



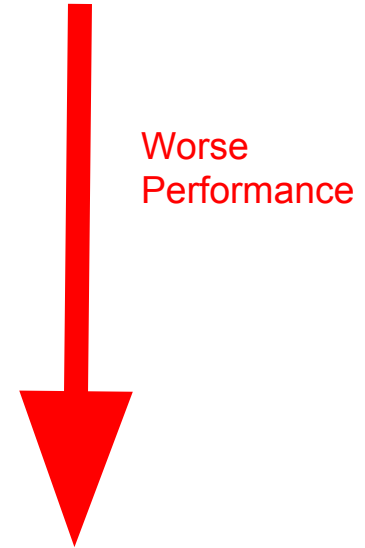
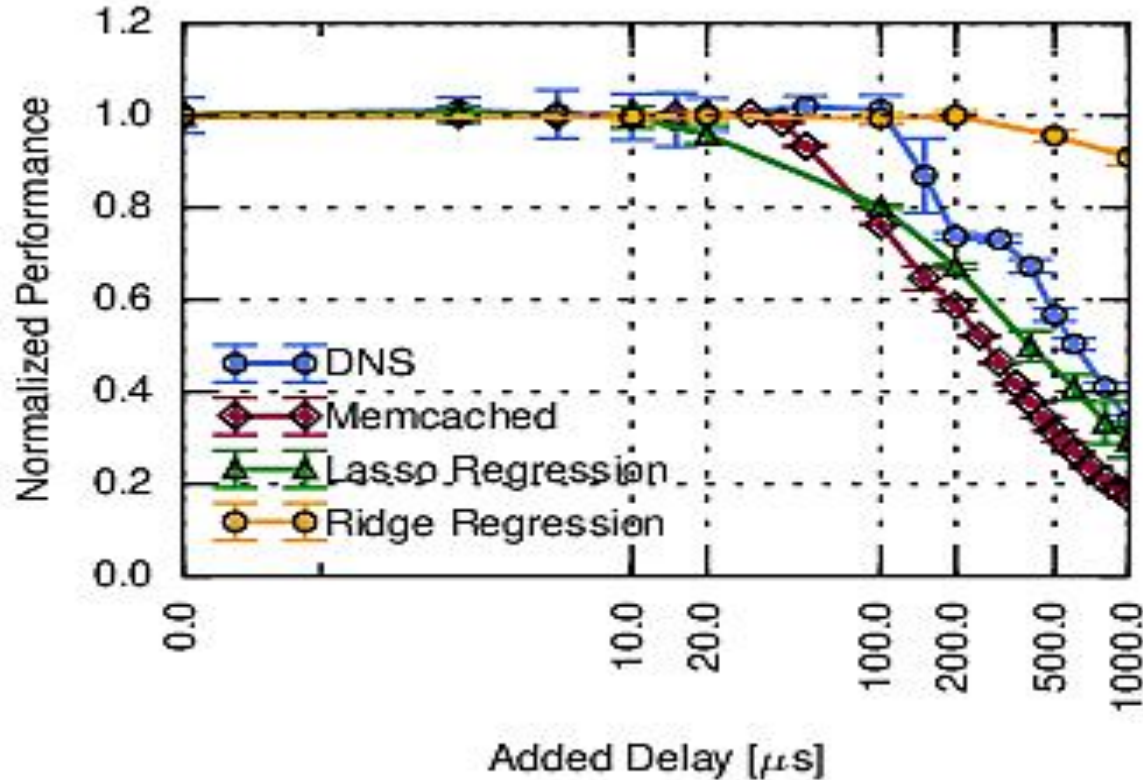
# Network Latency in Data Centres: Measurement, Impact and Mitigation

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# Small Network Latencies Dramatically Affect Performance



