

Building a Robust Learning Analytics Infrastructure

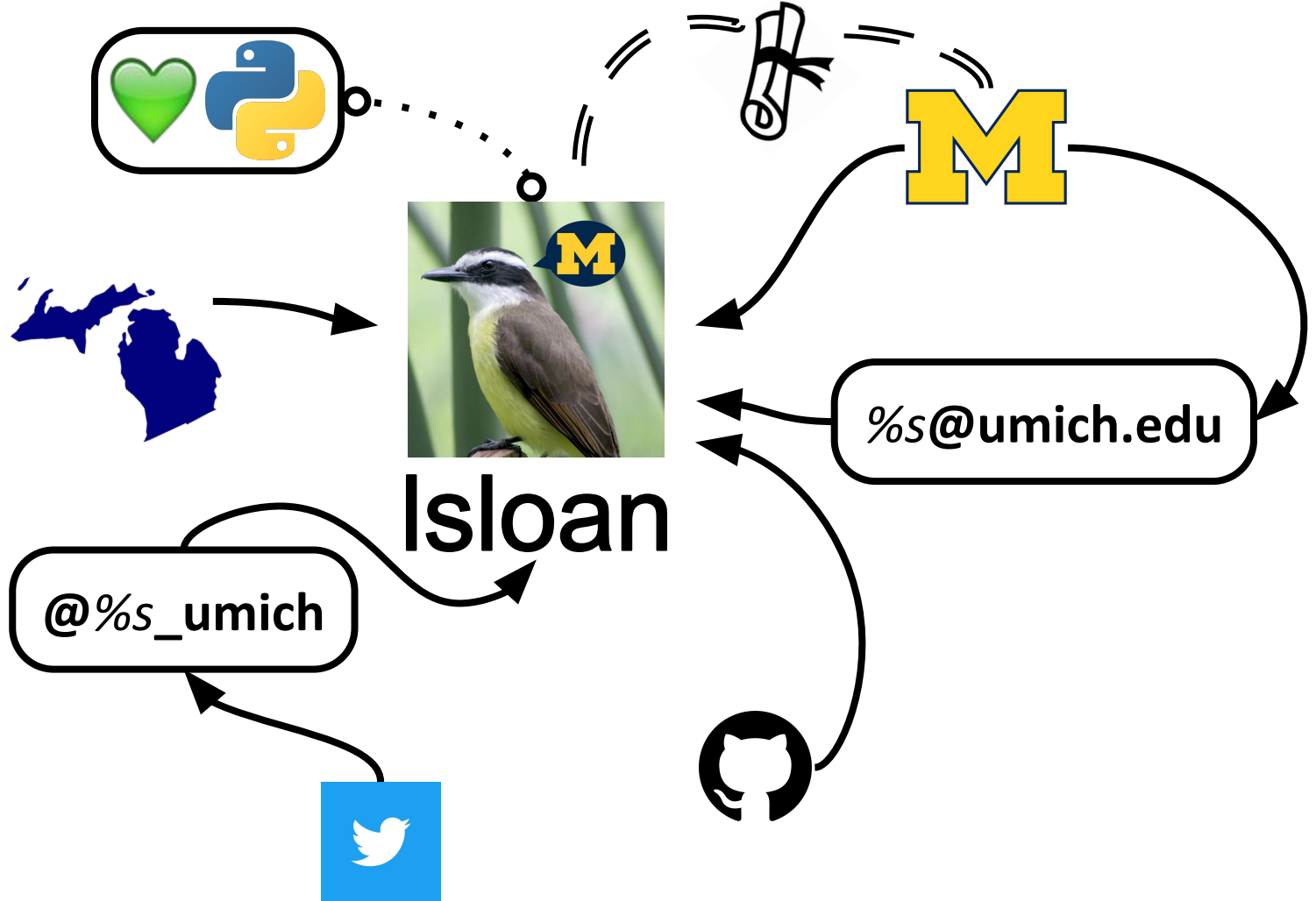


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About Me



Event Encoding

- xAPI or Caliper
- Why Caliper?
 - Extensible
 - Conformance certification
 - It's new
 - My colleague Anthony Whyte is very involved with developing the Caliper standard



