An Analysis of Signalized Intersection and Solution for Applying Real-Time Traffic Control Technologies: A Case Study for Mixed Traffic Condition in Hanoi City

Mr. Hoang Trung Thong

Institute of Planning and Transportation Engineering
National University of Civil Engineering, Vietnam

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Overview

Old & broke signal

Ineffective organization

Traffic congestion

It leads directly a series of problem on:

- traffic quality
- Environmental pollution

⇒ **Reducing quality of life**

How important Intersection issue is?

Intersection is an indispensable part of road network.

Insection issue : one of **the most important problems** in Hanoi City recent years.

Current situation of intersection in Hanoi

Number of congestion points

Year	2011	2012	2013	2014*
Number	124	67	57	46

Source: *Hanoi DOT, 2013; *) No.281/TB-VP, Hanoi People's Committee, 2014.*

=> The number of congestion points is reducing, but it is still quite high.

Number of Intersections in Hanoi

To the end of 2013 (HDOT), Hanoi has 2,150 intersections , in which :

- only 6 interchanges;
- around 214 signalized intersections;
- 33 intersections were installed monitoring camera with 52 cameras of VOV broadcast.

Quality of intersection infrastructure

- A large number of signalized intersections was old and broken.
- Almost intersections are operating separately, they are not connected together so they can not resolve problems of intersection generally.

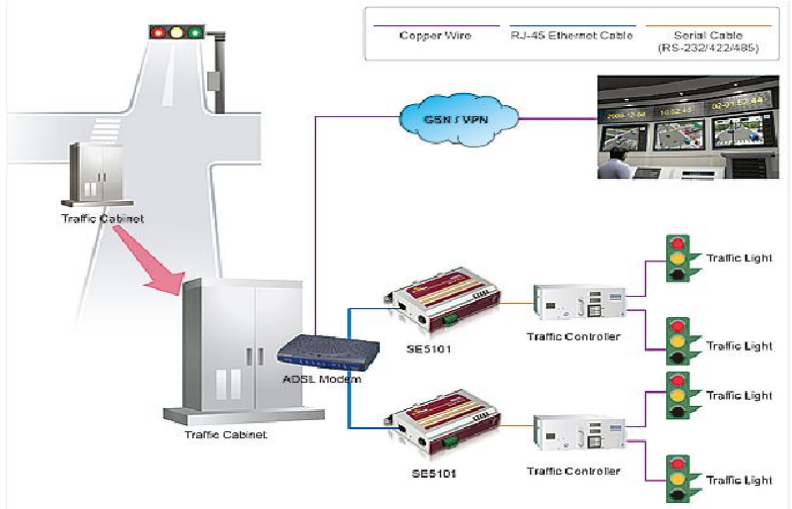
Problems and solutions

Intersection problems :

- The signal time cycle does not reflect axactly the current situation of traffic flow;
- The congestion situation is serious, especially at peak hours;
- The service level of intersection is quite low.

Proposed solution:

Using **a real-time traffic cycle measure** that reflects the traffic flow situation and does not require a large budget or changing infrastructure.



A case study: Pham Hung-Me Tri intersection

Pham Hung-Me Tri is a typical signalized intersection. It is located at west of Hanoi City and it has some following advantages:

- larger area, fully channels (4 right lanes are always free), and a pedestrian tunnel;
- A good traffic organisation => no intersection in the conflict area;
- Traffic infrastructure is still good (built in 2011)

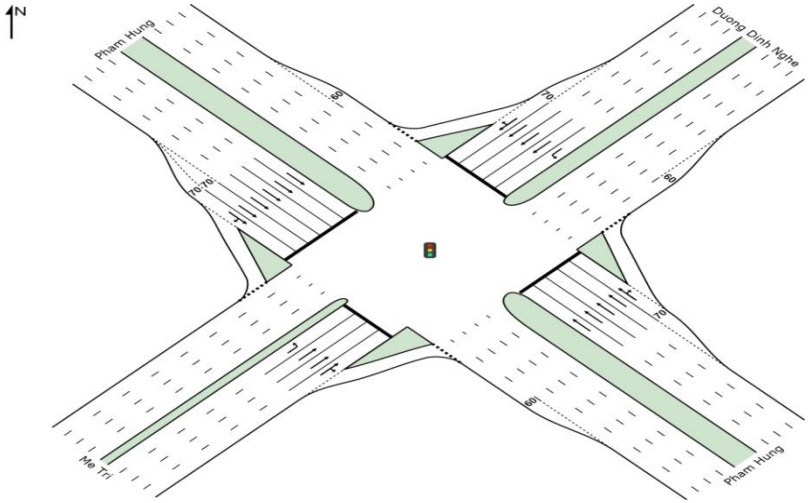
- Why is this **intersection always in congestion situation**?
- What is the **most effective solution**?

