Flood Monitoring & Warning

Resilience and Redundancy

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Toronto and Region
Conservation
Authority

Two Sides to the System

Gauges

- Sensors and Loggers
- Network Access
- Cameras

System

- Data Acquisition & Storage
- Data Delivery
- Alarming and Notifications

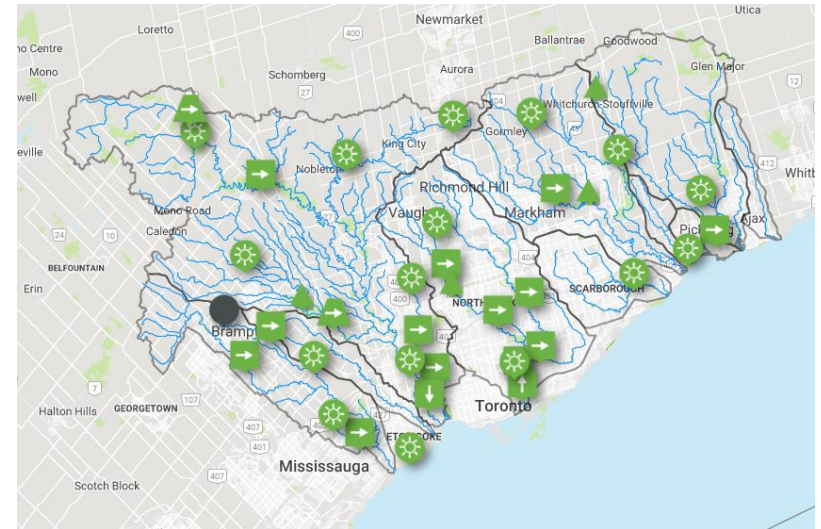# Gauge Reliability and Resiliency

Gauge Downtime

- Communication performance
- Security problems with online devices
- Power supply

Hardware Performance

- Sensor Failure
- Redundancy

Real-time Cameras

- Camera use as a form of redundancy

Gauge Downtime

All of TRCA's FFW gauges use cellular modems

- Cellular provider was initially chosen based on network reliability
- Devices would experience periodic faults
- TRCA began to use product-specific online software to diagnose and reboot modems
- Shift towards new modem has resulted in less faults
  - Lower power consumption added benefit
- Security features need to be used to prevent malicious attacks

Gauge Downtime – Power Constraints

Most FFW gauges are powered by off-grid PV panels

- Total power loss at a site results in data not being collected
- Efforts have been undertaken to improve this infrastructure
- Larger solar panels
- Larger battery storage capacity
- Routine gauge maintenance
- Extreme weather can still cause problems
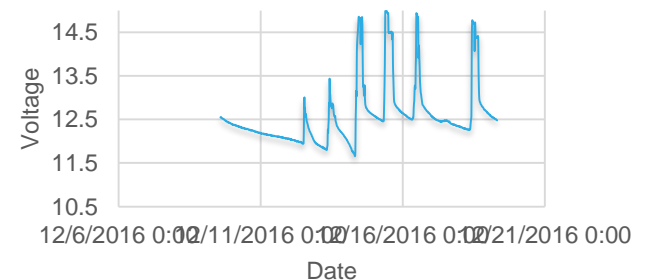
Gauge Downtime – Sensor Constraints

- Most sensors operate without issue

- Some sensor faults result in false alarms
    - Real-time cameras

- Sensor redundancy would be ideal
    - Simply switching programming at remote locations can be an easy fix

- Spare equipment reduces station downtimes

DON AT TODMORDEN

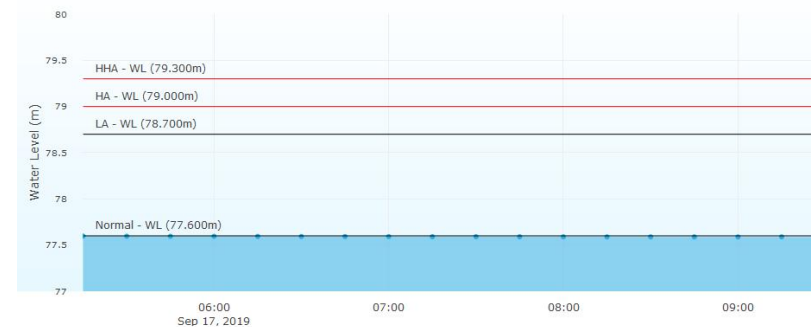2019-09-17   ID# HY019   Flow | **Water Level** | WI Backup |
Wt