# Step 1

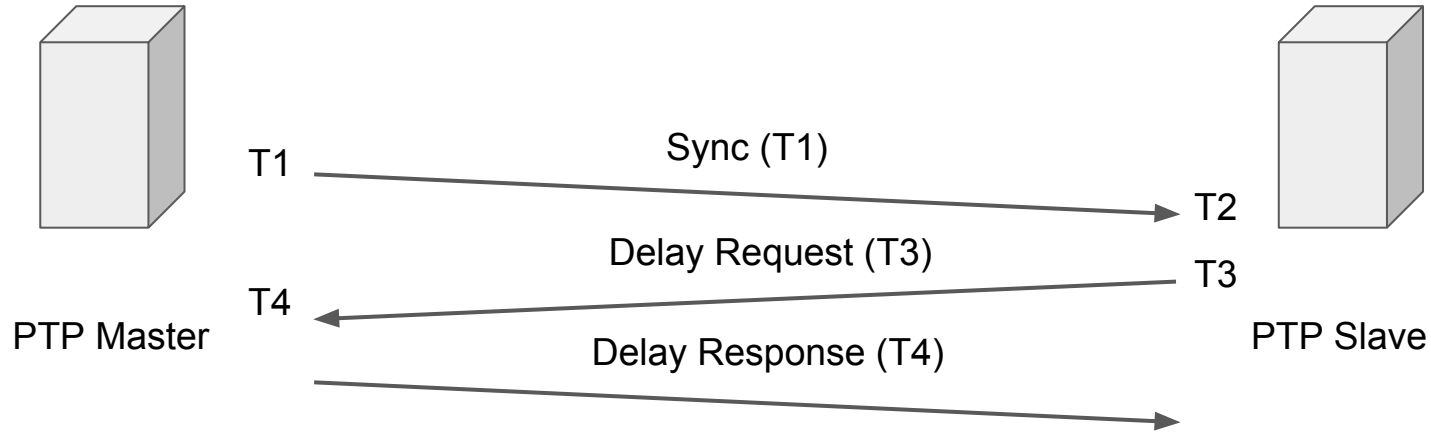
Measure



# How to measure network latency?

- Round-Trip Time
  - *Probing*
  - Customised systems for data centres: *Pingmesh, NetNORAD*
- (Estimated) One-way delay
  - Specialised hardware: *GPS, programmable data planes (INT)*
  - *Precision Time Protocol (PTP)*