1. Surveys content

No.	Type of survey	Contents
1	Dimensional survey	Features of dimension
2	Traffic signal timing cycle	Time of phases and cycle
3	Traffic volume counting	Traffic volume in directions
4	Queue length survey	Queue length in directions

2. Survey result (1)

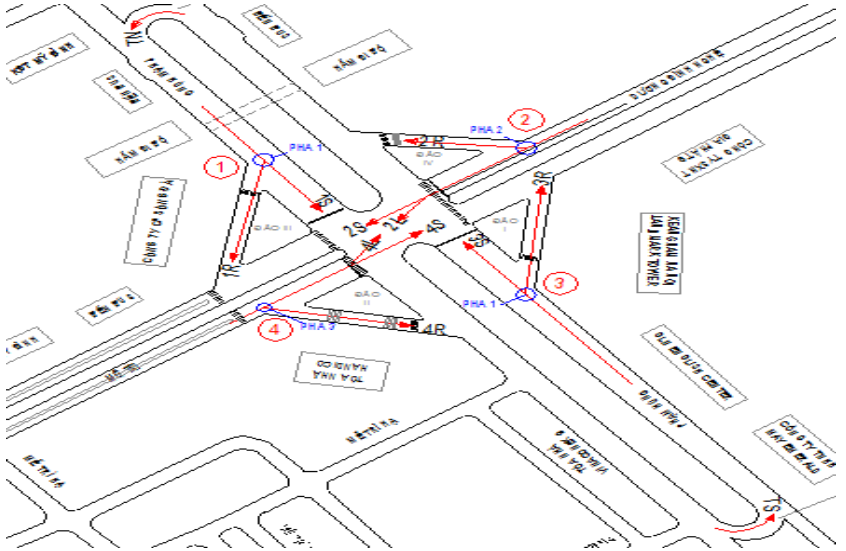
No.	Elements	Pham Hung – Me Tri Intersection
1	Type of intersection	• Signalized-intersection • Fully channelized intersection (4 channelizing triangular islands & divisional island in each approach)
2	Intersection axes	2 urban arterial road axes: • Pham Hung street axis; • Me Tri-Duong Dinh Nghe street axis.
3	Traffic organization	• 3 phases-traffic signal; • right-turns are always free; • Vehicle turns left directly in conflict area (Me Tri-DD.Nghe axis) & turns left by U-turning at northbound and southbound of Pham Hung (Pham Hung axis).



Survey result (2)

Queue length was measured every 5-minutes in peak hours
=> The queue length is quite long. In overall, **there were 47 and 35 vehicles at AM peak and PM peak.**

step / light	1	2	3	4	5	6	7	8	9	10	cycle
1 A											
2											
3											
traffic flow chart	1A		1A	A R		2	A R		3	A R	
morning	46		3	2	26	3	2	34	3	2	121
noon	40		3	2	25	3	2	25	3	2	105
evening	46		3	2	34	3	2	26	3	2	121



Pham Hung-Me Tri intersection is using 3 phase-signal. Signal time cycle is changing over time, but **it does not reflect exactly the situation of flow traffic.**

3. Summary Survey result

AM peak

Dir.	Deg. Satn V/C	Ave. Delay (s)	LOS	Queue length	Aver. Speed (km/h)
Pham Hung (side of DD.Nghe)					
3	0.778	27.5	C	34.5	41.4
Duong Dinh Nghe					
2	0.917	58.3	E	31.1	30.8
Pham Hung (side of Me Tri)					
1	0.604	28.8	C	17.6	40.9
Me Tri					
4	0.947	52.3	D	46.6	32.5
Ove.	**0.947**	**39.7**	**D**	**46.6**	**36.5**

PM peak

Dir.	Deg. Satn V/C	Ave. Delay (s)	LOS	Queue length (m)	Aver. Speed (km/h)
Pham Hung (side of DD.Nghe)					
3	0.759	25.8	C	19.6	42.2
Duong Dinh Nghe					
2	0.909	54.5	D	35.1	31.9
Pham Hung (side of Me Tri)					
1	0.657	28.3	C	18.2	41.1
Me Tri					
4	0.849	49.0	D	19.4	33.5
Ove.	**0.909**	**38.7**	**D**	**35.1**	**36.8**

4. Problems

Problems:

- The average speed & LOS are very low;
- The queue legth and delay time is very high;
- The congestion situation is serious, especially at peak hours.

