Reversible lane: Exploring Lane Management Alternatives

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Outline

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- Scope
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Introduction

- “The present roads are overbuilt for 18 hours a day and also the entire weekends”

- Need of the hour - Optimum utilization of existing infrastructure

- Lack of resources - land, money, impacting flow
Reversible Lanes

- **Mitigation** - directional biased, peak-hour movement
- **Increase the capacity** of a roadway significantly
- **Minimal need of investment** in roadway or control infrastructure
- **Objective** - take advantage of underutilized lanes.
History

- Direction biased traffic
- In 1928 Ralph T. Dorsey tested it in Los Angeles
- Reversible lane concept was introduced
- Used metal-based stanchions initially.
**Hines center line** concept - delineate traffic

A solid yellow line partitioning the roadway
- **Hines concept** - not appropriate for Reversible lane.

Depicting a reversible lane
(Contd.)

- Using **variable sign boards** - beginning of reversible lane
- Signs initially notifies driver - *doesn’t bind or remind* to follow the unmarked centerline.
Other Name

- Major hurdle - **Safety Factor**

Protest against Reversible*(Suicide)* Lane
Literature Review

- “65 percentage or more traffic moving in a particular direction during peak hours justifies the application of Reversible lanes”.
  - AASHTO

- Modern Advancement - Dynamic Lane Reversal

- Realigns lanes quickly and automatically - instantaneous traffic conditions
Literature Review (Cont’d)

- Matthew Hausknecht study - dynamic lane reversal - increase in efficiency by 72%
- Lamberti and Wolshon study - low confidence levels in pertaining to reversible lanes
- Drivers comfort level - tailgating than going alone.
Primary cause - driver’s limitation of understanding

“Driver is an outdated human with stone-age characteristics and performance who is controlling a fast, heavy machine in an environment packed with unnatural, artificial signs and signals.”

- Reflected in Rumar’s conclusion
Future of Traffic Management

- Solid yellow line was introduced in 1911 by Hines, and we are following it till now

- **Future**: Controlling the *Solid Yellow line*

- Requires *remote, reliable* and *dynamic* turning on
Purpose of Study

- Propose - New concepts and strategies - manage directional flows - both freeways and urban roads,
- Attractive alternative - solving traffic congestion.
Scope

- Development of methods and strategies - Optimum utilization
- A proved alternative - Safety Enhancement
PROPOSED APPROACHES FOR REVERSIBLE LANE MANAGEMENT

- Using Electro-luminescent paint,
- Using In-Pavement LED,
- Using Fully Automated Retractable Bollards.
Electro-luminescent Paint

- Illuminates with passage of electric current
- Practical implementations - motorcycle paint industry.

Painted on a motorcycle
Implementation

- Scenario 1: Heavy traffic - West bound - 1:3 ratio - 3 lanes favoring major direction
- Scenario 2: Near Equal Traffic - lane ratio 2:2
- Scenario 3: Heavy traffic - East bound - 3:1 ratio
Limitation

- Needs development to attain **durability**, to withstand repetitive passes from
  1) Vehicular traffic,
  2) Varying weather conditions
- Demand to **integrate** with traffic signal controller.
In-pavement LED markers

- **Usage** - smart crosswalks, lane delineation, route guidance on ramps, lane curvatures, pavement edges.
- **Alternative** - separate traffic flow based on real-time traffic demand.

Night view of In-Pavement LED markers
Implementation

Scenario 1

Scenario 2

Scenario 3
Limitations

- LED markers - closely spaced during daytime - **Discomfort**

- **Reliable** operation of LED’s - integrating to controller is a challenge.
Fully Automated Retractable Bollards

- Commonly used - safety barrier
- On freeways, opposing traffic separated - dividers
- Replaced by **Retractable Bollards**

Retractable bollards in a parking lot
Implementation

Scenario 1

Scenario 2

Scenario 3
Limitations

- Requires modification to its design parameters
  1) Deal with high speed car impacts,
  2) Ease in lowering and uplifting it,
  3) Controlling its operations remotely.
- Imbedding into the pavement - new constructions
Switching the Lane Alignment

- Movement of traffic changes - Time
- Re-orientation of Lane(s) - Traffic demand
Switching the Lane Alignment

Stage 1: **Monitor** the Traffic
Stage 2: **Flash, lights** for certain amount of time
Stage 3: **Turn on** lights

Stage 1

Stage 2

Stage 3
Switching the Lane Alignment

- For Retractable bollards, embedded pavement lights should be mounted on top of them.
Switching the Lane Alignment

- Commuters have to be *educated extensively* in this regard.

- Also *care* has to be taken during the *transition phases* like
  1) Allotting more time for flashing lights, and
  2) Checking no occupancy on the reversing lane.
Comparison of Proposed Approaches

<table>
<thead>
<tr>
<th>Areas of Application</th>
<th>Electro-luminescent paint</th>
<th>In-pavement LED markers</th>
<th>Fully Automated Retractable Bollard</th>
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<tbody>
<tr>
<td>Urban Areas</td>
<td>Urban Areas (no dividers)</td>
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<td>Freeways (alternate to dividers)</td>
</tr>
<tr>
<td>Development</td>
<td>Very Futuristic</td>
<td>Can be implemented right away</td>
<td>Can be implemented using present technology with major modifications</td>
</tr>
<tr>
<td>Cost</td>
<td>Not yet certain as it requires further research</td>
<td>Best alternative economically</td>
<td>Very expensive as it requires bollards assembly and control mechanisms, and re-paving of roadways</td>
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<tr>
<td>Limitation</td>
<td>Development of this kind of paint to handle wear and tear of the roads is a major challenge</td>
<td>To achieve high intensity light LED markers have to be closely spaced which may result in discomfort for the driver while changing lanes.</td>
<td>This requires relaying the pavement to accommodate the retractable bollards so appropriate for new roads</td>
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Conclusion

- Using the proposed technologies - improves traffic safety
- Paving a viable solution for dynamic lane management system.
- Innovative way to optimize the use of existing infrastructure