# Precision Time Protocol (PTP)

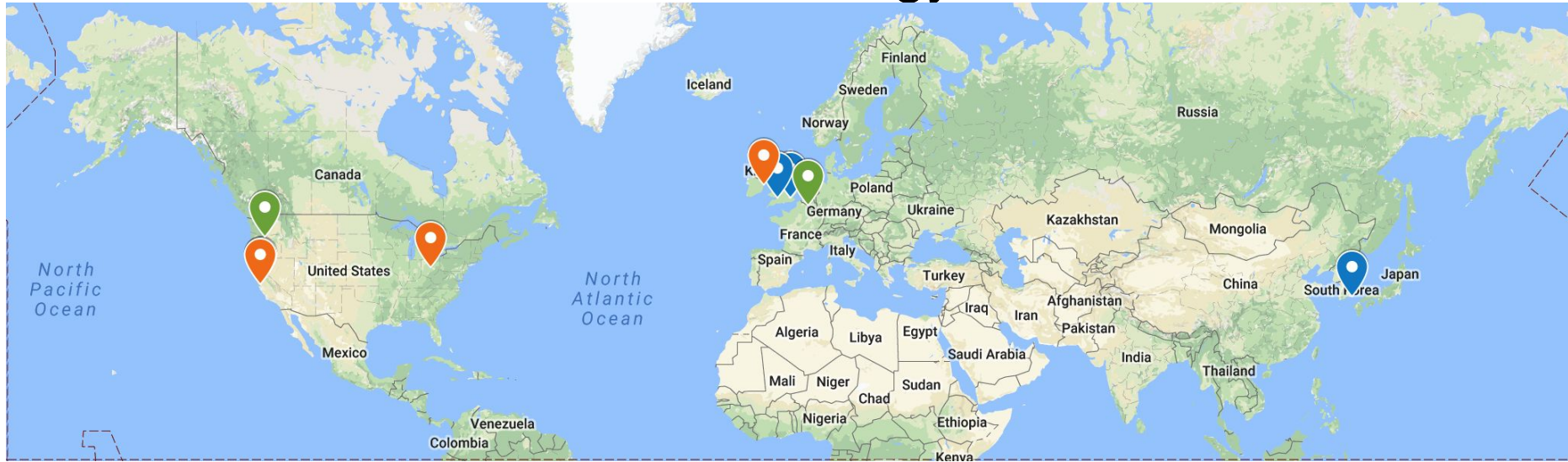


T1, T2, T3, T4 timestamps

$$\text{one-way delay} = (\text{master-to-slave delay} + \text{slave-to-master})/2$$