⇒the main reason:

Signal time cycle is not inadequate anymore,
it does not reflect exactly the curent traffic situation.

Application a new real-time signal cycle is an effective solution, which is much appreciated in aspects of economy, technology and apropos time.

5. Solution

Proposed new signal time cycle

Optimum cycle time:

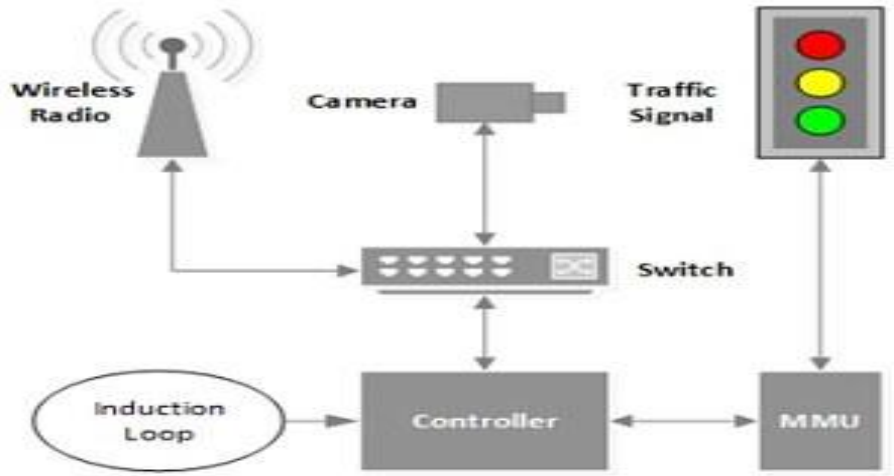
- Optimum cycle time was calculated by SIDRA INTERSECTION software.
- The optimum cycle time at both AM and PM peak is 70 seconds.

TRAFFIC LIGHT \ STEP	1	2	3	4	5	6	7	8	9	10	TRAFFIC LIGHT CIRCLE TIME
1											
2											
3											
AM PEAK	21		3	2	19	3	2	15	3	2	70
PM PEAK	17		3	2	24	3	2	14	3	2	70

Proposed new signal control technology

Sensor control technology system consists of 4 parts:

- sensors cameras that detect cars;
- controllers that use the sensor data to control the lights;
- radios for wireless communication among intersections;
- malfunction management units (MMUs)



