuery + plugins
- Uses Backbone as MVC framework
  http://documentcloud.github.com/backbone/
- See poster:
  *[514] Recipe for a successful application*

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# Conclusions



- It is possible to build sustainable large-scale JavaScript applications with limited resources
- Our approach works for us …
  - Client-side MVC + Web API
  - jQuery + plugins: BBQ, Highcharts, DataTables
  - Configurable UIs
- … but it could be improved
  - Standardize on common MVC framework
  - Fix remaining issues:
    - search engine support
    - accessibility support
  - Testing
  - Documentation
  - Mobile support
  - Optimization
  - …

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# Thank you



## Thank you for your time

http://dashboard.cern.ch/

dashboard-support@cern.ch