“InSync Adaptive Traffic Control System”

Jim Clark, PE
Engineering Manager - Southeast U.S.
1920s, Detroit, “A cop in a box” --- first adaptive traffic control system

Human could see demand, assess delay, anticipate arrivals and control signals

Flexible, fluid, dynamic and immediate
Electromechanical

Dial – Cycle Length
Pins – Green Splits
Fixed Point - Offset

Analog Architecture

InSync is protected by U.S. Patent Nos. 8,050,854; 8,103,436; 8,253,592 and other patents-pending.
Traditional Methods \approx \text{Analog}

the real \textbf{Problem}

- Common Cycle Lengths
- Hold on Main St. Green
- Signal Transition
Evolution of Adaptive Control Systems in the U.S.

1970s ...Research & Development of Fully Adaptive Control
- Goal: Dynamically change signals as traffic cops did 50 years earlier
- Challenging assignment - sadly, U.S. traffic engineers gave up
- SCOOT & SCATS were first to appear on the market

1990s .....U.S. Returned to Fully Adaptive Control
- FHWA research and development of Real Time Traffic Adaptive Control System (RT-TRACS) --- 1st “U.S. version” adaptive control
- RT-TRACS .....OPAC, RHODES, RTACL
- RT-TRACS 1st deployment (OPAC); Reston VA - 1996
- LADOT Adaptive Traffic Control System (ATCS)

2000s .......Development of ACS-Lite
- By 2008 - FHWA research, development and deployment of ACS-Lite

......... Analog systems are adolescent stage of adaptive control
InSync Adaptive Traffic Control System

Year 2008

InSync is real-time (second by second) optimization using artificial intelligence.

Profoundly different than all other optimization/adaptive methods.

Three major components of InSync:

- Digital “state machine” not Analog
- Global Optimizer
- Local Optimizer
InSync Adaptive Traffic Control System

Profoundly Unique Attributes

1. **DIGITAL STATE MACHINE** not Analog
   - Digitized signal states
   - No NEMA ring/cyclic operation
   - Bi-directional progression
   - Reduce/eliminates signal cycle transitioning!

2. Varying Green Tunnel Durations
3. Adaptive Periods between tunnels
4. Dynamic Phasing
5. Green Time Allocation
6. Dynamic Sequencing

InSync combines Local and Global optimization:
- Move bi-directional traffic platoons along route with minimum delay
- Better and safer operations
Native Adaptive Detection

- **332 Style Cabinets**
  - 170 & 2070 Controllers

- **NEMA TS1 & TS2 type 2 Cabinets**
  - TS1 & TS2 type 2 Controllers

- **NEMA TS2 type 1 & 2 Cabinets**
  - TS2 type 1 & 2 Controllers
InSync is protected by U.S. Patent Nos. 8,050,854; 8,103,436; 8,253,592 and other patents-pending.
**Benefits**

- Existing equipment - 100% compatibility
- Overlay – plug & play
- Hardware settings remains – conflict monitor, clearance intervals, preemptions
- Installs easily
- No central command
- Distributed intelligent network
- Rapid adaptation to current needs

*InSync is protected by U.S. Patent Nos. 8,050,854; 8,103,436; 8,253,592 and other patents pending.*
Controller & Firmware Agnostic

NEMA TS1 & TS2 type 2 Cabinets
TS1 & TS2 type 2 Controllers

No Controller Upgrades Needed
No Firmware Upgrades Needed

332 Style Cabinets
170 & 2070 Controllers

NEMA TS2 type 1 & 2 Cabinets
TS2 type 1 & 2 Controllers
InSync requires:

- Interconnect between cabinets
- Facilitator - Remote communications out of corridor
### InSync Experience – As of Spring 2014

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Analog to DIGITAL

Local Optimizer

Global Optimizer
Analog to DIGITAL

“State condition” machine

*InSync is protected by U.S. Patent Nos. 8,050,854; 8,103,436; 8,253,592 and other patents-pending.*
“State Condition”

A
Leading Lefts

B
Lead-Lag

C
Leading Left with Overlap

D
Lagging Left with Overlap

E
Lead-Lag

F
Lagging Lefts

G
Leading Left with Overlap

H
Lagging Left with Overlap
“State Condition”

A 
- Leading Lefts

B 
- Lead-Lag

C 
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D 
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H 
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“State Condition”

A 1 2 3
B C

E 1 2 3
F G

A:
- Leading Lefts

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A. Leading Lefts

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E. Lead-Lag

F. Lagging Lefts

G. Leading Left with Overlap

H. Lagging Left with Overlap
“State Condition”

A

1

2

3

Leading Lefts

C

G

1

2

3

Leading Left with Overlap

Leading Left with Overlap
InSync is protected by U.S. Patent Nos. 8,050,854; 8,103,436; 8,253,592 and other patents-pending.

