



## csc09: Maintaining Large(r) Web Apps

# Who are we?



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CSCC09 TA (Winter 2019)



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# Overview

- 1. What we do at Verto!**
- 2. What is a large scale web application?**
- 3. Golden Signals of Monitoring**
- 4. Calling External Services**

# Verto Health

## At a Glance

Founded in  
**2017**

Patients Served  
**5M+**

Deployed In  
**80+ sites**

Verto is a **Toronto-based** Digital Health startup creating solutions that grow healthcare capacity while **bringing patients, providers, payers and caregivers closer together** in alignment with quadruple aim.

### Primary Offering:

A **Digital Twin platform** that creates a contextual snapshot of each patient in a health system from legacy systems that can interoperate with modern systems and devices.

### Projects we are going to cover today:



Vaccination workflow solution supporting **22% of Ontario's rollout** and ~6M doses to date



**COVID19 testing study** based out of Pearson with digitally orchestrated 0,7 & 14 day testing follow-ups



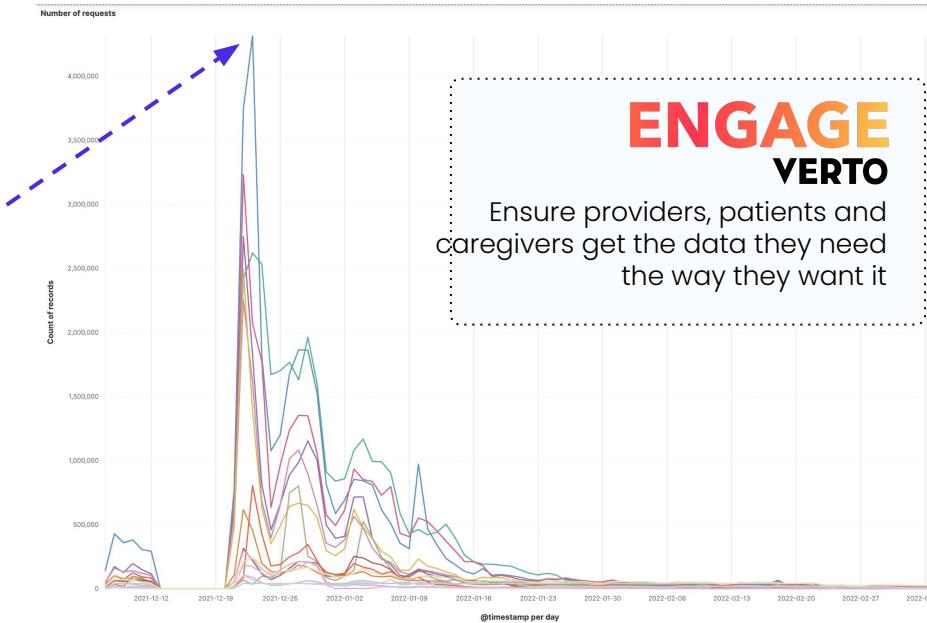
# Supporting Ontario's Vaccine Rollout

We've enabled over **5.8M** vaccination  
appointments in Ontario through regional  
and hospital partners.

# Large scale web applications

Serve **lots of people** with **reliability**

When the government announced third dose appointments for the general public



Well, what is unreliable?

Ottawa

## Frustration mounts as vaccination booking system hits more snags



Mayor Jim Watson calling for 40,000 more dos

[Matthew Kupfer](#) · CBC News · Posted: Jun 07, 2021 6:05 PM



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'Giving up after an hour of trying': Ontarians report problems with booster booking portal





## HAMILTON REGION

# Hamilton dumps Ontario's COVID shot booking system citing ongoing problems

City launches its own online appointment booking as it prepares for surge in demand



By **Joanna Frketich** Spectator Reporter  
Mon., Nov. 1, 2021 | 4 min. read

# Monitoring

Collecting, processing, aggregating, and displaying real-time quantitative data about a system.

**Applications**

**ENGAGE**  
VERTO      **FLOW**  
VERTO      **CONNECT**  
VERTO

**Databases**



**Infrastructure**



# Four Golden Signals of Monitoring

1. Traffic
2. Latency
3. Saturation
4. Errors



# Traffic

Measure the **demand** put on the system.

## Why?

- Is my application reaching the breaking point?
- Do I have enough resources provisioned to serve everybody properly?

