Coordinated City-Scale Traffic Management *using* **Quartz "Time-as-a-Service"**

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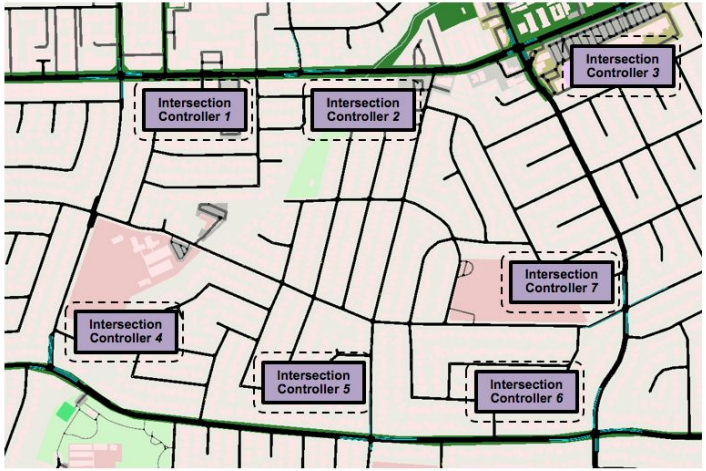
Traffic-Control Demo Scenario

- **Sunnyvale Traffic Scenario**
  - 16 intersections
  - 40 vehicles per hour per lane-Km
- **TrafFlow: Distributed Traffic Control**
  - ***Generate***, ***Train***, ***Deploy*** and ***Run*** Distributed Traffic Control in simulation
  - SUMO Traffic-Simulation Framework
  - ***Deep RL-based*** intersection controllers



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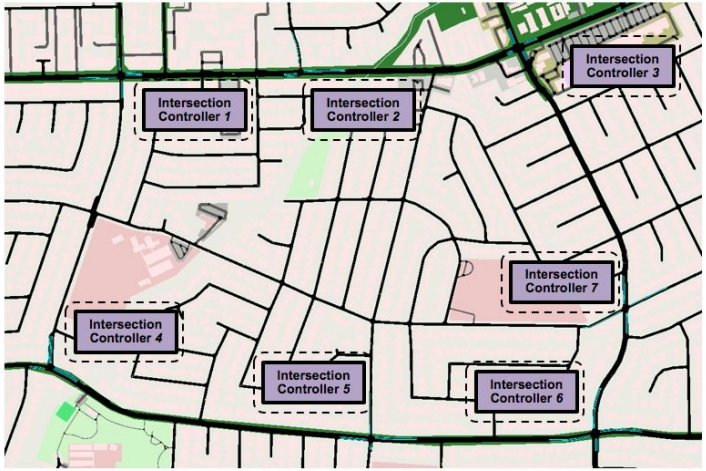

Synchronized Clocks are useful

→ clocks help ***order events***, build ***distributed state***

→ clocks enable ***distributed-coordinated*** scheduling

Enabling Coordination at Scale

- **Quality of Time (QoT)**
  - ***end-to-end*** **uncertainty** in the notion of time
  - each timestamp has bounds $\mathbf{t \in \{t-\varepsilon_l, t+\varepsilon_h\}}$
  - helps applications ***detect*** clock-sync failure

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- ***Coordinated actions*** **on distributed components**
  - all components ***bind*** to a common timeline
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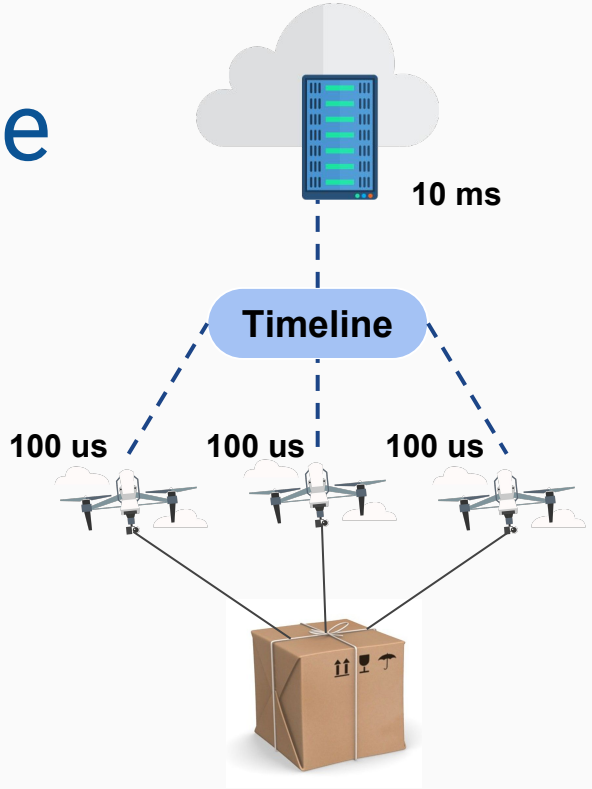

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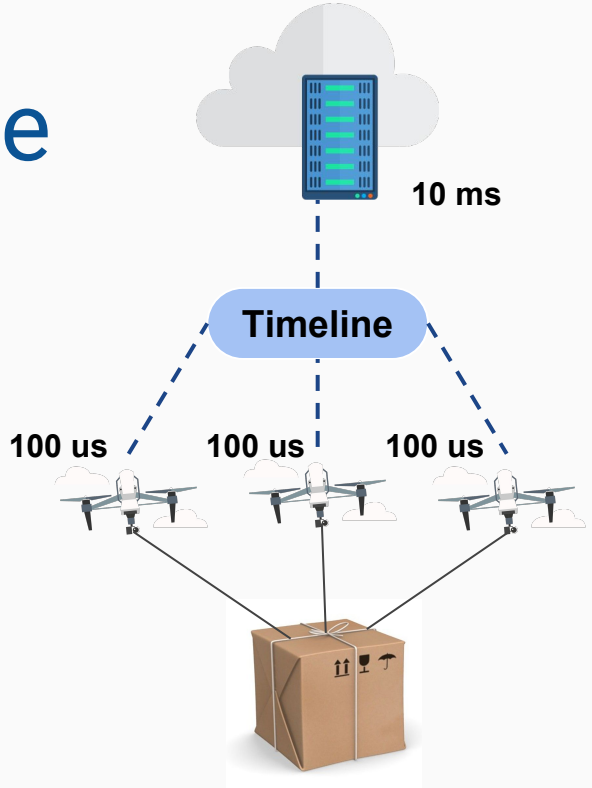

Timelines *abstract* away clock synchronization
→ Applications *specify* QoT requirements, TaaS *orchestrates* the system

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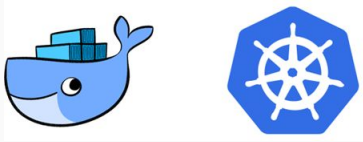
Quartz Time-as-a-Service (TaaS)

- **Adapts to Application QoT Demands**
  - ***tunable*** clock synchronization
  - probabilistic QoT-estimation mechanisms
- **Autonomous & Fault-Tolerant**
  - ***adapts*** to clock-sync failures
  - ***notifies*** apps if QoT degrades beyond spec
- **Built for Containerized Applications**
  - user-space ***micro-service*** implementation
- **Easy-to-use API**
  - ***TimelineBinding*** class (C++ & Python bindings)



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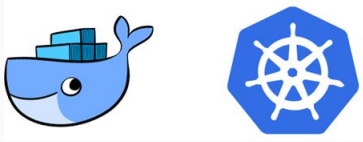

Micro-service architecture → *meeting* QoT requirements + *maintaining* timelines over a wide area

Quartz: Wide-area Deployment