Download Tabular Data (last 72 hours)

77.588m 77.588m 77.589m 77.590m
10:45 AM   10:30 AM 10:15 AM 10:00 AM

Lowest Battery Level (24h): 14.1v

1h | 2h | **6h** | 12h | 18h | 24h | 48h | 72h

Real-Time Camera Use

- TRCA is currently operating five real-time flood warning cameras within our watershed

- Images used by staff, partners and public

- Different camera types for different applications (Fixed vs. Pan-Tilt-Zoom)

- Images are displayed on TRCA's FFW website
  - Pictures generated every page load
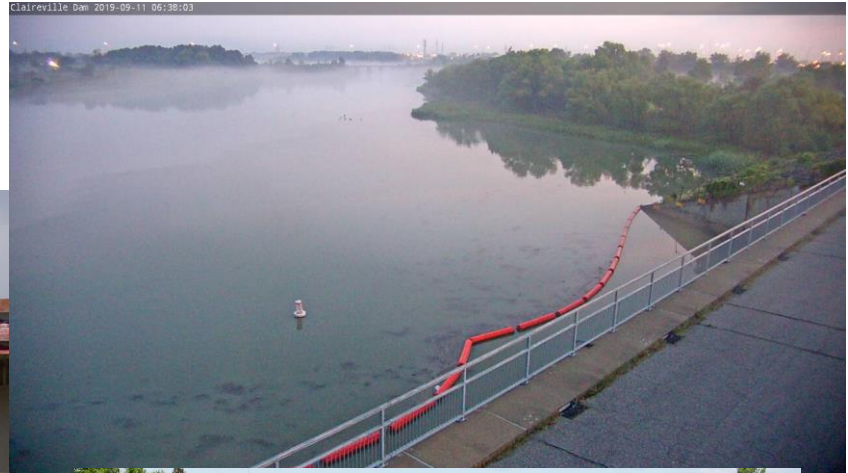
Black Creek Current Conditions
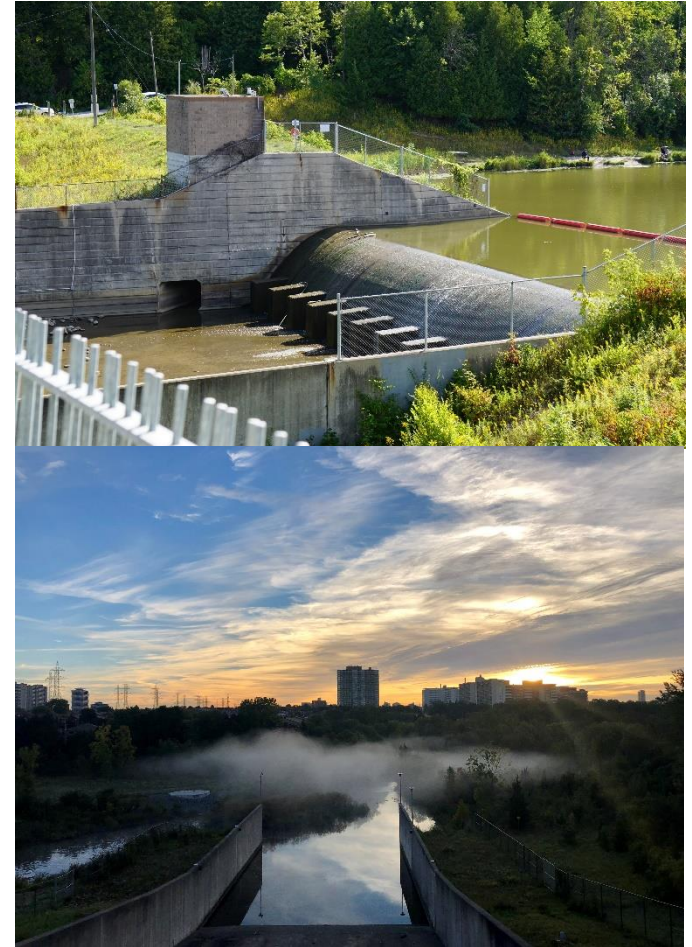
One Camera – Multiple Images

G. Ross Lord Dam

Claireville Dam

Milne Dam

Milne Dam 2019-09-11 06:40:47

Don at Todmorden

Black Creek at Alliance

Black Creek at Alliance 2019-09-03 09:08:31

www.trca.ca

Modernization of ITM Processes & Infrastructure

Moving to Off-Premises

- Striving for LEED Platinum

- No more server rooms

- Cloud-first strategy

Strategic Actions:

- Phase out on-premises systems

Modernization of ITM Processes & Infrastructure

Key Enterprise Architecture Principles:

- IT Solutions Functionally and Technically **Scalable**

- Data is Provided by **Authoritative Source**

- Data is **Captured Once** and Exchanged

- Prefer **Real-Time** Data Exchange

Digital Transformation Strategy

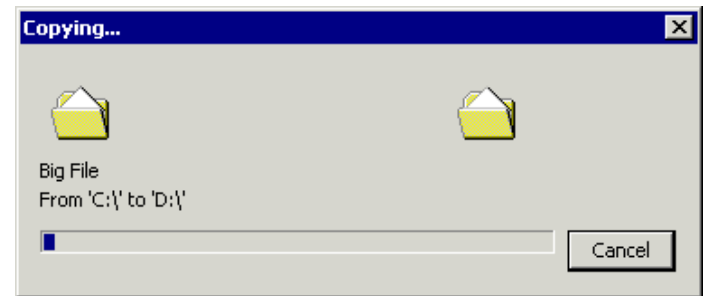Toronto and Region Conservation Authority

Strategic Actions:

- Opportunity to rearchitect FF&W system w/ consideration of new principals
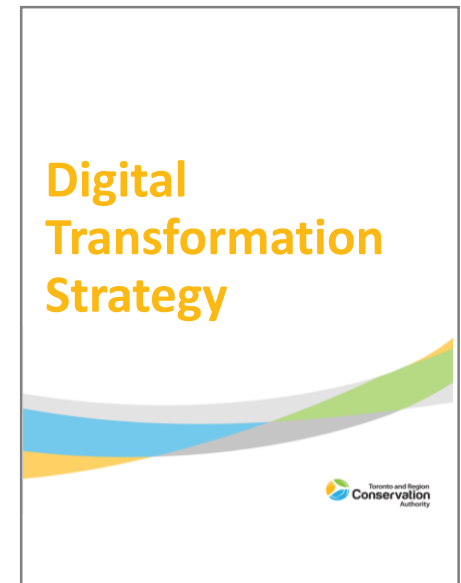
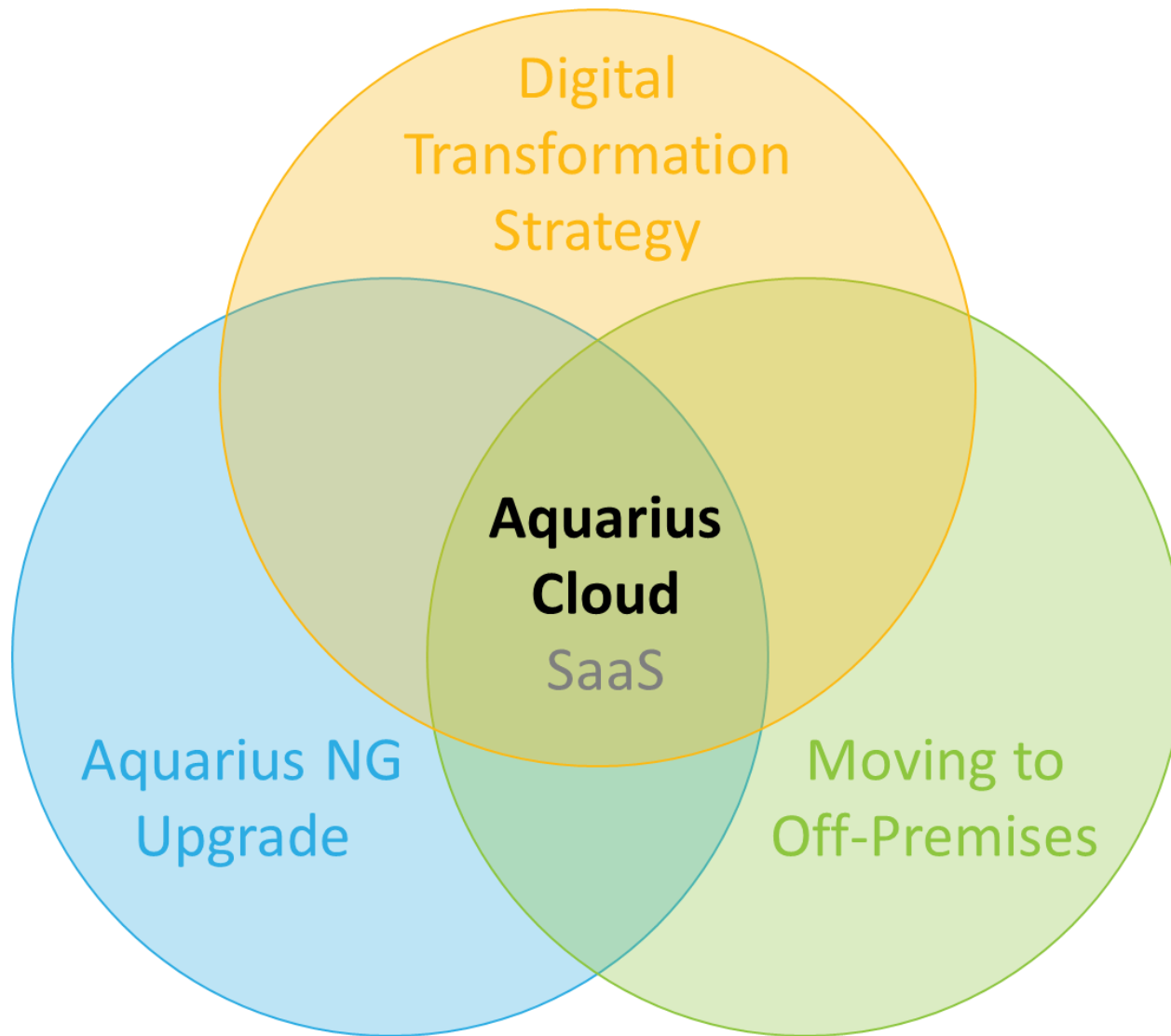# FF&W Aquarius "NG" System Update

