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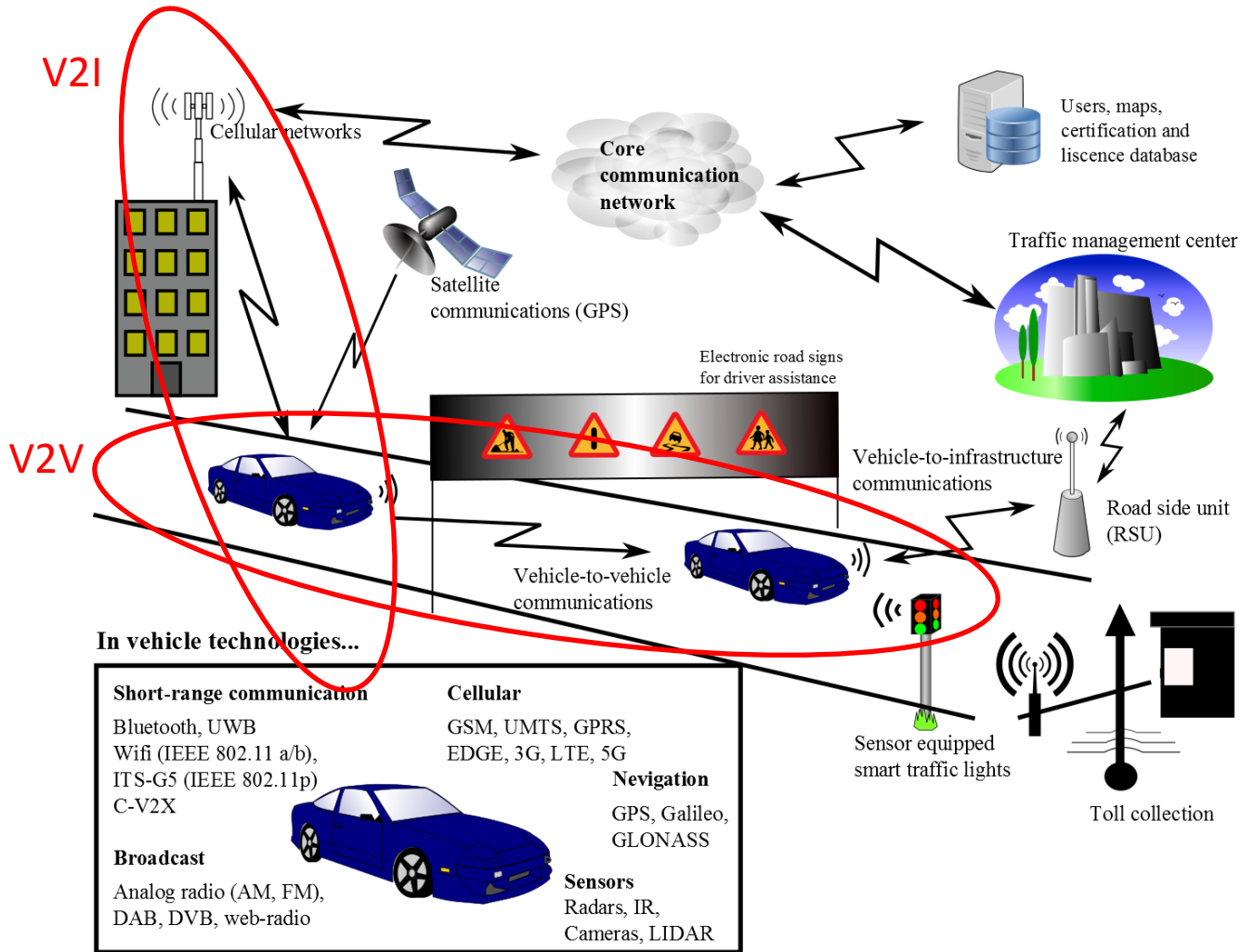
# *V2X Channel Measurements and Modeling*

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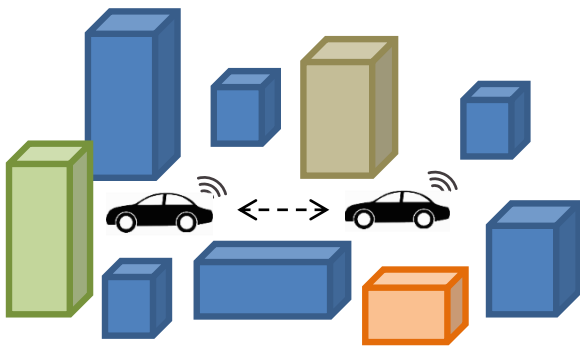
mate.boban@huawei.com  
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# V2X Communications