$$\text{clock offset} = \text{master-to-slave} - \text{one-way delay}$$

# Methodology



Azure-USW

Azure-UKW & Azure-UKS

Azure-KS



EC2-USW    EC2-USE

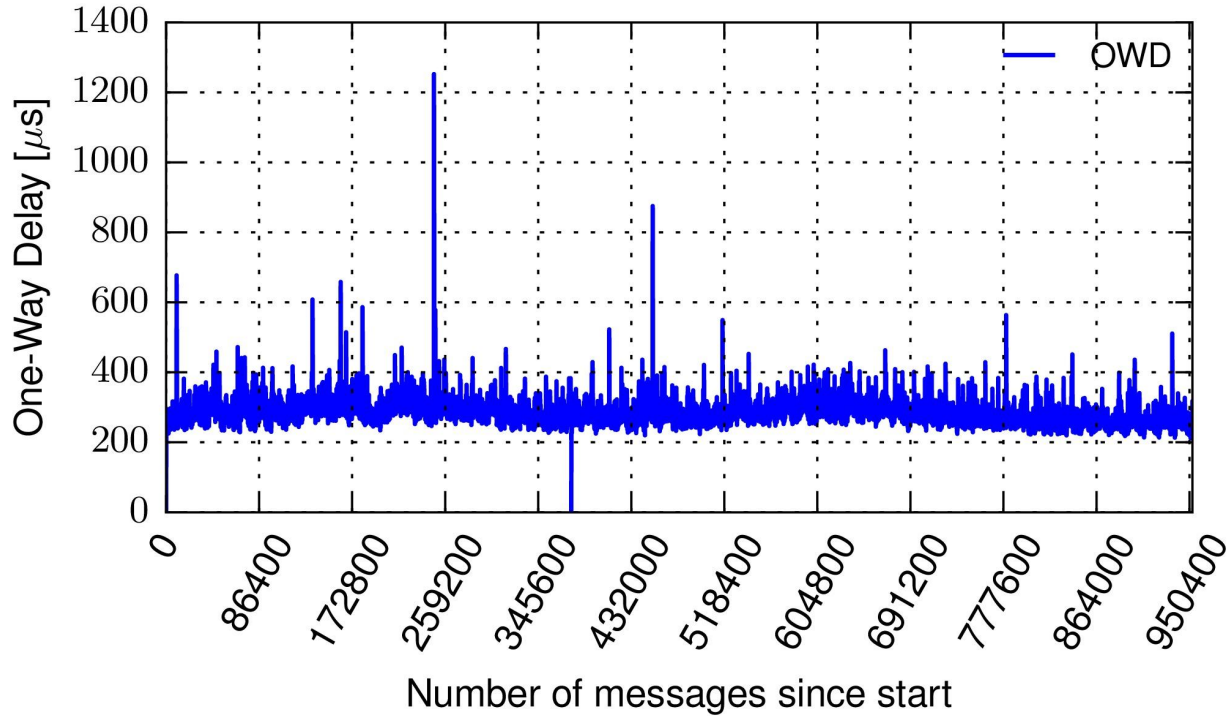
EC2-EUW



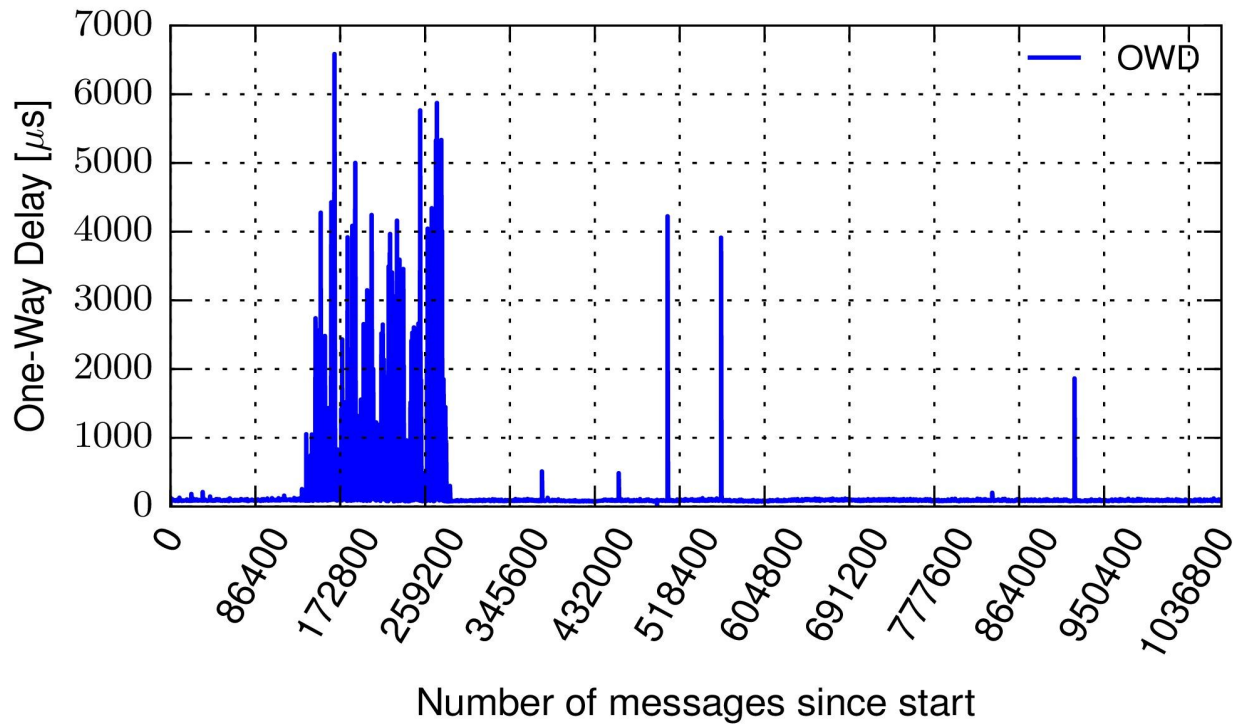
GCE-USW & GCE-USW2

GCE-EUW

# EC2 EU West

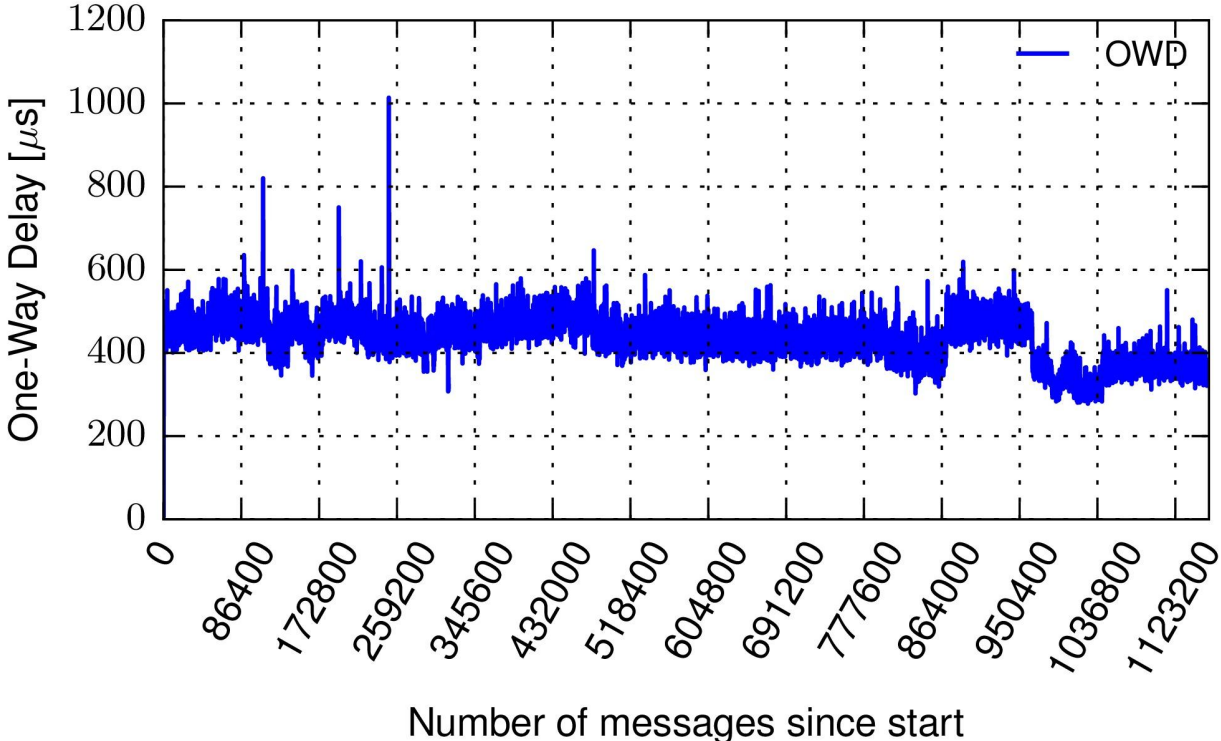


# GCE EU West





# Azure UK West



## Step 2

Measure