NG is major system update

- Required full data review and reload

- OS refresh recommended
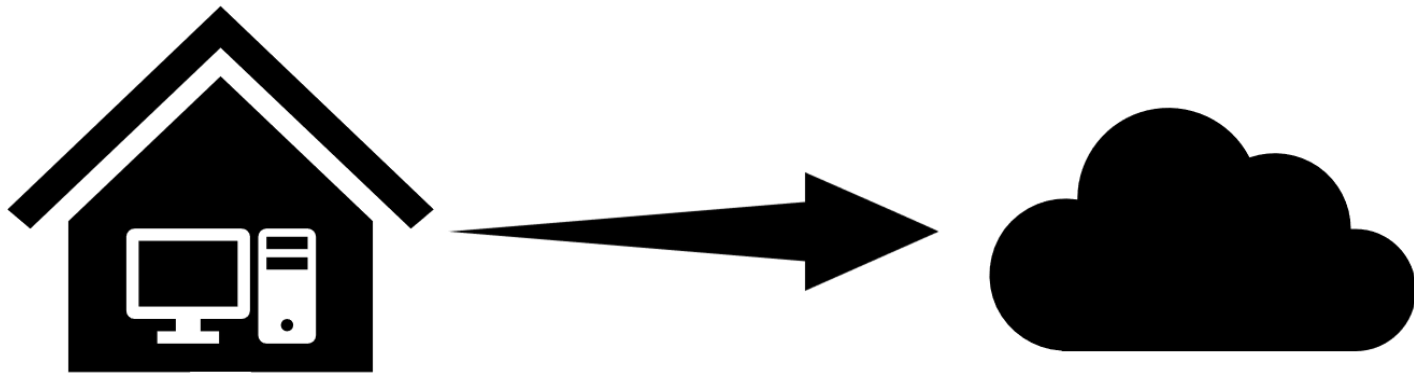
- Software reinstallation and restore

Strategic Opportunity:

- New option to rebuild existing instance in "Aquarius Cloud" SaaS

How to Maintain or Enhance current Resiliencies while moving to cloud?

Resilience with On Premises

Mirrored Approach

- Have a spare one of everything

✓ Very low likelihood of both systems failing.

✗ Twice the cost & maintenance!

Fully Mirrored Legacy System

Remote Stations

Gauging Network

Cloud Hosted Servers (IaaS)

Data Acquisition & Alarming

Data Storage

Data API   **Website**

Self Hosted Servers (On-prem)