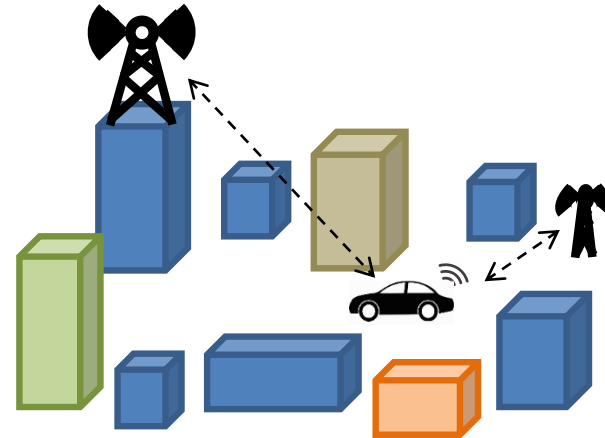
# V2X Channel: Basic Characteristics

## ■ V2V



- Antennas close to ground
- Surrounded by scatterers
- Dual mobility
- More dynamic

## ■ V2I



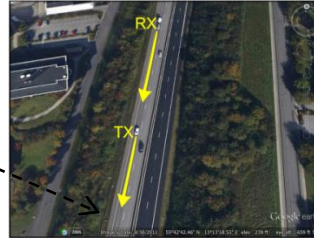
- Base-station or side-link at elevated position
- Vehicle surrounded by scatterers
- Infrastructure often scatterer free
- Single mobility
- Less dynamic

# V2X- Channel: Specific considerations

Environment



Rural



Highway

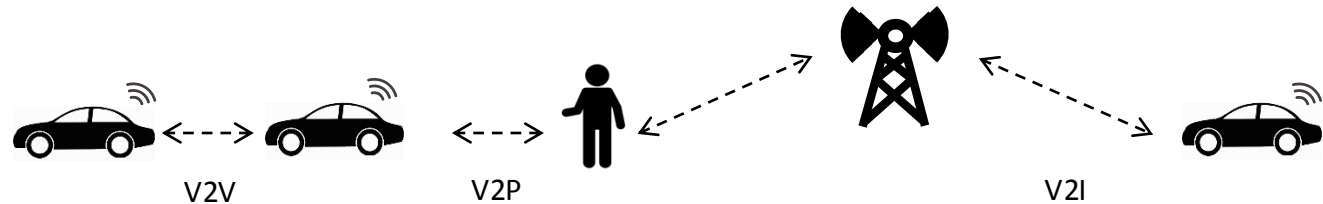


Urban

Special scenarios:

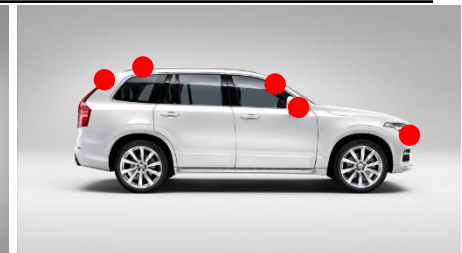
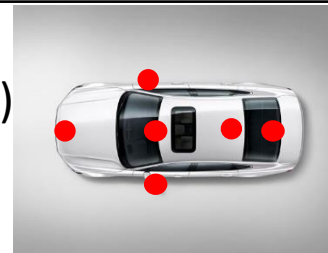
- Tunnel
- Bridge
- Covered parking
- Multi-level roads