# Load test server capacity limits

How many **queries per second** can your API handle?

<https://github.com/choyiny/locust-demo>

# Perform capacity planning

Figure out the breaking point of an application.

**eg. 50QPS.**

Figure out the peak load

**eg. 500QPS**

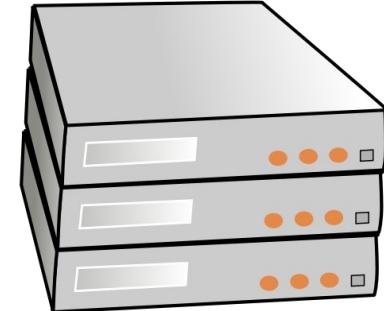
10 replicas required for peak capacity.

**Plan for N+2 (why?)**

N+2

Plan for...

- 1 server will crash and burn
- Another prepared for rolling updates



# How to monitor traffic

- Collect, parse, and transform logs
  - Application logs
  - Reverse Proxy logs (eg. Cloudflare)
  - Example stack: Elasticsearch, Logstash, Kibana (ELK)

# Latency

Measure the **time** it takes to serve a request.

## Why?

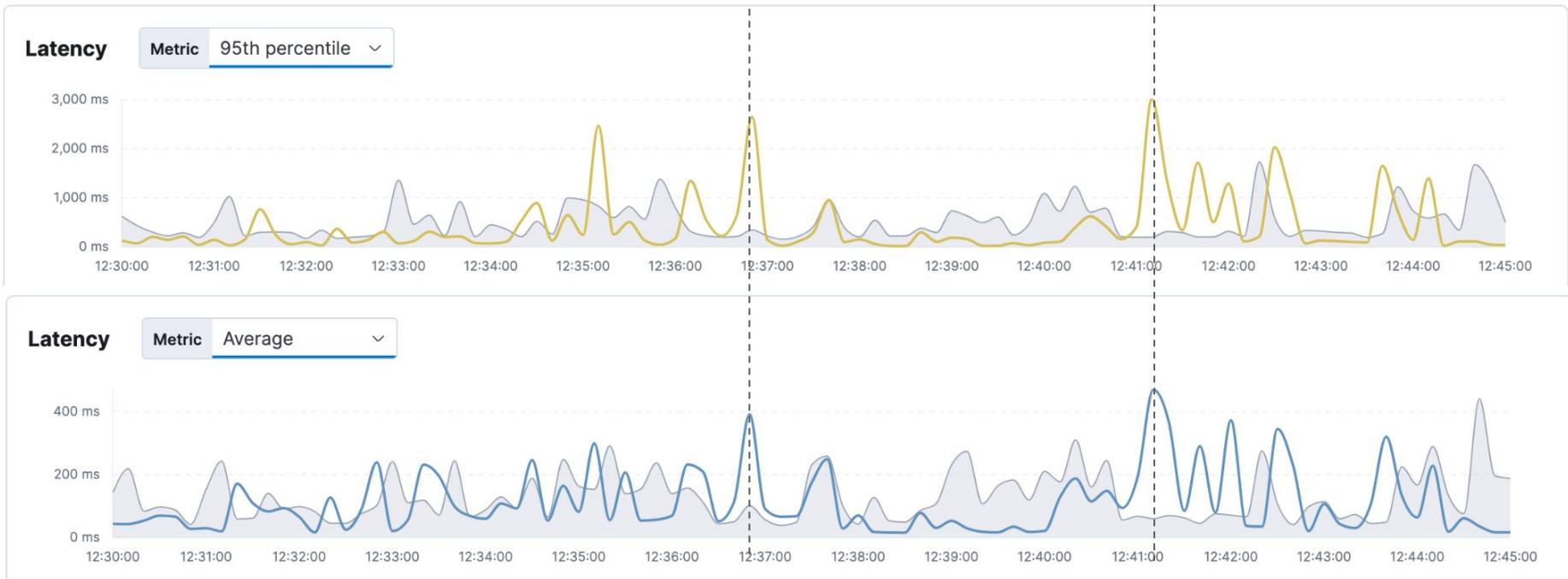
- Am I serving users in the right amount of time?
- Why are requests taking longer/shorter than expected?