Data Acquisition & Alarming

Data Storage

Data API   **Website**
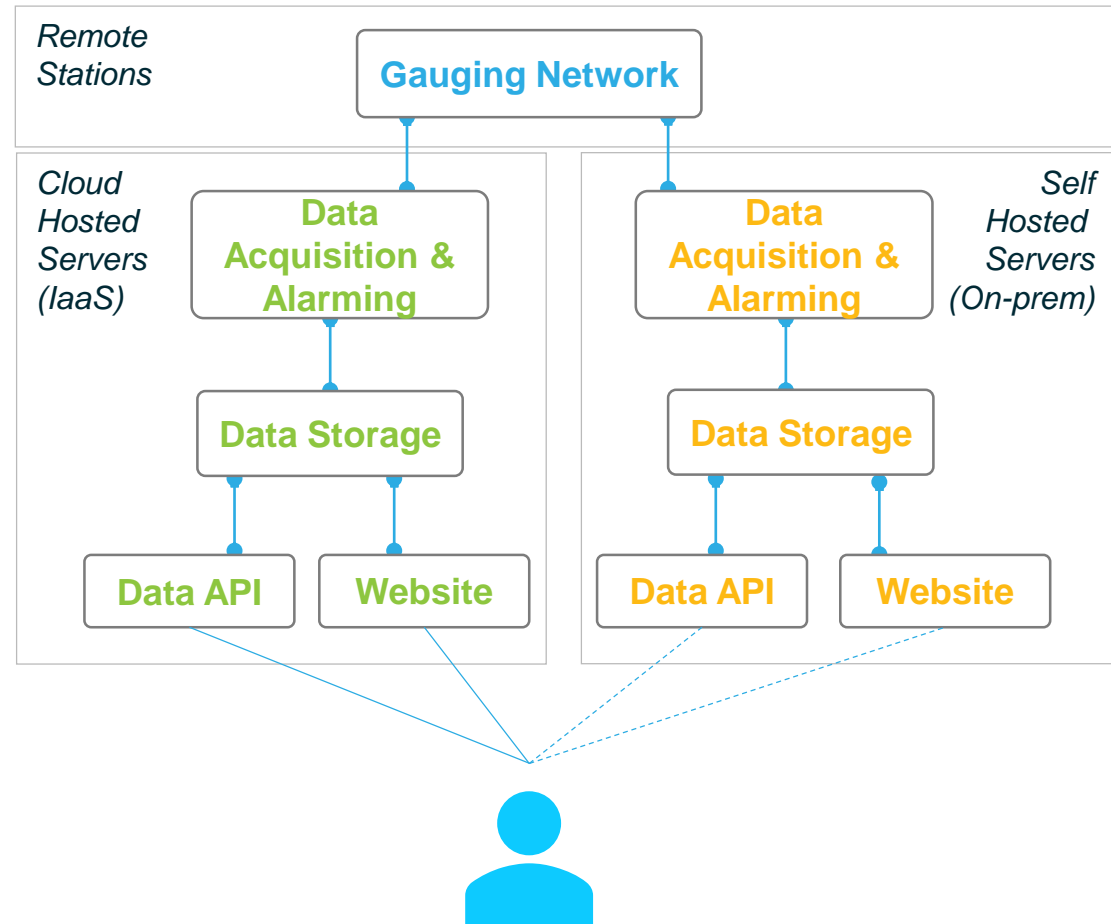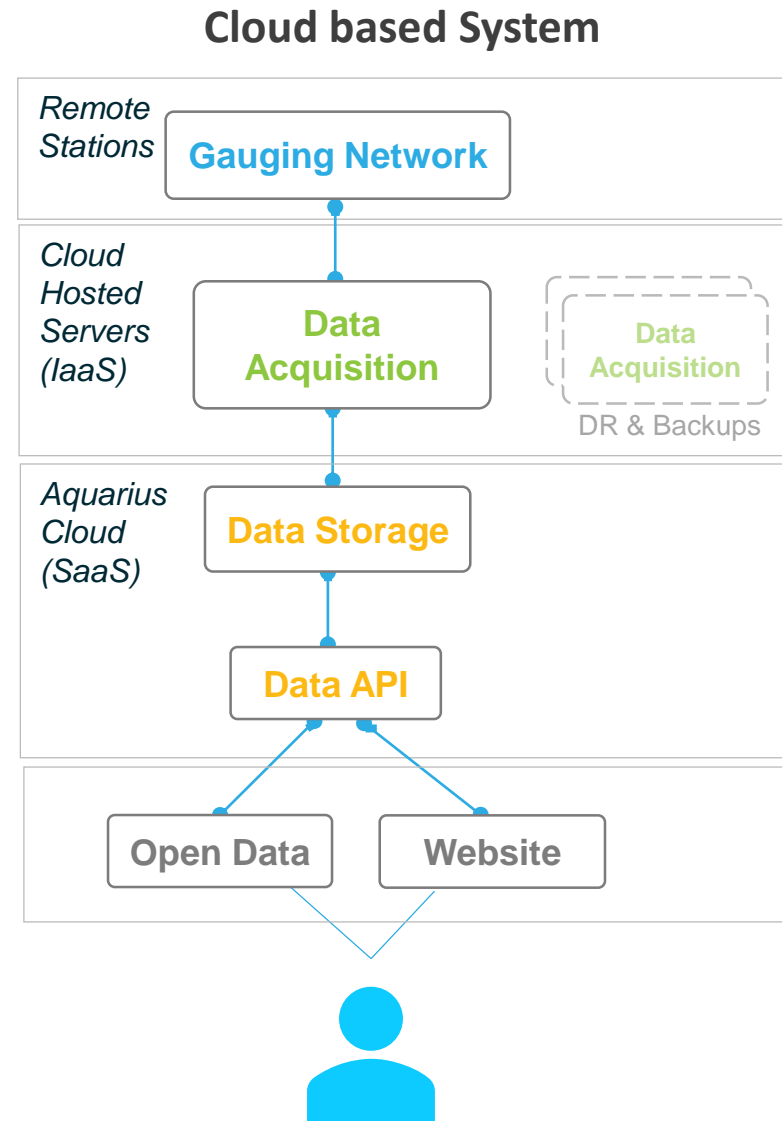
Resilience in the Cloud