Selecting Application

- Which application should we instrument first to generate events?
 - One with many users and content types?
 - An LMS?
 - Sakai?
 - Canvas?
 - One with many users and one content type?
 - UMich Problem Roulette?
 - Random problems for student test prep
 - UMich Lecture Capture?
 - View recorded lectures with synced whiteboard or other materials



Application Chosen

- Selected application:
 - Lecture Capture
- Why?
 - Enthusiastic developers
 - LTI provider (local and LMS users)
 - Very active usage
- Why not LMS?
 - UMich was transitioning from Sakai to Canvas
 - Not enough Canvas experience



Completing Caliper

- Lecture Capture: PHP application
- Problem: caliper-php incomplete
 - Use caliper-java and other implementations as references
 - Test with phpunit and caliper-common-fixtures
 - "Certify" with caliper-conformance-tests
 - At release 1.0.0, I had written 90%



Instrumenting Lecture Capture

- Add Caliper API calls to LC to emit select events and actions
 - SessionEvent: LOGGED_IN, LOGGED_OUT, TIMED_OUT
 - MediaEvent: STARTED, ENDED, PAUSED, RESUMED
- Work on Lecture Capture done in parallel of that for completing Caliper
- Caliper events sent to local development tools or simple remote services (<http://RequestB.in/>)



We're Certifiable

Product: Lecture Capture + Caliper

Organization: University of Michigan

Registration Number: IMSk1un2015W1

Compliance Category: Classroom Capture/Lecture Tools

Status: Caliper Analytics v1.0 Compliant

Conformance Date: Monday, August 24, 2015

Metric Profile Support: Media Event, Session Event

IMS GLOBAL



Current Registrations:
imscert.org

***Currently one of only nineteen applications
with Caliper certification.***



**INFORMATION AND
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Select a Learning Record Store

- An LRS keeps events for later analysis
- 3 or 4 products considered
- OpenLRS (Aperero) was chosen. Why?
 - Open Source
 - U-M is an Aperero member
 - Its two-database architecture is clever
 - Its Caliper support was incomplete; I'd have fun implementing it



Caliper in OpenLRS

- OpenLRS accepts xAPI and Caliper
- When queried for one event type, matching events of the other type are converted
- We had little time and wouldn't use xAPI
- We implemented enough Caliper support to store and retrieve raw events



Robustness Concern

- Lecture Capture service owners concerned about effects of OpenLRS problems
- My solution, Viadutoo, is a caching proxy endpoint for Caliper events
- Quickly accepts events and closes connection
- Attempts to send events to OpenLRS
- If send fails, store the event
- Stored events may be sent later



A unique solution as far as we know.

Deployment and...

- With everything ready it was deployed early 2016
- After fixing some minor bugs, it worked well