6. Analysis

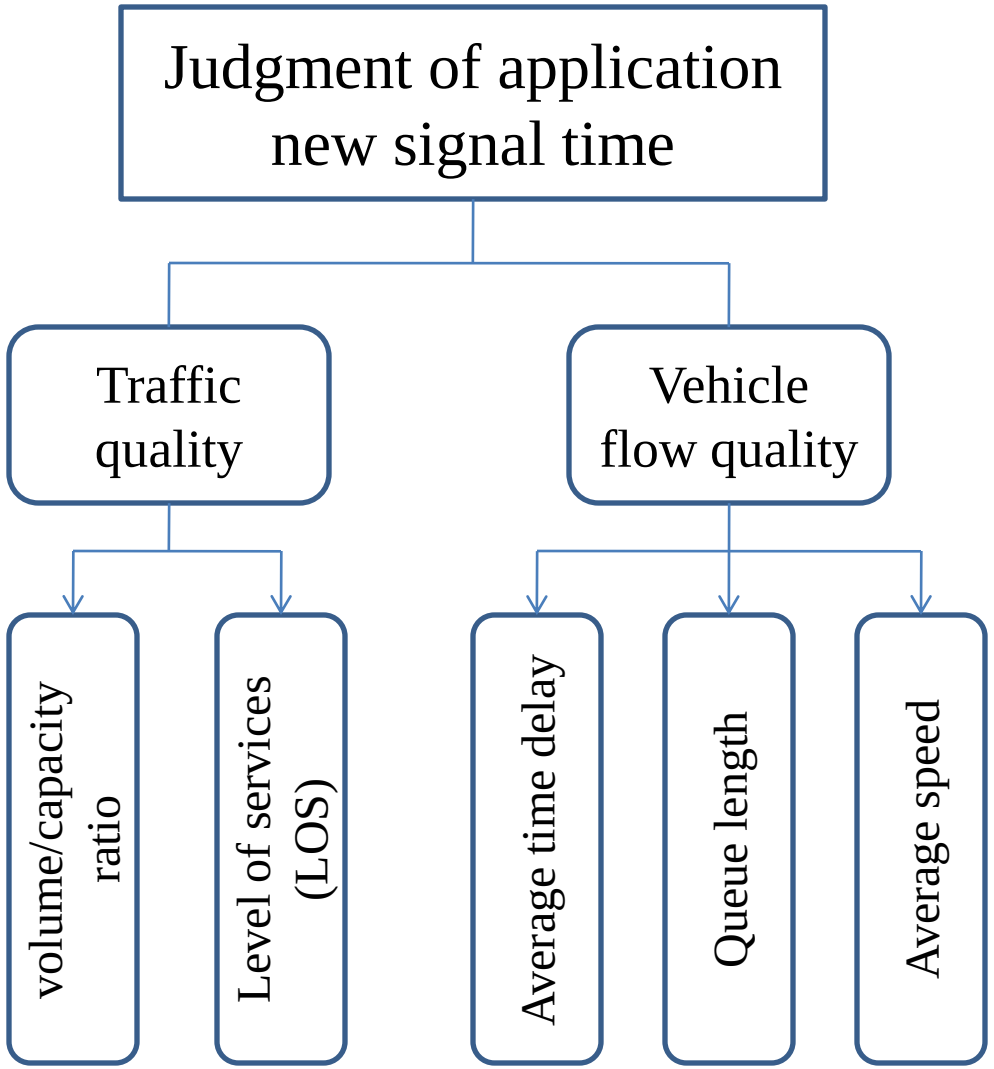
Analysis of typical elements
after changing time cycle at AM

Dir.	Deg. Satn V/C	Ave. Delay (s)	LOS	Queue length	Aver. Speed (km/h)
Pham Hung (side of DD.Nghe)					
3	0.846	23.4	C	23.0	43.4
Duong Dinh Nghe					
2	0.934	29.7	C	14.0	40.4
Pham Hung (side of Me Tri)					
1	0.702	21.9	C	10.6	44.3
Me Tri					
4	0.937	33.4	C	28.8	38.9
Ove.	**0.937**	**26.8**	**C**	**28.8**	**41.8**

Analysis of typical elements
after changing time cycle at PM

Dir.	Deg. Satn V/C	Ave. Delay (s)	LOS	Queue length	Aver. Speed (km/h)
Pham Hung (side of DD.Nghe)					
3	0.814	24.3	C	15.9	42.9
Duong Dinh Nghe					
2	0.925	23.9	C	19.8	43.1
Pham Hung (side of Me Tri)					
1	0.870	30.2	C	13.4	40.2
Me Tri					
4	0.899	34.8	C	12.8	38.4
Ove.	**0.925**	**27.4**	**C**	**19.8**	**41.5**

7. Performance Judgment



Before and after using optimum time cycle (AM & PM peak)

Element	AM		PM	
	Before	after	Before	after
LOS	D	C	D	C
DOS (%)	95	94	91	93
Avg. delay (s)	40	27	39	27
Queue length	47	29	35	20
Avg. speed (km/h)	37	42	37	42
Impact on queue	**- 38%**		**- 43%**	

Conclusions

- Therefore, using optimum signal time will help to reduce queue situation as well as average delay timing.
- In addition, it also helps to increase the average vehicle speed and directly to improve the service level of intersection.
- Currently, Hanoi has not any plans to expanse intersections in the city as well as build an intersection network plan, thus applying new real-time traffic control technology solution as mentioned above will play an important role in improvement the traffic situation at intersection.
- It can be applied not only for Pham Hung – Me Tri signalized intersection but also for other similar intersections in Vietnam.

Thank you for your kind attention !!!

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