# Latency Distribution chart with **Elastic APM**:

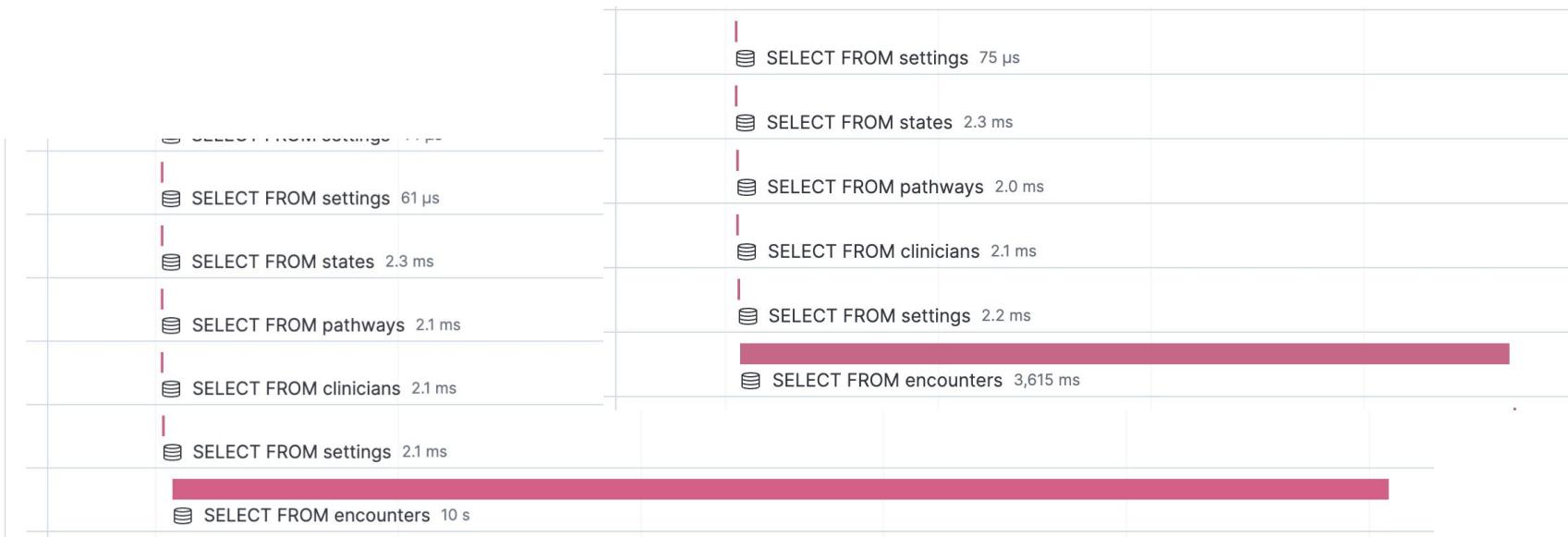
## What's important?



Look at the tail. The **95th percentile** tells us much more than the mean.



# Result - Ability to perform optimizations and performance improvements



# Saturation

A measure of how “full” the system is, **emphasizing the resources that are most constrained.**

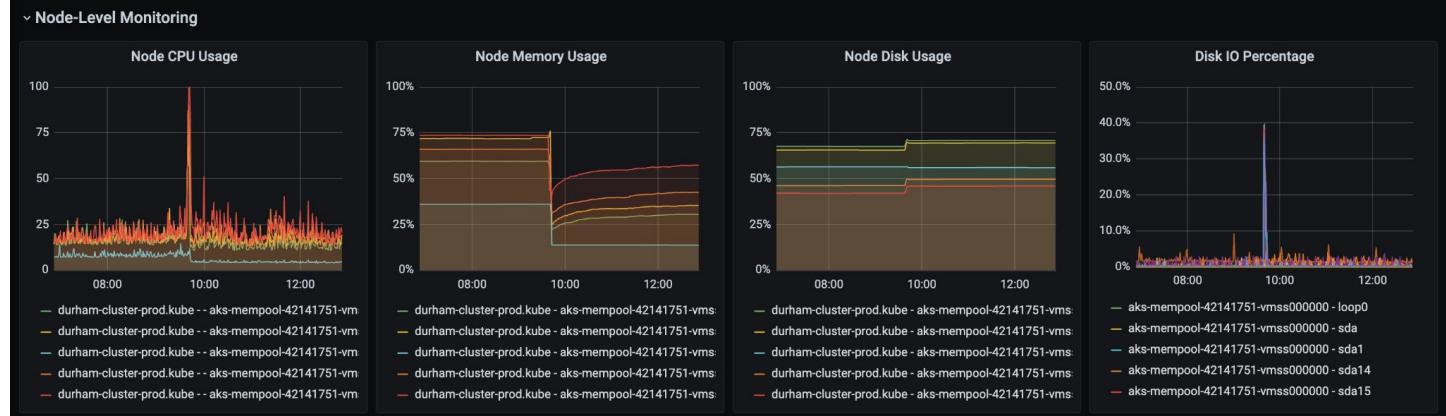
## Why?