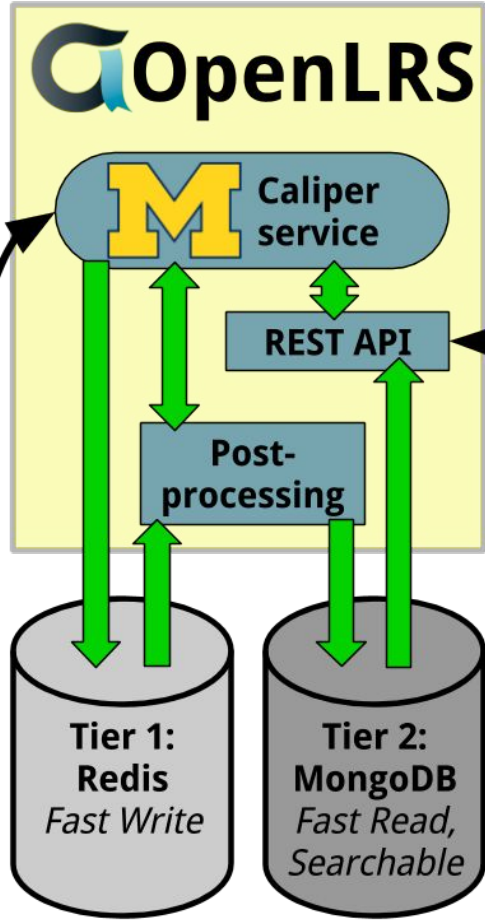
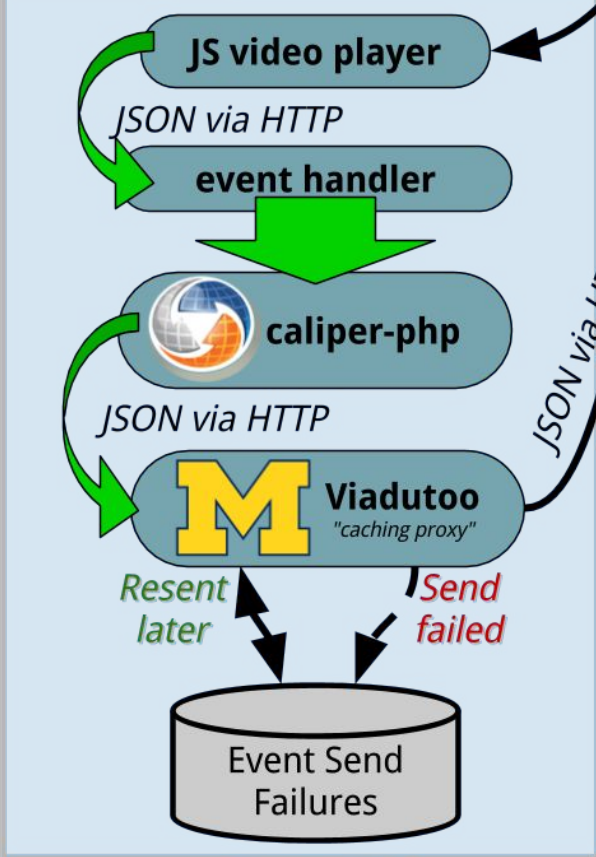
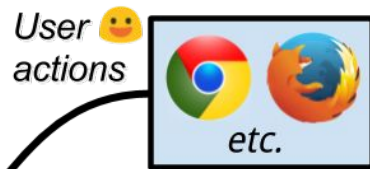
...SUCCESS!

- By July 2016, almost ***one million*** events were collected each month
- May 2017: almost ***twenty-one million*** events



***Now take an aerial view
of this infrastructure...***

CA-EN Lecture Capture



Data Analysis and Visualization Tools

TBD

- Tableau?
- OpenDashboard?
- R + RJSONIO?
- Python + pandas/Matplotlib?

Inside a Learning Analytics Architecture



Next Steps

- Analysis: With sound infrastructure and growing data, we encourage our Univ. IT colleagues and faculty to consider ways to take advantage of it
- Growth: A second application, Problem Roulette, will also be instrumented to emit Caliper events



Instrumenting Problem Roulette

- Add Caliper API calls to Problem Roulette to emit select events and actions
- About a dozen combinations of event and action, more than Lecture Capture
- Implementation completed and included Viadutoo support
- Deployed during spring/summer time of school year, which has low-enrollment



