2019 NSF CYBER-PHYSICAL SYSTEMS PRINCIPAL INVESTIGATORS' MEETING

TickTalk: Timing API for Federated Cyber-physical Systems

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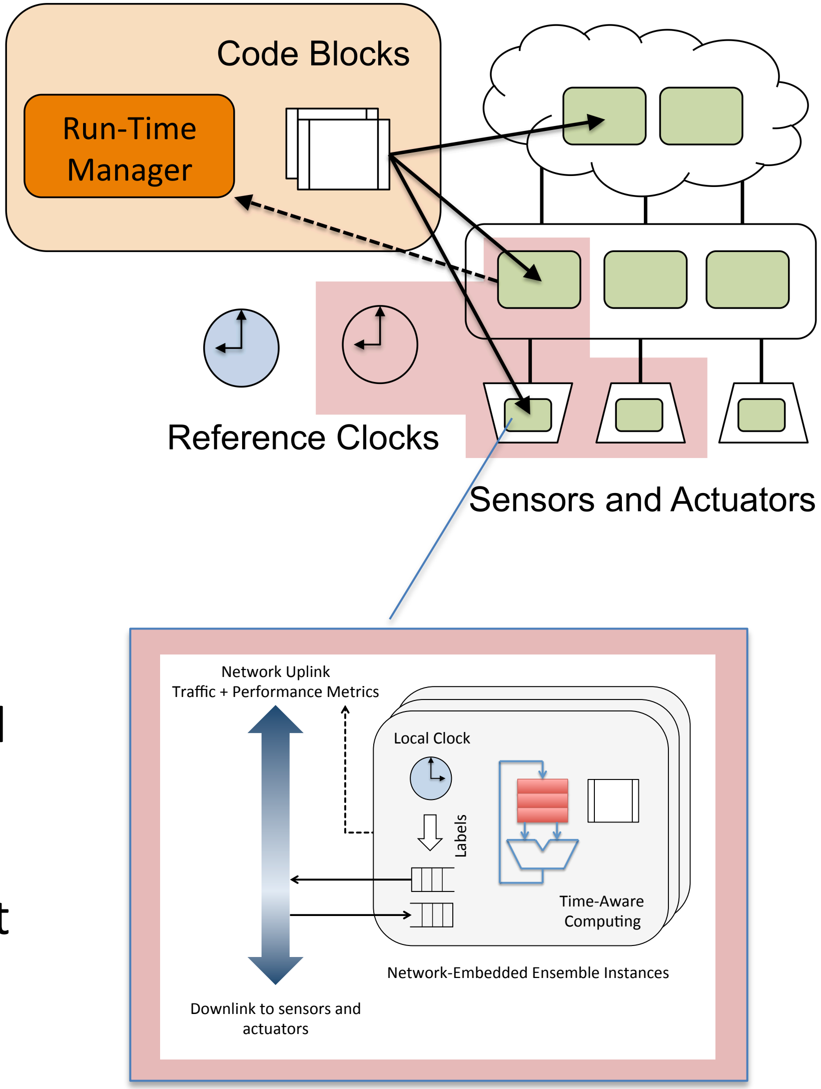
Description

Realizing the economic potential of large-scale CPS (*e.g.,* smart cities and environments) will be enabled in part through "app like" programmability by non-specialists

Goals of This Project:

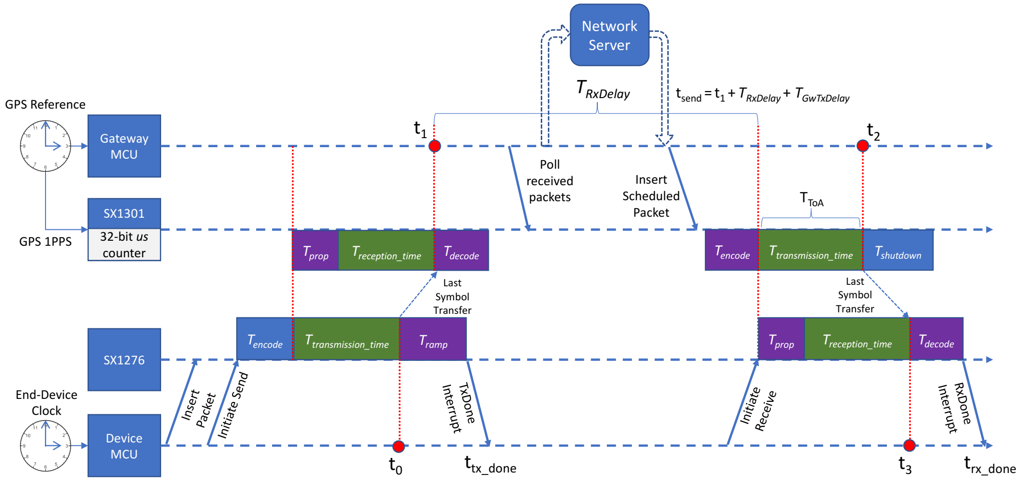
- Create a programming language that abstracts timing, timing-fault handling and related power management issues
- Develop hardware extensions that support low-power sync, timing-related power reporting, and multi-tenancy
- Create an end-to-end demonstration including a compiler and runtime; deploy in a real-world testbed



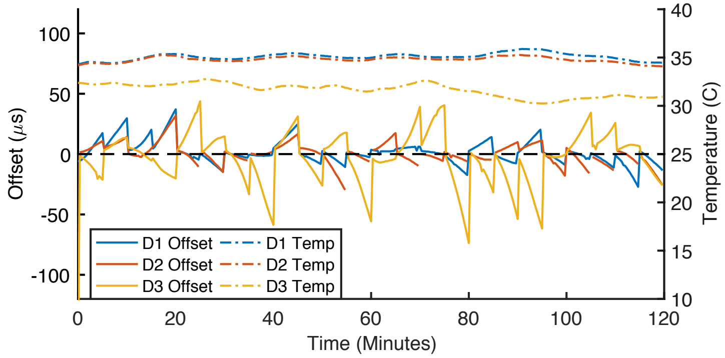
Applications are compiled to a dataflow graph representation in which macro-block timing is derived from programmer specifications. Network and devices support **multi-tenant** sync with **timing-fault reporting**

Findings

- Power self-aware sensor hardware: **EnviSense** that builds on our prior power self-aware programming environment **PowerDué**
- Establishment of field testbed at the **Pepperwood Preserve** (through collaboration with the USGS)
- Creation and characterization of “one shot” LoRa-based time sync (**LongShoT**) that piggybacks on data comms – essentially no incremental power



Piggybacking precise NTP-like sync on LoRa data traffic



Time sync performance and local clock drift
with devices at distances up to 4 km.
Future work: improved drift modeling and compensation

C. Ramirez, A. Sergeyev, A. Dyussenova, and B. Iannucci. “LongShoT: Long-Range Synchronization of Time.” 2019 18th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN). April, 2019. DOI 10.1145/3302506.3310408