- How many more visitors can I take on my website?
- How many hours until my hard drive is full?

# Detection - Monitoring Servers

Monitoring servers

Set thresholds for alerts



## # grafana-alert ▾



Grafana APP 9:25 PM

[Alerting] [ ] topped Docker Container alert

[Alerting] IRC Stopped Docker Container alert

Docker Container stopped working

Error message

alert execution exceeded the timeout

Grafana v7.3.6 [ ]

[Alerting] [US] High Disk Usage

[Alerting] [US] High Disk Usage

High disk usage detected (average from past 3 minutes)

Error message

alert execution exceeded the timeout

Grafana v7.3.6 [ ]

[Alerting] [US] High CPU Usage

[Alerting] [US] High CPU Usage

High CPU usage detected (average from past 3 minutes)

Error message

alert execution exceeded the timeout

Grafana v7.3.6 [ ]

# Errors

The rate of requests that fail.

## Guiding Questions

- How many users were affected by errors caused by code?
- Why did requests not work as intended?



Find out code/infrastructure problems through real usage

Sentry interface showing issues for Verto Inc. (Cho Yin Yong) across all environments over the last 14 days.

Issues:

- All Unresolved (20)
- For Review (2)
- Ignored
- Saved Searches

Search bar: is:unresolved

Sort by: Last Seen

Action	Issue Type	Environment	Created	Last Seen	Events	Users	Assignee		
<input type="checkbox"/> Resolve	ActiveRecord::RecordInvalid	Api:V1::OpenClinic::AppointmentsController#book	42min ago	4mo old	ruby	6	1		
<input type="checkbox"/> Ignore	NoMethodError	Api:V1::StatesController#encounters	New Issue	2hr ago	2hr old	ruby	4	1	
<input type="checkbox"/> Merge	ArgumentError	Api:V1::StatesController#encounters	6hr ago	4mo old	ruby	4	1		
<input type="checkbox"/> ...	PG::ConnectionBad	Sidekiq/UserAuditBackupWorker	14hr ago	3mo old	ruby	376	8.4k	0	
	TypeError	Api:V1::OpenClinic::SlotsController#capacity	21hr ago	1wk old	ruby	7	3		
	PG::ConnectionBad	PublicController#ping	21hr ago	1wk old	ruby	3.8k	14		

A red oval highlights the first five items in the list, specifically the ActiveRecord::RecordInvalid, NoMethodError, ArgumentError, PG::ConnectionBad, and TypeError entries.

# Meaningful alerts

- Memory usage at 90%
- CPU usage has been at 100% for 15 minutes
- Elevated request failures detected
- Hard drive is predicted to be full in 2 hours



# Linking it all together

## Alerts:

1. **Traffic:** Surge traffic detection
2. **Latency:** requests are taking longer than usual
3. **Saturation:** High I/O on database
4. **Errors:** Elevated API error rate





# Calling External Services

2

# How we support Air Canada

Verto connects passenger & consumer data from the point of collection, through in lab and testing processes, to communicate timely results back to the participants

**5K+**

**Patient Engagements  
delivered daily**



Seamless integrated lab experience with reliable tracking of test creation, assignment, testing and reporting



# Overall Workflow

## Consumer Experience

User signs up with verified email/sms

User provides demographic data

User performs supervised COVID test at the airport

User receives take home test kits to perform 7/14 days later

7/14 days later  
User performs test, fills out survey

Verto facilitates courier sample collection

## Laboratory Workflow

Lab receives sample from courier

PCR testing is performed

Verto parses result files

Sends results to registered participants

# Reinventing the wheel?

- Evaluating external solutions - transferring risk



# Picking the Right Approach

- Assessing the technical/business requirements
  - How critical is the engagement timing?
  - Can it be safely resent?
  - User feedback?
  - Anticipated throughput?
  - Error handling?

