Presentation: Advanced Accessible Pedestrian Signals Research

Richard W. Wall, Ph.D.
NIATT
Department of Electrical & Computer Engineering
Presentation Outline

• Rules, regulations, and standards
• Current pedestrian control practices and technology
• Problem definition
• Proposed solution
• Implementation strategy
• Research activities at the University of Idaho
• References
AAPS Design Team
Washington Laws

• Drivers must yield to pedestrians at intersections
  – Vehicles shall stop at intersections to allow pedestrians and bicycles to cross the road within a marked or unmarked crosswalk (RCW 46.61.235).

• Pedestrians must obey traffic signals
  – Pedestrians must obey traffic-control signals and traffic control devices unless otherwise directed by a traffic or police officer (RCW 46.61.050).
Idaho Laws

TITLE 49 MOTOR VEHICLES CHAPTER 8 SIGNS, SIGNALS AND MARKINGS

49-803. PEDESTRIAN-CONTROL SIGNALS. Whenever a pedestrian-control signal showing the words "Walk" or "Wait" or "Don't Walk" is in place, the signal shall indicate the following:

(1) Flashing or Steady "Walk". A pedestrian facing the signal may proceed across the highway in the direction of the signal, but shall yield the right-of-way to vehicles lawfully within the intersection at the time the signal is first shown.

(2) Flashing or Steady "Don't Walk" or "Wait". No pedestrian shall start to cross the highway in the direction of the signal, but any pedestrian who has partially completed crossing shall proceed to a sidewalk or safety island while the "Don't Walk" or "Wait" signal is showing.

49-702. PEDESTRIANS' RIGHT-OF-WAY IN CROSSWALKS.

(1) When traffic-control signals are not in place or not in operation the driver of a vehicle shall yield the right-of-way, slowing down or stopping, if need be, to yield to a pedestrian crossing the highway within a crosswalk.

(2) No pedestrian shall suddenly leave a curb or other place of safety and walk or run into the path of a vehicle which is so close as to constitute an immediate hazard.
Driver Attitude
Driver Attitude
Problem

• Infrastructure design
  – Archaic design methodologies
  – vehicle centric
• Inaccurate information for abnormal operations
• Technical limitations
  – Countdown pedestrian signals
  – MMU cannot validate pedestrian display and audible messages
• Inconsistent compliance to MUTCD
• Driver attitude
Current Engineering Practices
Current Engineering Practices

Traffic Controller Cabinet – before - after
Infrastructure Complexity
Contradictory Information
The Source of the Problems

• Lack of communications
  – Single function outputs
  – No feed back

• Legacy traffic control engineering practices
  – NEMA
    • SDLC based upon 35 year old technology
    • Independent processor control of signals not observable by MMU
  – MUTCD (Manual for Uniform Traffic Controller Devices)
    • Based on technical constraints
    • Lacks human factor justification (not my opinion only)
Human Factors in Layman’s Terms

Traffic: Why We Drive the Way We Do (and What It Says About Us)

Tom Vanderbilt
Solution Requirements

• Better communications
  – Bi-direction communications
    • Higher bandwidth
    • More information

• Economics: Low cost
  – Equipment
  – Installation
  – Operations and maintenance
Smart Signals Research History

• Smart Signals
  – 2004-05: Plug and Play Traffic signals using IEEE 1451
    • Ethernet distributed control
  – 2005-06: Smart Signals Demonstration
    • Addressed countdown pedestrian timer
  – 2006-07: NTCIP distributed architecture
    • TS2 compatible
  – 2007-2008: Advanced APS
    • Distributed network control based upon NTCIP
    • TS1 – TS2 compatible
NTCIP Smart Signals

