Ambient Informatics – NDN Bus Bench

Alex Horn, Adeola Bannis, Jeff Burke, Dana Cuff, Jason Payne
Center for Research in Engineering, Media and Performance; Dept of Architecture and Urban Design
University of California, Los Angeles (UCLA)

Introduction: Illuminating Urban Transportation with NDN

Goals

- NDN-based transit state diffusion using Interest / Data exchange
- Apply earlier research (2011-2012) in NDN Lighting Control
- NDN deployed on embedded systems (Raspberry Pi)
- Public deployment of NDN
- Demonstration of NDN within Internet of Things (IOT)
- Aesthetically pleasing
- Can ambient informatics improve transit outcomes, especially, informed travel choice and passenger wait-time experience ?
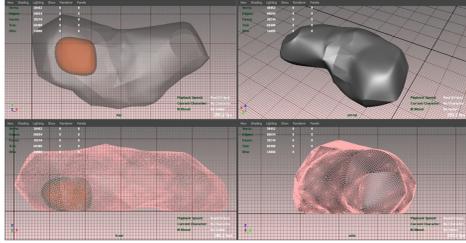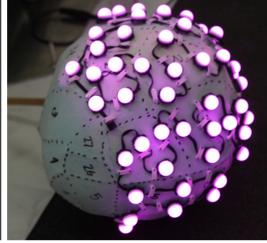

Figure 1. 3D Model of Bus Bench

Figure 2. lighting test

Figure 3. view of bus stop from IP Cam

Application Architecture and Namespace Design

- **HTTP Archiver**
  - HTTP based REST consumer, stores requests in MongoDB every 4 seconds (rate limited by NextBus API
  - Runs on server (borges.metwi.ucla.edu)
- **NDN Publisher**
  - Accesses MongoDB and publishes NDN Data Object for each sample (FreshnessSeconds=4)
  - Runs on server (memoria.ndn.ucla.edu)
- **NDN Controller**
  - Expresses interests to NDN testbed for latest transit Data Object
  - Expresses lighting control messages (Signed Interests)
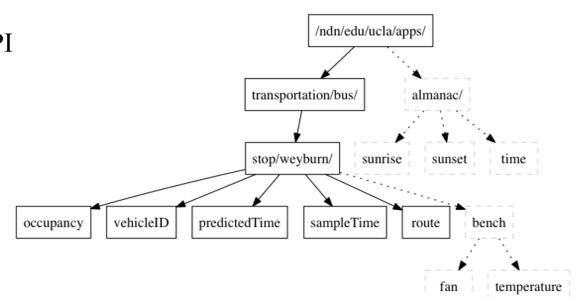 - Runs on Raspberry Pi, physically inside the bench.

Table 1. NDN Namespace of Transit State (dotted lines are pending)

Implementation and Continuous Testbed Publishing

Implementation Milestones

- **Summer 2012**
  - NextBus Archiver written (python)
  - Basic NDNPublisher written (PyNDN)
  - Camera installed for data verification
- **Summer 2013**
  - Lighting Control introduced
  - Hardware and assembly prototyping
- **Summer 2014**
  - Lighting Control and NDNPublisher refined w/ PyNDN2
  - Web Consumer upgraded to use NDN-JS

Testbed Publishing

- **June 2012 – Ongoing**
  - HTTP Archiver running continuously
  - NDN Publisher also running continuously on NDN testbed
  - Analysis Bus data and arrival timing
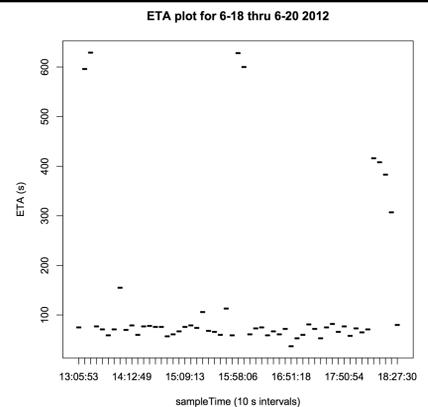 - Web Consumer for simple visualization:

    http://memoria.ndn.ucla.edu/bus/view/

Table 2. ETA valid within 1.5 minutes.
(outliers are when bus is parked)

Public Demonstration / Manufacture and Installation

- **Summer 2014**
  - Physical fabrication (fiberglass)
  - Final NDN Platform (IOT Toolkit / Raspberry Pi)
- **Fall 2014**
  - Physical installation on campus

Figure 4. lighting test

Figure 5. fiberglass construction

Figure 6. rendering of final installation

Future Work

- **Pre-Installation**
  - Implement NDN versioning of data instead of merely freshness
  - Aesthetic refinement (explore other mappings of data to lighting patterns)
  - Add humidity and temperature sensor
  - Add almanac data for night/day awareness (see above namespace)

- **Post-Installation**
  - Monitor temperature and system performance
  - Monitor bench performance and bus synchrony.
  - Program Day/Night modes
  - Aesthetic refinement