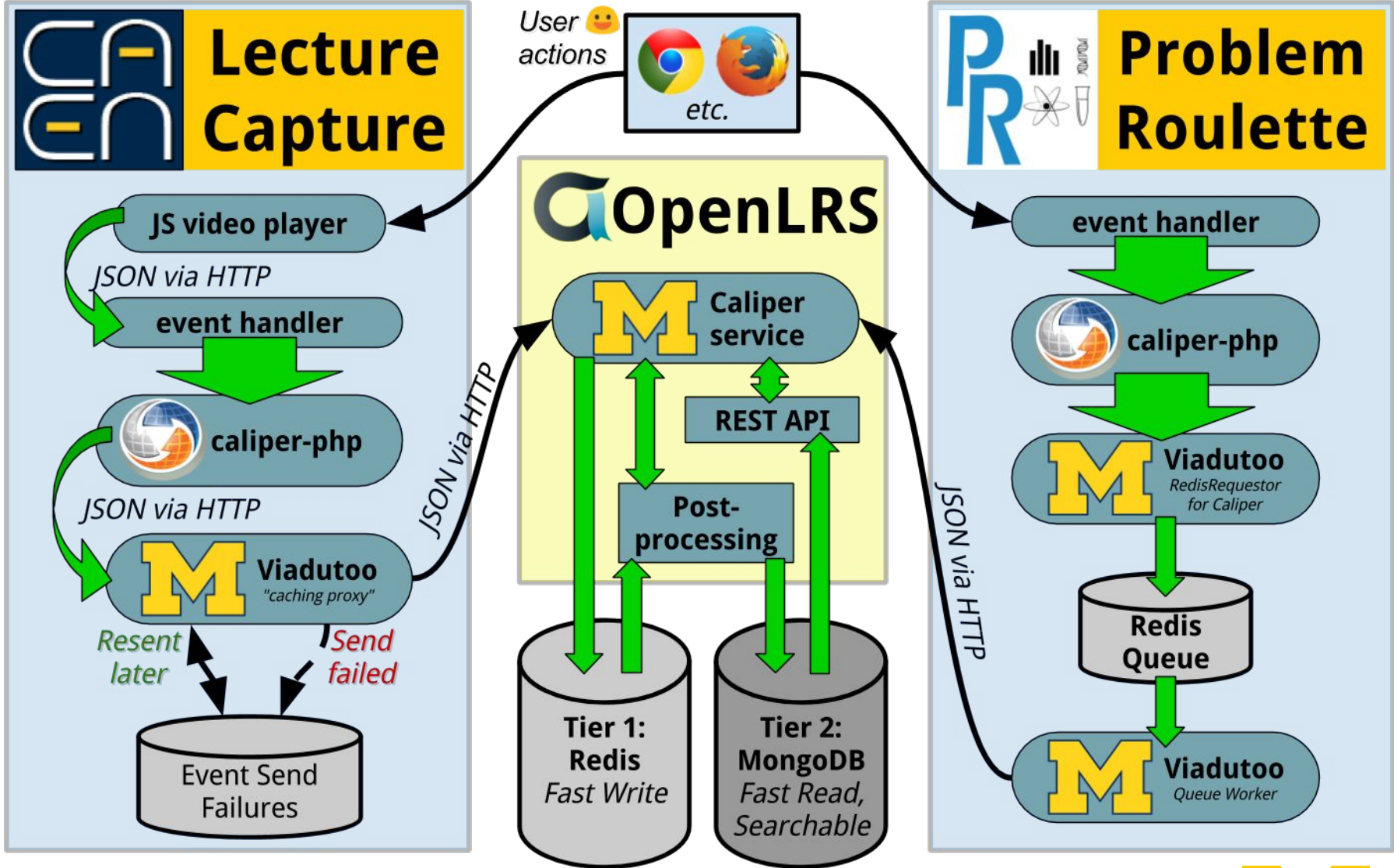
***All seemed well as Caliper events
poured in from Problem Roulette***

Viadutoo Inefficiency and Fix

- Problem Roulette's usage pattern meant that more events were sent in a small period of time
- Viadutoo's design to accept events via HTTP became a bottleneck, slowing PR's server
- Decision: Add Caliper Requestor subclass to Viadutoo to store events in a Redis queue
- A worker process sends queued events to OpenLRS when PR server resources are free



*A view of the updated
infrastructure...*



Inside an LA Architecture: Updated

(More) Next Steps

- Release new version of Viadutoo
- Caliper 1.1 will be released soon, so update Lecture Capture and Problem Roulette to use it and take advantage of its new features, especially lighter weight JSON
- Continue efforts to encourage event analysis



Thanks

I'm grateful to the developers and organizations that helped create an environment that encourages the growth of these technologies.