# Three Approaches for External Calls

- Synchronous
- Asynchronous
- Asynchronous Task Queues / Workers

# Case 1 – Contact Verification

- **User receives timed code to confirm**
  - User requires action to proceed
  - Timing and feedback is critical

→ Communications Consents:

How would you like to receive your registration confirmation and electronic communications?

Choose one to proceed:

Sign up with Text Message

Sign up with Email

Email:  
szhou@verto.ca

Enter your email to receive your verification code. You will need to be able to access your email to receive a verification code.

This reCAPTCHA is for testing purposes only. Please report to the site admin if you are seeing this.

I'm not a robot

reCAPTCHA  
Privacy - Terms

Back Submit

→ Verify your identity

Your Verification Code is:  
**93158841**

If you have closed the webpage to enter your verification code, then please click the link below:

Verify My Identity

Please use the above verification code or button to verify your email address. Your email address must be verified before your new account information can be saved.

Back Submit

# Synchronous Approach

```
const client = require('@sendgrid/mail');

client.setApiKey(process.env.SENDGRID_API_KEY);
const message = {
  // message object as defined in API docs
}

let apiResponse = await client.send(message).catch((err) => logError(err));
// return response based on if apiResponse is defined
```

- Instant feedback for user
- Response time dependent on external call completion

# Case 2 – Registration Confirmation

- **User receives a confirmation email upon registering**
- No need for instant feedback, no action required
  - Can be resent afterwards
  - Registration is complete regardless of engagement

# Asynchronous Approach

```
let saved = persistRegistrationData(req.body)

if (saved) {
  client.send(message).then(() => logSuccess()).catch((err) => logError(err));
  // return successful response without waiting for the external call to return
} else {
  // return errors from saving registration data
}
```

- Critical workflow completes regardless of engagement
- User can potentially register without confirmation

# Case 3 – Kit and Survey Reminders

- **User is reminded to administer test and register for pickup**
  - Queueing up engagements to the future



Thank you for your participation in the MHL Study. This is a reminder to complete your weekly test kit today.

Please ensure you are able to collect a COVID-19 test-kit from your site manager and self-administer it today.

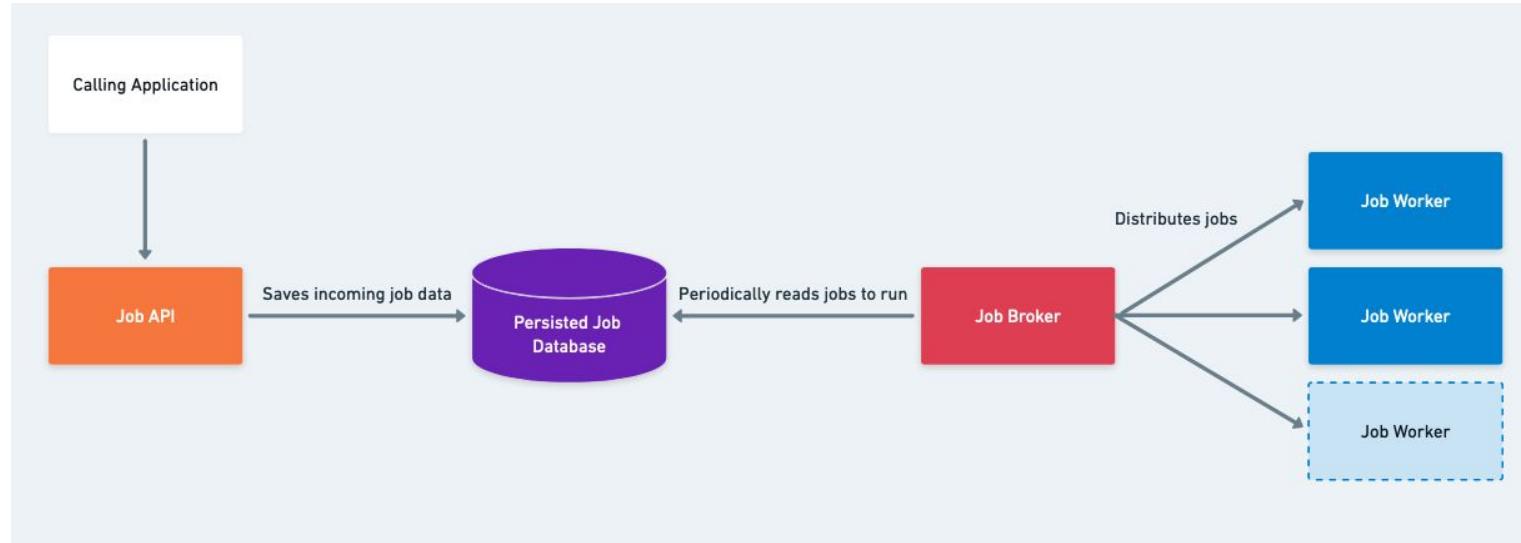
[Click here to register your test kit](#)