NOTE: Reduce/eliminate signal TRANSITION!
Global Optimizer

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Global Optimizer

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How does the Tunnel Initiate?

**Period: Fixed or Dynamic?**

**Fixed Period**
- **Duration**: 150 sec
- **Constant**

**Dynamic Period**
- **Max Period**: 164 sec
- **Min Period**: 138 sec

**Global Optimizer**
Immediate adaptation
Real-time demand inputs
No fixed cycle/sequence
No ring (NEMA ring/barrier)
No TOD plans
Intelligently fully-actuated intersections to optimize all approaches

and

Coordinated progression

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Integrated Corridor Management - Safety

I-540/US 71 at New Hope Road/ S 52nd St – Rogers, AR

-- InSync Deployment 2011
Integrated Corridor Management - Safety

VDOT: Transportation Operations Center and Statewide Advanced Traffic Management System

**Awarded to Team SERCO INC;** private sector consortium to operate, integrate and innovate the state's Transportation Operations Centers.

VDOT operates centers in five geographic locations that monitor traffic conditions via cameras and other technology, providing traveler information on road conditions and coordinating congestion management and incident response.

- Developing, implementing, operating and maintaining a new state-wide ATMS platform across five TOCs that is flexible for future enhancements and includes advanced components such as interoperability, **Integrated Corridor Management, Active Traffic Management and Arterial Signal Management**. Increase operational efficiency and safety through economies of scale gained by having one contract for responsible for traffic operations and ATMS.
- Providing performance-based management of TOC Operations and ATMS services.
- Protect and enhance current asset value/investment.
- Providing a platform for **innovation** of VDOT’s traffic operations and an opportunity for the private sector to test new products and strategies

......InSync is being deployed statewide as the preferred solution for ICM and advanced arterial signal management.
Integrated Corridor Management - Safety

I-95/I-395 Integrated Corridor Management Initiative
Integrated Corridor Management - Safety

**Arterials**

**CANDIDATE SIGNAL GROUPS**

- Transit signal priority along express bus routes
- Adaptive control along:
  - Arterial alternate routes (incidents, congestion)
  - Key routes between park-and-ride and I-95

I-95/I-395 Integrated Corridor Management Initiative
“InSync Adaptive Traffic Control Shows Initial Safety Benefits”
By Jim Clark, P.E. March 2013

Objective: To convey the importance of real-time (second by second) adaptive traffic control, specifically InSync, in improving roadway safety.

Topics:
• Road Safety Problem – Collisions and Other Traffic Accidents
• Strategies to Improve Road Safety
• InSync Adaptive Control Solution and Initial Results

InSync adaptive control proven to improved road safety
“InSync Adaptive Traffic Control Shows Initial Safety Benefits”
By Jim Clark, P.E. March 2013

Note:

This presentation does not present the findings of rigorous statistical analyses or the use of extensive tables, figures or graphs.

Rather, this is a discussion focusing on the initial field results that demonstrate improved safety aspects associated with the deployment of the InSync adaptive traffic control system.
Road Safety Problem – Collisions and Other traffic Accidents
Road Safety Problem – Collisions and Other traffic Accidents

World Health Organization (WHO):
• Traffic injuries ..... a “global public health problem.”
• Human cost ........... 1.27 million lives lost per year

United States:
• Year 2006 ..... one worst years for accidents
• 42,642 traffic fatalities
• 3,305,237 non-fatal road traffic injuries
Road Safety Problem – Collisions and Other traffic Accidents

Insurance Provider AAA:
• Beyond the lives cut short ..... Fatality = $6 million
• Less but substantial............... Non-fatal injury = $126,000

Getting the attention of the public and elected officials.
Strategies to Improve Road Safety

• Long Term Strategies
• Immediate Strategies
Strategies to Improve Road Safety - Long Term

Intelligent Transportation Systems (ITS)

• Significant advancements in intersection collision avoidance systems

• USDOT Major initiative:
  o Working with traffic control and automotive industries
  o Vehicle-to-vehicle and vehicle-to-roadside device communications
  o Research is proving these are viable solutions
Strategies to Improve Road Safety - Long Term
Strategies to Improve Road Safety - Long Term