Cloud Approach

- Only one of each component!

- Redundancies via AWS Cloud 'Magic'

- Allowed for Managed DR for SCADA system

✓ Abstracted from much of the complex pieces

✗ Similar cost w/ no maintenance!

Cloud based System

Remote Stations
Gauging Network

Cloud Hosted Servers (IaaS)
Data Acquisition
Data Acquisition
DR & Backups

Aquarius Cloud (SaaS)
Data Storage

Data API

Open Data   **Website**

System Resilience Considerations

On-Prem Hybrid

- In-house physical server management (Power, Network, DB Server, App Server, Security)

- Manual Disaster Recovery

- Semi-Virtualized Systems

Cloud Data Centre and Services

- Fully Virtualized Systems

- Managed Security and Quick Disaster Recovery

  - AWS Security (Firewall, Antivirus, IDS, SQL protection, Vulnerability Scans)

  - AWS Redundancies (DR Plan, RAID 6, 2x Firewall, 2x Load Balancers, 2x Application and 2x Database Servers)
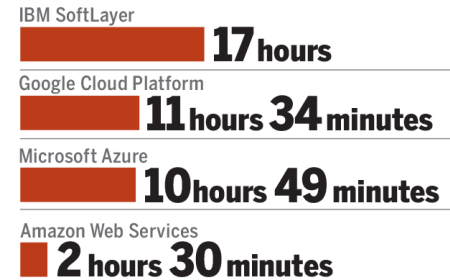
Counting on the Cloud

- Data centre in-built redundancies and failovers are key to current resilience

- Downtime as low as 2.5 – 5 hours per year

- Cloud adoption is growing across most industries.
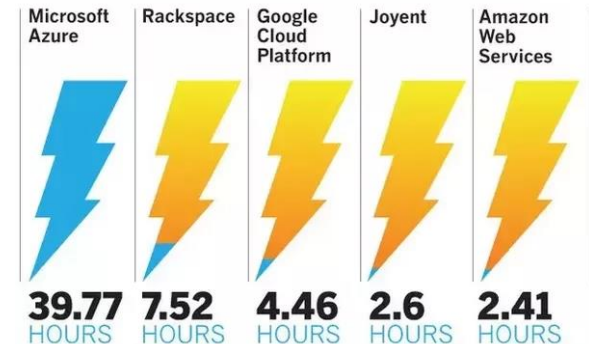 - Still up for debate in Emergency and Mission Critical systems

2018 global average downtime*

Azure — 2033 min
AWS — 312 min
Google Cloud — 208 min

CLOUD DOWNTIME IN 2015

IBM SoftLayer — 17 hours
Google Cloud Platform — 11 hours 34 minutes
Microsoft Azure — 10 hours 49 minutes
Amazon Web Services — 2 hours 30 minutes

SOURCE: CLOUDHARMONY

How reliable is the cloud?
Downtime in 2014 of compute services (in hours)

Microsoft Azure	Rackspace	Google Cloud Platform	Joyent	Amazon Web Services
39.77 HOURS	7.52 HOURS	4.46 HOURS	2.6 HOURS	2.41 HOURS

SOURCE: CLOUDHARMONY

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