Smart Traffic Signals
Application of Real-Time
Distributed Embedded Systems

Dr. Richard Wall
Department of Electrical & Computer Engineering
NIATT Researcher
University of Idaho
What’s wrong with this picture?
What’s wrong with this picture?
What’s wrong with this picture?
What about this picture?
What are the problems?

- Misinformation – incorrect operations
- Services a limited clientele
- Archaic electrical practices
- Costly installation and maintenance
- Difficult to “tune” controls
- Why are they called “stop lights”?
What are the results?

- Safety
  - Road and street hazards for all users

- Efficiency
  - Congestion and delays (green lights – no cars)

- Expense
  - Funding (taxes)
  - Long construction times
  - Delayed implementation
Solution

- Redistribute complexity
  - Fewer conductors and mechanical connections
  - Use silicon instead of copper

- Robust Systems
  - adaptive, scalable, reliable

- Improved information

- Move traffic signals into the 21st century!
Smart Signals - Where did it begin?

- “I was sitting in my car at an intersection one day ....”
- IEECON meeting in Spain
  - Smart sensor PnP networks, IEEE 1451
- NIATT development of the CID
  - so many wires!
Smart Signals History 101

Conventional TS2 Traffic Controller
Smart Signals History 101

- Bullock Purdue, 1992: Echelon PLC

Diagram:

- NEMA 170 or ATMS 2070
- Conflict Monitor
- Power Line Modulation Interface
- Neuron Chip
- Inputs & Outputs
- 120 VAC
- Traffic lights connected
Smart Signals History 2005-2006

- Verification
  - Safety Critical Design Concepts (IEEE 1588)
  - Network – Ethernet over power lines

- Innovations
  - Remote pedestrian button access
  - Works with existing traffic controller systems
  - Lights are programmable arrays
  - LED intensity control
  - Signal failure identification
What are ADA and APS

Eighty-five percent of Americans who live to their full life expectancy will suffer a permanent disability.
Infrastructure Challenges

- Infrastructure Problems: impediments for vision and mobility impaired

Inaccessible Pedestrian Button

Unusual intersection geometries
Why address Pedestrians?

- Legitimate intersection users (walking is a viable alternative mode of transportation)
- Cost of a vehicle-pedestrian accident is $312K each!
- Accidents slow down traffic
- Pedestrians in Idaho are 3 times more likely to be killed in car-ped accidents than being shot with a gun.
Smart Signals Today

TS2 Traffic Controller with Smart Signals AAPS
Advanced Pedestrian Controller

- WEB based HMI
- Safe fail operation
- Time of Day functions
- Operations logs
- Activity counters
- Single point maintenance
Advanced Pedestrian Button

Diagram of the Advanced Pedestrian Button:
- EoP Modem
- RF Coupler
- Zero Crossing Det
- Power Supply
- NXP LPC2478
- LED Array
- Serial Port
- Vibrotactile Motor
- Call Placed LED
- Preamp
- Microphone
- Audio Speaker
- Power Amplifier
- Pedestrian Button

Power Supply:
- 12-18 VAC
- 3V
- 5V
- 12V
Field Testing - Minnesota
Field Testing - Minnesota
Why 6th & Deacon?

- Isolated actuated intersection
- A major access point to the UI campus
- High volume of pedestrian and bicycle traffic
- Close proximity to the UI campus
- Limited amount of required equipment
- Common approach for emergency vehicles
- Place to mount cameras for research
Smart Signals Future

Target Intersection
Installation 6th and Deakin
Future Research Areas

- AAPS Beaconing
- Passive pedestrian detection
- Pedestrian tracking
- Intersection Information Systems
- Speech Recognition
- Mid-block crossing controls (roundabouts)
Pedestrian movements integrated System Level Control
Human Factors

- Personal responsibility
- Attentiveness to task
- Technology induced distraction
  - Selective attention
  - Cognitive task loading
- Information overload
  - Information concentration
  - Rapid recognition