[Register Test Kit](#)

# Implementation Options

- Provided by email service
  - Sendgrid has scheduled send
  - Want to be service agnostic
- Asynchronous Task Queue

# Asynchronous Task Queues



# Delivery Reliability

- Third party services go down
- Handling callbacks



Past Incidents      Knowledge Base

Contact support

Subscribe To Updates

● 1 INCIDENT REPORTED

REPORT AN INCIDENT

Twilio Status Page

## Current Information on Service Availability.

Check here for updates about Twilio's service availability and the status of telecom carriers globally.

Subscribe to get real-time updates via email, RSS, Slack, and more.

SMS Delivery Delays to Canada Rogers and Fido Networks

SMS LONG CODE, NORTH AMERICA

Investigating - We are continuing to work with our carrier partner to resolve the issue of SMS delivery delays to Canada Rogers and Fido networks from a subset of longcodes. We expect to provide another update in 2 hours or as soon as more information becomes available.

POSTED: MAR 7, 10:04 PST

Investigating - We are experiencing SMS delivery delays when sending messages over a subset of longcodes to Canada Rogers and Fido networks. Our engineers are working with our carrier partner to resolve the issue. We will provide another update in 1 hour or as soon as more information becomes available.

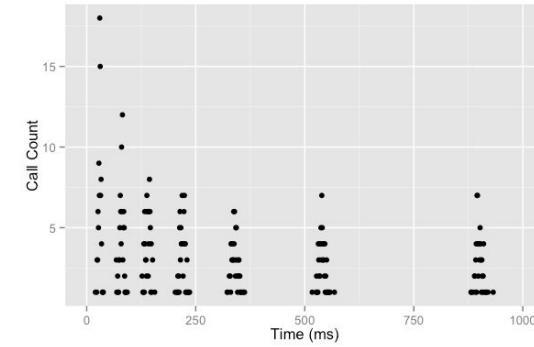
POSTED: MAR 7, 09:04 PST

# Dealing with Failures

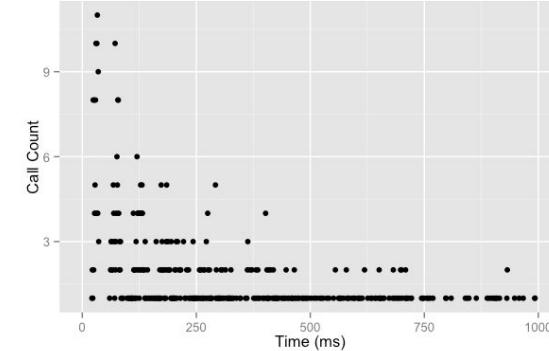
- Retry strategy
  - What can we safely retry?
  - How should we retry?
- Spreading out requests to optimize resource utilization
  - <https://aws.amazon.com/blogs/architecture/exponential-backoff-and-jitter/>

# Exponential Backoff and Jitter

```
sleep = min(cap, base * 2 ** attempt)
```



```
sleep = random_between(0, min(cap, base * 2 ** attempt))
```