- Vehicle-to-Vehicle
- Vehicle-to-Vehicle
- Vehicle-to-Roadside
- Vehicle-to-Cellular
- Traffic Management Center (TMC)
  - Infrastructure data
  - Road eMap data system
  - Real-time traffic info
  - Vehicle probe data
Strategies to Improve Road Safety - Long Term

Unfortunately, many years before needed roadway and vehicle fleet infrastructure are in place to realize the full magnitude of this safety improvement initiative.
Strategies to Improve Road Safety – Immediate

World Health Organization (WHO) and National Transportation Safety Board (NTSB)

Ample recommendations:
• Embracing in-vehicle technologies
• Law enforcement practices
• Human factors engineering
Strategies to Improve Road Safety – Immediate

American Association of State Highway and Transportation Officials (AASHTO) in conjunction with other highway safety agencies:

- Proposed a comprehensive Strategic Highway Safety Plan (SHSP)
- Addresses 22 specific challenges
- Accidents at or near intersections present a particularly important challenge
Strategies to Improve Road Safety - Immediate

In 2009:
- 33,808 fatalities on US roadways
- 7,043 or approximately **21%** were intersection-related
Strategies to Improve Road Safety - Immediate

Intersection-related crashes are an urgent crisis

From AASHTO:
• On average five (5) crashes at intersections every minute
• A person dies every hour of every day at an intersection somewhere in US

Need
Improvement of intersection infrastructure should be a high priority in reducing human and economic costs of traffic collisions.
Strategies to Improve Road Safety - Immediate

Crash On Tolland Turnpike In Manchester
(Jesse Leavenworth, Hartford Courant / May 16, 2012)
Adaptive Control Solution - Background

‘Real-time’ signal timing optimization

Adaptive control solutions, improve safety.........

.....”through reductions of some efficiency-related performances measures, which highly correlate with some safety metrics (e.g., a reduction in the number of stops reduces the chance of rear-end collisions).”
InSync Adaptive Control Solution - Background

Accidents occurring at intersections nationwide reveal:

• Prominent
  o Rear-end collisions and
  o Crashes involving left-hand turns
• Right angle collisions being most cause of fatal injuries

InSync has proven to reduce the likelihood of these accidents
Crash reduction results

- 24%  
  Source: Topeka, KS  
  City Traffic Engineer

- 17%  
  Source: Lee’s Summit, MO  
  Police Department

- 30%  
  Source: Springdale, AR  
  Police Department

- 26%  
  Source: Columbia County, GA  
  County Traffic Engineer
Highway 291, Lee’s Summit, Missouri

- Oddly-spaced arterial
- 12 intersections on
- ADT of 25,779
- Previously controlled by coordinated timing plans
- **Red-light running problem**
  - warranted extra enforcement
    - “tattle-tale” lights
    - police patrols
Highway 291, Lee’s Summit, Missouri

Overall operational improvements
• Stops reduced 95%
• Delay reduced 87%
• Travel time reduced 58%
• Operational benefit = $2,452,493/yr

• Reported Crash Reduction = 17%
• Crash reductions = $1,247,895/yr

Operations + Safety = $3,700,388/yr
By InSync substantially reducing stops and delay:

- Crashes reduced by 17% over the previously operating coordinated timing plan and

- Key result of InSync’s improvement:

  Red light running enforcement program was suspended ---- to quote the Lee Summit police captain ---- ”there were just no cars there to run the red light when it goes red.”
InSync Adaptive Control Solution - Initial Results Summary

InSync before/after data reflects:

• key benefit of reduced stops, delay and travel time

• a corresponding decline in intersection-related traffic accidents

.........*InSync Proven to Improved Road Safety*
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Better operations = safer

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<th>Better levels of service</th>
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<td>No signal cycle transitioning</td>
<td>Less delay/driver frustration, improved traffic flow, less opportunity for crash</td>
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InSync Adaptive Control Solution – Overall Summary

• Safety benefits are so significant
• Initial evidence is so deterministic
• Important to share information with traffic engineers, safety professionals and other stakeholders

........InSync Proven to Improved Road Safety
InSync®

Crash reduction results

24%  
*Source: Topeka, KS City Traffic Engineer*

17%  
*Source: Lee’s Summit, MO Police Department*

30%  
*Source: Springdale, AR Police Department*

26%  
*Source: Columbia County, GA County Traffic Engineer*
“InSync Adaptive Traffic Control System”

- Profoundly unique advanced technology
- Proven to significantly improved roadway safety

Questions, feedback, ideas?