Link Type



Vehicle Type & Antenna Location

- Motor Bike
- Cars (Sedan, SUV or Hatchback)
- Bus
- Truck

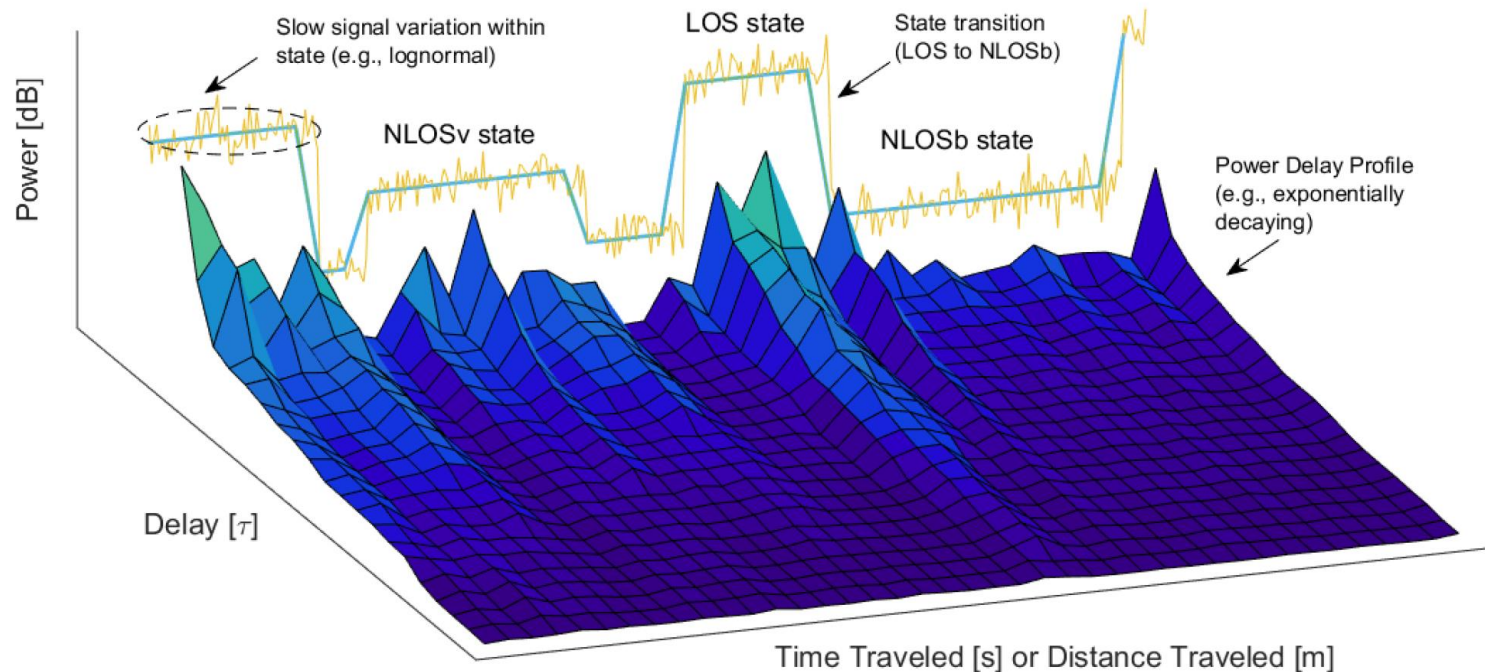


Shadowing & Propagation Conditions

- LOS being blocked by larger objects on road such as other vehicles
- LOS being blocked by nearby building

# Key Differences in V2X Channel Modeling

- Three instead of two propagation states: LOS, NLOS due to static, NLOS due to mobile obstacles (e.g., highway, same-street urban)
  - Including spatially consistent LOS blockage modeling
- Support for dual mobility in V2V (Doppler, AoA/AoD, antenna patterns,...)
  - Incorporating moving environment (cars, trucks,...)



# V2X Channel Models Classification

- Propagation Mechanism
- Large-scale fading
  - Small-scale fading
  - Correlated fading effects for single and multi-links

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- Model properties
- Spatial-temporal dependencies
  - Non-stationarity
  - Extensibility
  - Double-directional, antenna configuration dependency
  - Applicability
  - Scalability and complexity

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- Modeling approach
- Non-geometry based
  - Geometry based deterministic
  - Geometry based stochastic

# 3GPP Activities on Channel Modeling

- 3GPP TR 38.901: “Study on channel model for frequencies from 0.5 to 100 GHz”

- GBS framework that specifies:

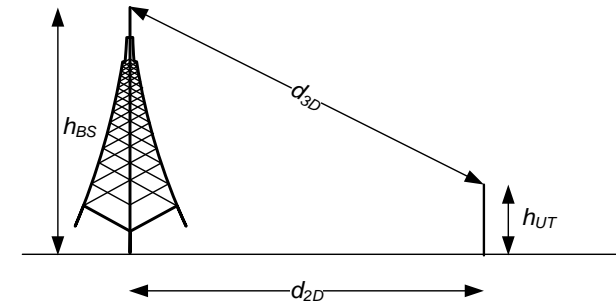
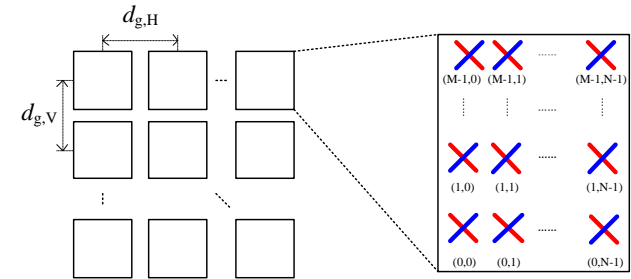
- Parameters for LOS prob., PL, SF, fast fading
- Scenarios: UMa, UMi, Indoor Office, RMa
- Antenna parameters