• Ethernet Distributed control
• Uses NTCIP MIB objects
• Safety Critical Network based upon IEEE 1588 PTP
• Utilizes 200MB Ethernet over power line for field wiring
  – Minimum network security issues
  – High data rates
  – Long distance (tests > 2500’)
  – Uses existing infrastructure
• Modified Econolite ASC/3 TS2 controller
  – Required software modification for pedestrian timing objects
NTCIP Smart Signals

Smart Signals Network Architecture

- Wire Ethernet
- Ethernet over Power Line
- Safety - Critical Monitor
- Smart Ped Signal
- New Traffic Cabinet Hardware
- Load Switch
- MMU / Conflict Monitor
- Conventional Traffic Signals
- TS2 Traffic Controller Cabinet
- Ped Smart Signal Controller
- Service Computer

6/27/2012  University of Idaho - NIATT
Current Smart Signals Research

• Advanced Smart Signals Pedestrian Call System
  – Campbell Company
  – ADA APS operations
    • Audio beaconing
    • Night time mode
    • WWVB time synchronization
  – MMU type functionality
  – Uses existing pedestrian button wiring
    • No external wiring to pedestrian signals
    • Low voltage Ethernet over power line
    • Intellon MX5500 200 MB communications
  – WEB based installation and maintenance
Advanced Smart Signals Pedestrian Call System

© University of Idaho 2008
Advanced Pedestrian Controller (APC)
Advanced Pedestrian Controller (APC)

- CPU Network controller
  - $90 - 200MHZ Linux kernel
  - Free development environment
  - 32MB SDRAM / 16MB Flash / 256 MB SD-card
  - 2 - 10/100 Mbps Ethernet ports
Advanced Pedestrian Button (APB)
APB – Under Development
Advanced Pedestrian Assistant

• What is it:
  – A handheld device for activation of pedestrian calls
  – Provides orientation and guidance information to user while in intersection
  – Interacts with traffic controller to protect user

• Why is it needed:
  – 4.3 million Americans are severely visually impaired
  – Incidence increases with age
  – By 2010, expect there to be 20 million visually impaired persons over age 45
Advanced Pedestrian Assistant

• Infrastructure Problems: impediments for vision and mobility impaired

Inaccessible Pedestrian Button

Unusual intersection geometries
Advanced Pedestrian Assistant

• Functionality
  – Remote pedestrian button
  – APS audible messages
  – Navigation cues to user
  – Traffic control
Advanced Pedestrian Assistant

UI System

Nokia 6210
GPS Testing – Off course
Advanced Pedestrian Assistant

• Preliminary test results
Conclusion

• Pedestrians at intersections are underserved
• Better information can resolve some known issues
• Smart Signals is an enabling technology
• Distributed control methodologies has untapped potential for traffic controls
• Research in distributed technology for traffic controls is gaining recognition
Smart Signals Bibliography

Pedestrian Safety Links

- **Pedestrian Forum - Summer 2008**
  http://safety.fhwa.dot.gov/PED_BIKE/ped/pedforum/pedforum_sum08.htm

- **Intersections**
  http://safety.fhwa.dot.gov/intersections/intersectionsap.htm

- **Senior Pedestrian**

- **Road Engineering Journal**
  http://www.usroads.com/journals/p/rej/9710/re971002.htm

- **No signals**
  http://www.bikewalk.org/pdfs/trafficcontrol_backtobasics.pdf

- **SPECIFICATIONS FOR PEDESTRIAN LED COUNTDOWN TIMER FEBRUARY 14, 2005**
  https://www.nysdot.gov/portal/page/portal/divisions/operating/oom/transportation-systems/repository/pcdspec.pdf

- **NEMA TS2 Standard**
  www.ite.org/standards/ITScabinet/ITS_Cabinet_v01.02.17a.doc

- **Low Vision Pedestrians**

- Idaho Statutes TITLE 49 MOTOR VEHICLES
  http://www3.state.id.us/cgi-bin/newidst?sctid=490070002.K

- Washington Department of Transportation
  http://www.wsdot.wa.gov/walk/laws.htm