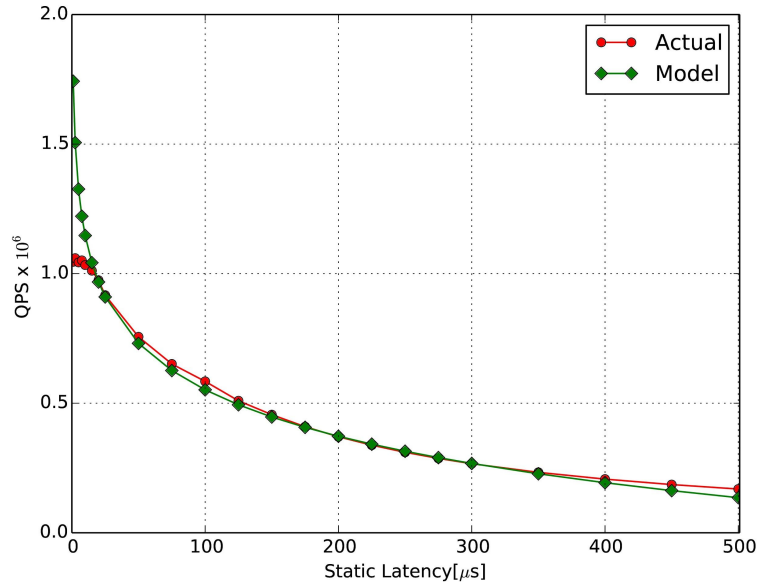


Analyse

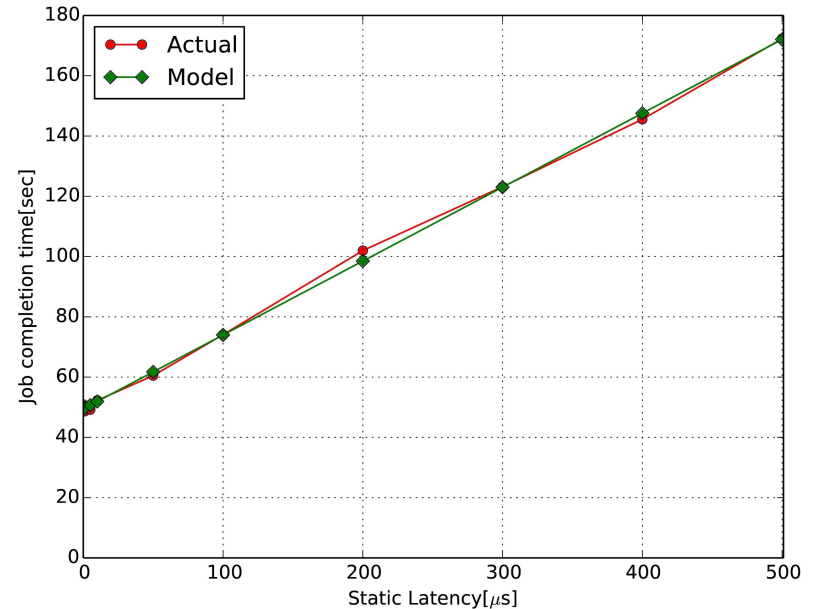


# Network Latency To Application Performance Functions

## Memcached



## STRADS Lasso Regression



# Step 3

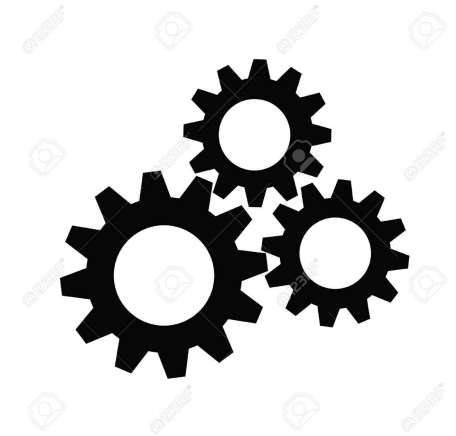
Measure



Analyse

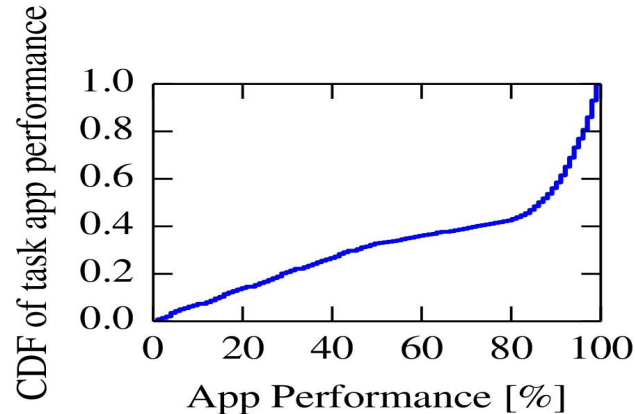


Act



# NoMora: Latency-Driven Application Performance Aware Cluster Scheduling

1. Network latency measurements between hosts
2. Network latency to application performance functions
3. Cluster scheduling as a flow network - *Firmament* (Gog et. al, OSDI 2016)



# Conclusion

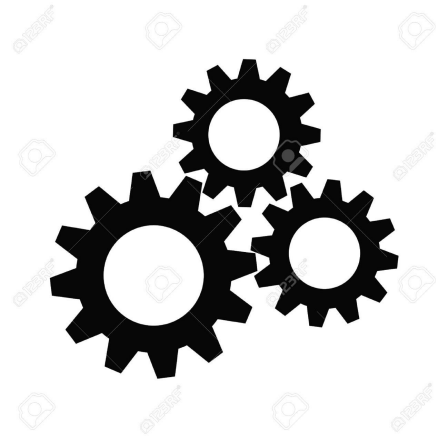
Measure



Analyse



Act



# Thank you!

Questions?

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[www.cl.cam.ac.uk/~dap53](http://www.cl.cam.ac.uk/~dap53)