- Focus on BS-to-UE, missing V2V features

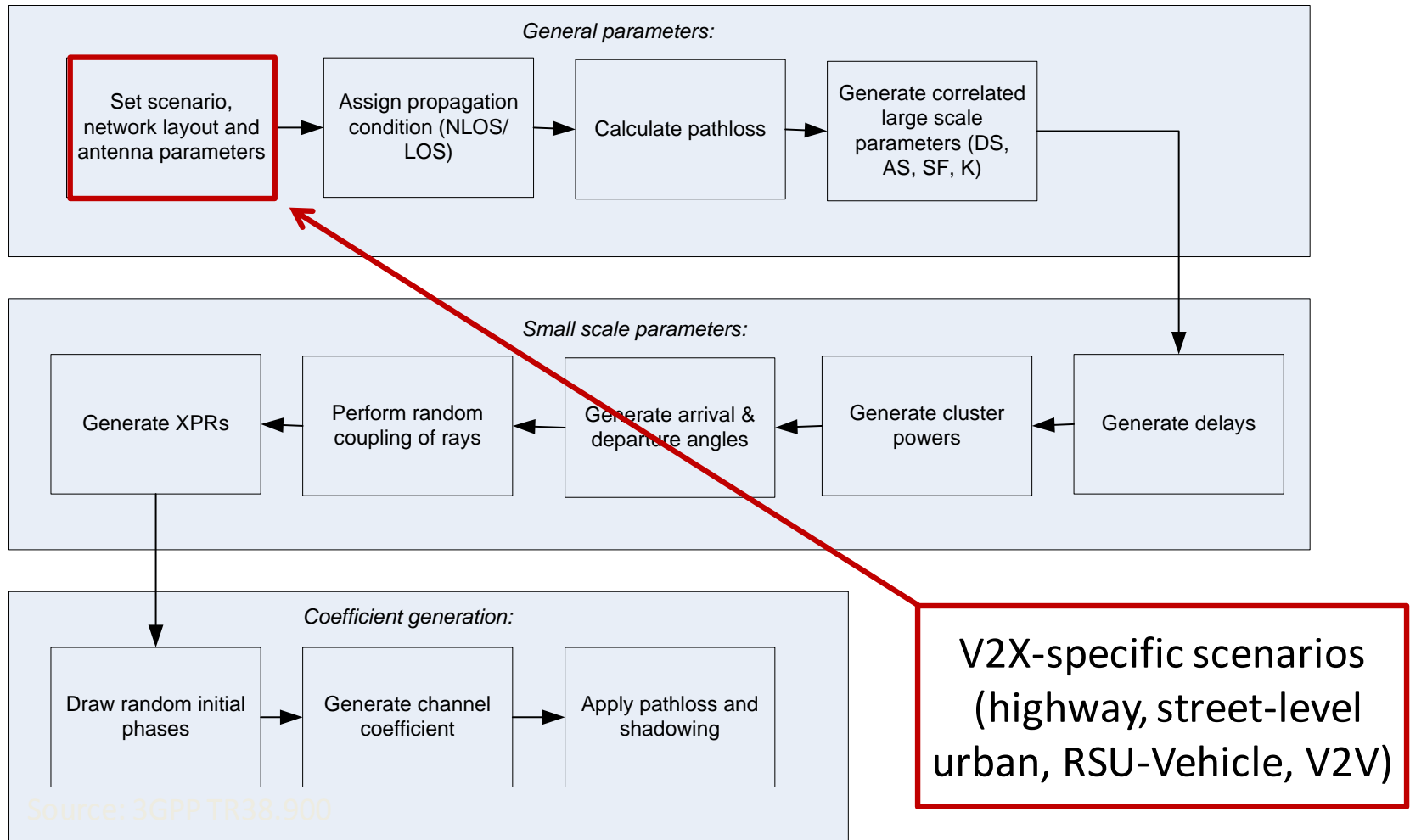
- No dual mobility (V2V)
- No V2X-specific scenarios (highway, street-level urban, RSU-Vehicle, V2V)
- No V2X-specific antenna considerations