# Supportability

- When we can't safely retry, we need ways to investigate

Robots > Logs

## Execution Logs

Search Query	Status	Workflow	Creation Date Range		
eg. email=cyong@verto.ca	▼	▼	10/11/2020 14:40	10/11/2020 14:40	Show More Filter X
<input type="checkbox"/> 0 Selected <a href="#">Clear</a> <a href="#">Retry</a> <a href="#">Cancel</a>		<a href="#">«</a> <a href="#">1</a> <a href="#">2</a> <a href="#">3</a> <a href="#">4</a> <a href="#">5</a> <a href="#">6</a> <a href="#">7</a> <a href="#">8</a> <a href="#">9</a> <a href="#">10</a> ... <a href="#">380</a> <a href="#">»</a> 7600 result(s) <a href="#">20</a> <a href="#">Executions per page</a>			
<a href="#">Checker: On Patient Registration</a>	6238978e9bcfc2a2373612b	2022-03-21 11:19:42	N/A	<span style="color:red;">!</span>	Codeblock cannot be initialized. Is it w...
<a href="#">Send verification code to patient</a>	62389687a63fb6d74094d8f	2022-03-21 11:15:19	0.69 sec	<span style="color:green;">✓</span>	Success
<a href="#">Send verification code to patient</a>	6238960345ef8dbbb8b6541c	2022-03-21 11:13:07	0.78 sec	<span style="color:green;">✓</span>	Success
<a href="#">On Resource Update: Update CHL Lab Resource</a>	623795147b6a53f308e9fb69	2022-03-20 16:56:52	1.948 sec	<span style="color:green;">✓</span>	Success
<a href="#">On Testing Complete: Mark Kit as Administered</a>	6237951445ef8dbbb8b6541b	2022-03-20 16:56:52	0.22 sec	<span style="color:green;">✓</span>	Success

# In Summary

- Introducing external services can add uncertainty to your project
- Choose an integration approach appropriate to your use case
- Plan for the worst case scenario to ensure reliability

# Verto's Digital Twin Platform

## CONNECT VERTO

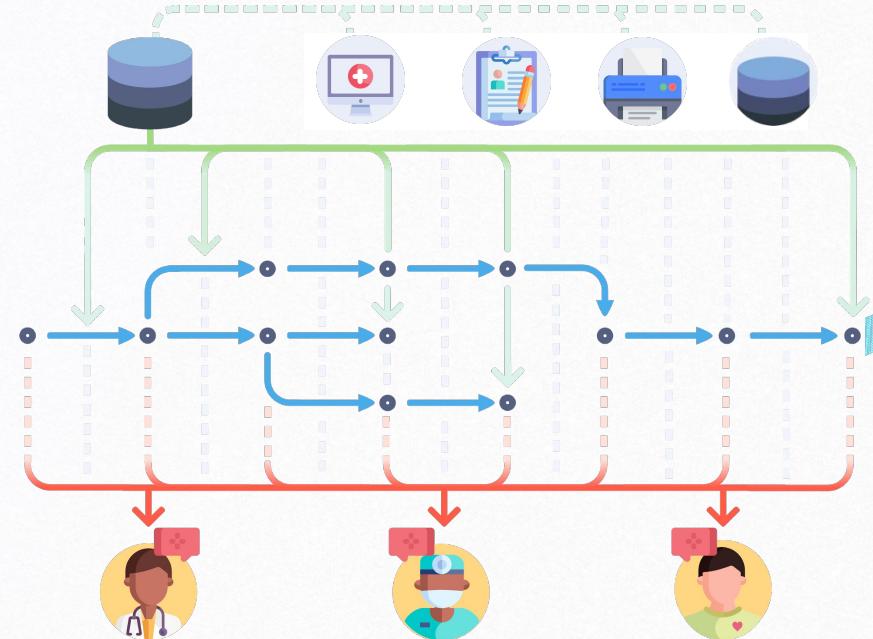
Connect to disparate data sources to provide ML-enabled Data Virtualization

## FLOW VERTO

Digital encode and automate standard and non-standard clinical workflows

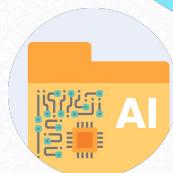
## ENGAGE VERTO

Ensure providers, patients and caregivers get the data they need the way they want it



## INSIGHT VERTO

Real-time visibility into patient flow and population analytics



# We are hiring full times and co-ops

- **Full Stack Software Developer**
- **Infrastructure Developer**
- **QA Automation Developer**



## Email Us

Resume, transcript and what you are doing for your C09 project.

[dev-hiring@verto.ca](mailto:dev-hiring@verto.ca) >



# References

<https://thenewstack.io/deployment-strategies/>

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<https://toronto.citynews.ca/2021/12/13/ontarians-50-plus-covid-boosters/>

<https://www.cbc.ca/news/canada/ottawa/vaccine-booking-ontario-second-dose-covid-19-1.6056652>