Traffic Signal Timing Maintenance

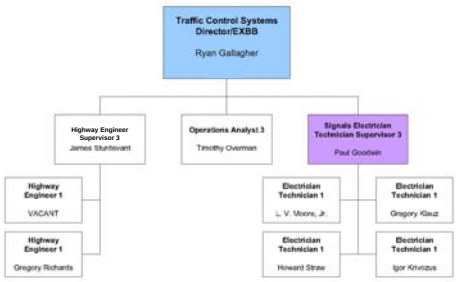
Division of
Traffic Control Systems

Division of Traffic Control Services

Tasked with:

- Assisting the District Traffic Systems Engineers with retiming coordinated signals
- Providing technical support
- Researching and implementing new technology
- Providing traffic signal equipment & equipment repair.

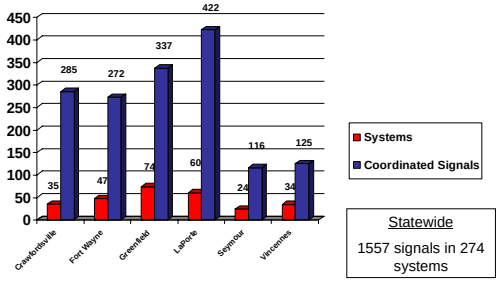
Organization



Division of Traffic Control Systems

- District Retiming Plan
  - Four-year cycle to retime all coordinated traffic signal systems.
- District Traffic Systems Engineers
  - Report results for each quarter (system reports, number of signals and systems retimed).
  - Scores are calculated for each district based on the number of coordinated signals in the district divided by 16 (16 quarters/4 year cycle).
  - The average number of signals per quarter retimed is compared to the rate necessary to complete a 4-year cycle (Total retimed/# of quarters).

Who has what?

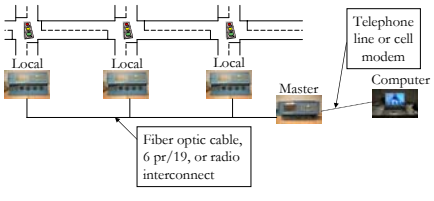


Statewide

1557 signals in 274 systems

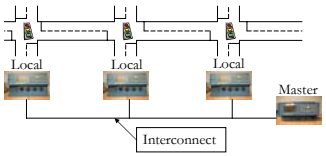
Closed-Loop Systems

- System status can be checked from district office or mobile location with cell modem and laptop. Requires functioning communication between remote computer and master and master and secondary controllers.



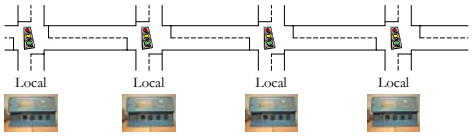
Interconnected Systems (non-closed-loop)

- Requires site visit to master controller location to ensure that master has functioning communication with the secondary controllers and that controllers and detection are functioning correctly.



Time-based Systems

- Requires site visit to ensure that controllers' time clocks are synchronized and the controllers are running the same timing plan.
- Requires site visit to ensure detection is working correctly.



Data Collection

- 12-hour traffic count data (PETRA)
- Road and intersection geometry
- Existing signal timings
- Floating car studies for existing conditions using either count board or GPS units and PC Travel software

System Model Construction

- Build a base model of the system in Synchro using geometric data, speed data, and background aerial.
- Decide on number of peak periods and times they apply.
- Copy and rename model and import traffic data for each peak period.

Existing Model

- Add existing phasing, splits, and offsets for each peak period to Synchro models.

Proposed Model

- Calculate and enter ITE clearance intervals for yellow and all-red periods.
- Use Synchro to optimize existing base model for each peak period.
- Document changes to each run for each period-(cycle lengths, splits, offsets, lead/lag lefts, floating/fixed force-offs, protected/protected-permitted left turns, etc.).
- Select timings for each peak period.

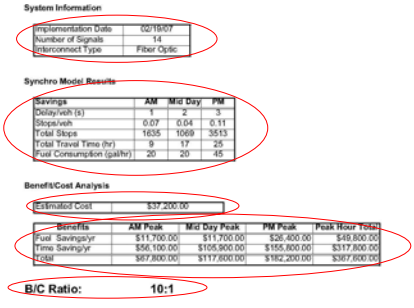
Implementation

- Make changes to signal equipment if necessary.
- Download timings to controllers.
- Observe and adjust offsets and splits where necessary.
- Drive the system, especially during peak periods, to determine performance. One person driving, others making adjustments to system works well.
- One to two weeks afterward, run floating car study again and compare to the “before” study.

Systems Report

- District Traffic Systems Engineers prepare a report for each retimed system containing estimates of fuel saved, travel time saved, and reduction in delay/vehicle, stops/vehicle, and total stops for each peak hour.
- A benefit/cost ratio is calculated from the estimated value of fuel and travel time savings divided by the cost of the retiming effort (including direct and indirect costs).
- Detailed multifile comparisons of Synchro Measures of Effectiveness.
- Before and after floating car study comparison using PC Travel showing overall output statistics and time-space trajectories for peak periods.
- Twelve hour count for each signalized intersection.

Systems Report



System Information

Implementation Date	02/15/07
Number of Signals	14
Interconnect Type	Fiber Optic

Synchro Model Results

Savings	AM	Mid Day	PM
Delay/veh (s)	1	2	3
Stops/veh	0.07	0.04	0.11
Total Stops	1635	1069	3513
Total Travel Time (hr)	9	17	25
Fuel Consumption (gal/hr)	20	20	45

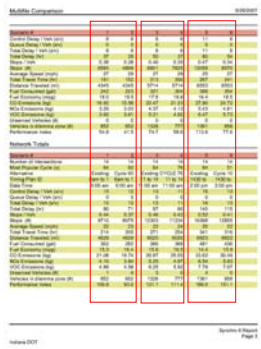
Benefit/Cost Analysis

Estimated Cost	$37,200.00

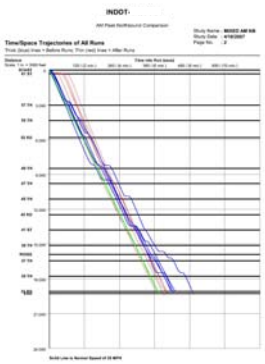
Benefits	AM Peak	Mid Day Peak	PM Peak	Peak Hour Total
Fuel Savings/yr	$11,700.00	$11,700.00	$26,400.00	$49,800.00
Time Saving/yr	$56,100.00	$105,900.00	$155,800.00	$317,800.00
Total	$67,800.00	$117,600.00	$182,200.00	$367,600.00

B/C Ratio: 10:1

Detailed Multifile Comparison



Before and After Floating Car Study



Pitfalls/Traps

- Areas with bus/school traffic- Collect traffic data when school's in session if possible
- Implement when school's in session if possible
- Models have perfect detection
- Models have perfect weather
- Models have perfect drivers
- Effects of accidents and construction during implementation
- "Field of Dreams"

Maintenance After the Fact

After the effort and expense put into retiming coordinated signal systems, what must we do to keep them functioning?

- Scheduled signal maintenance and inspections.
- For time-based, regular controller clock checks.
- Functioning detection.

2007 Results

- District results in 2007- Estimates based on Synchro projections from before and after runs

2007 Signal Systems Retiming Estimate of Benefits

District	No. of Signals Retimed	No. of Systems Retimed	Fuel Savings	Delay Reduction	CO Reduction	VOC Reduction	NOx Reduction
			gallons	hours	lbs.	lbs.	lbs.
Crawfordsville	70	11	32,647	24,817	4,918	1,132	965
Fort Wayne	70	15	3,458	4,502	620	138	118
Greenfield	87	12	39,998	37,410	6,130	1,413	1,193
LaPorte	71	10	194,902	313,070	29,932	6,928	5,830
Seymour	36	7	34,430	37,084	5,297	1,228	1,023
Vincennes	38	11	21,032	21,141	3,185	742	619
Statewide Total	372	66	326,468	438,023	50,082	11,582	9,749

Future Plans

- Count Loops
- Cell modems
- Central Data Collection and Storage
- NTCIP Controllers
- Ethernet/TCP-IP PC Communications
- Central Systems- Systems Integration Software

Questions?

Gregory J. Richards
TCS Signal Operations Engineer
Division of Traffic Control Systems
(317)233-3947
grichards@indot.in.gov