- NR V2X SI - Evaluation Methodology of New V2X Use Cases

- Complete the evaluation methodology
- Specify sidelink (V2V) channel model for spectrum above 6 GHz



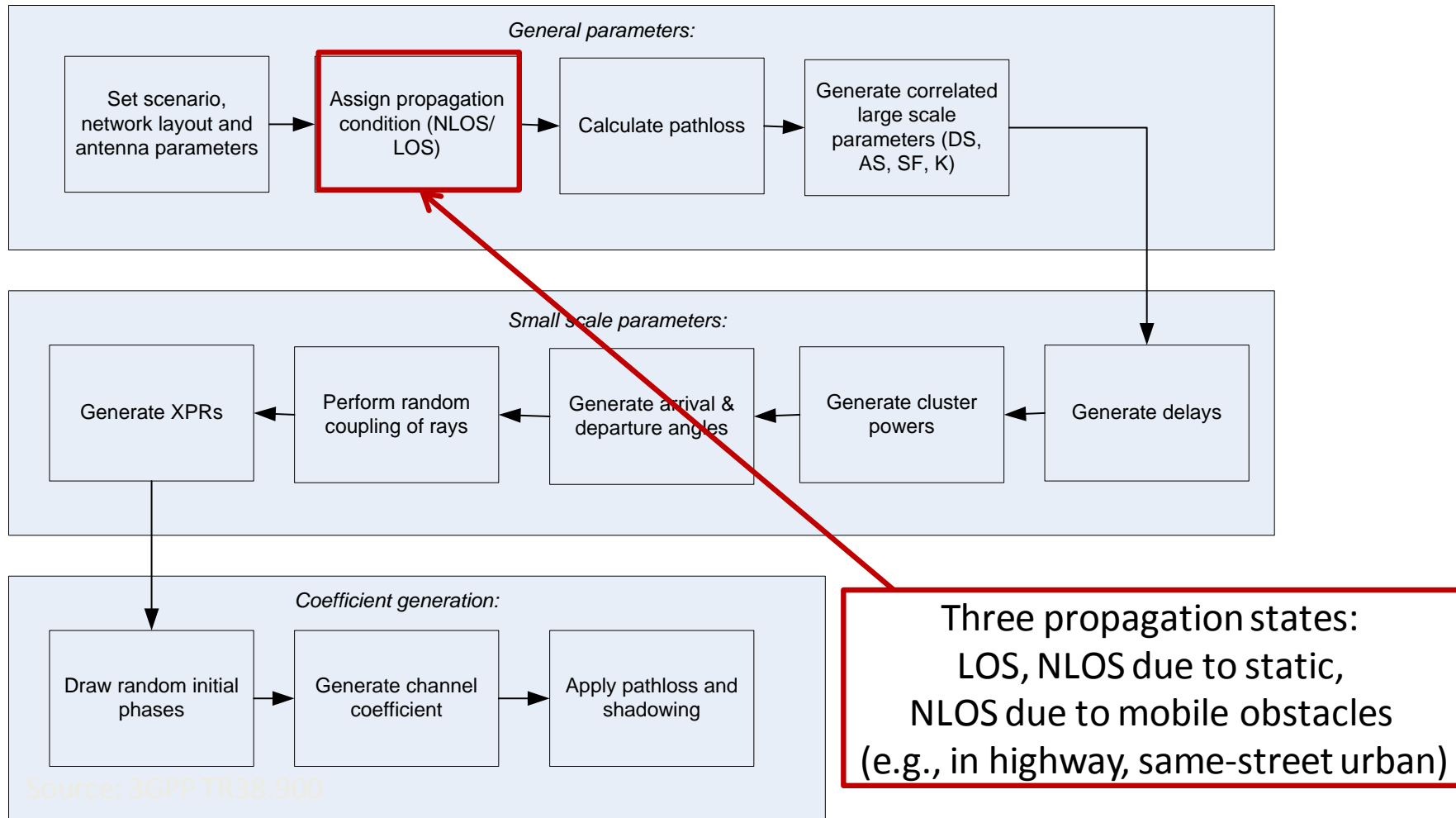
# 3GPP TR38.901: V2X-specific Considerations



\* 3GPP TR 38.901, Study on channel model for frequencies from 0.5 to 100 GHz, March 2017

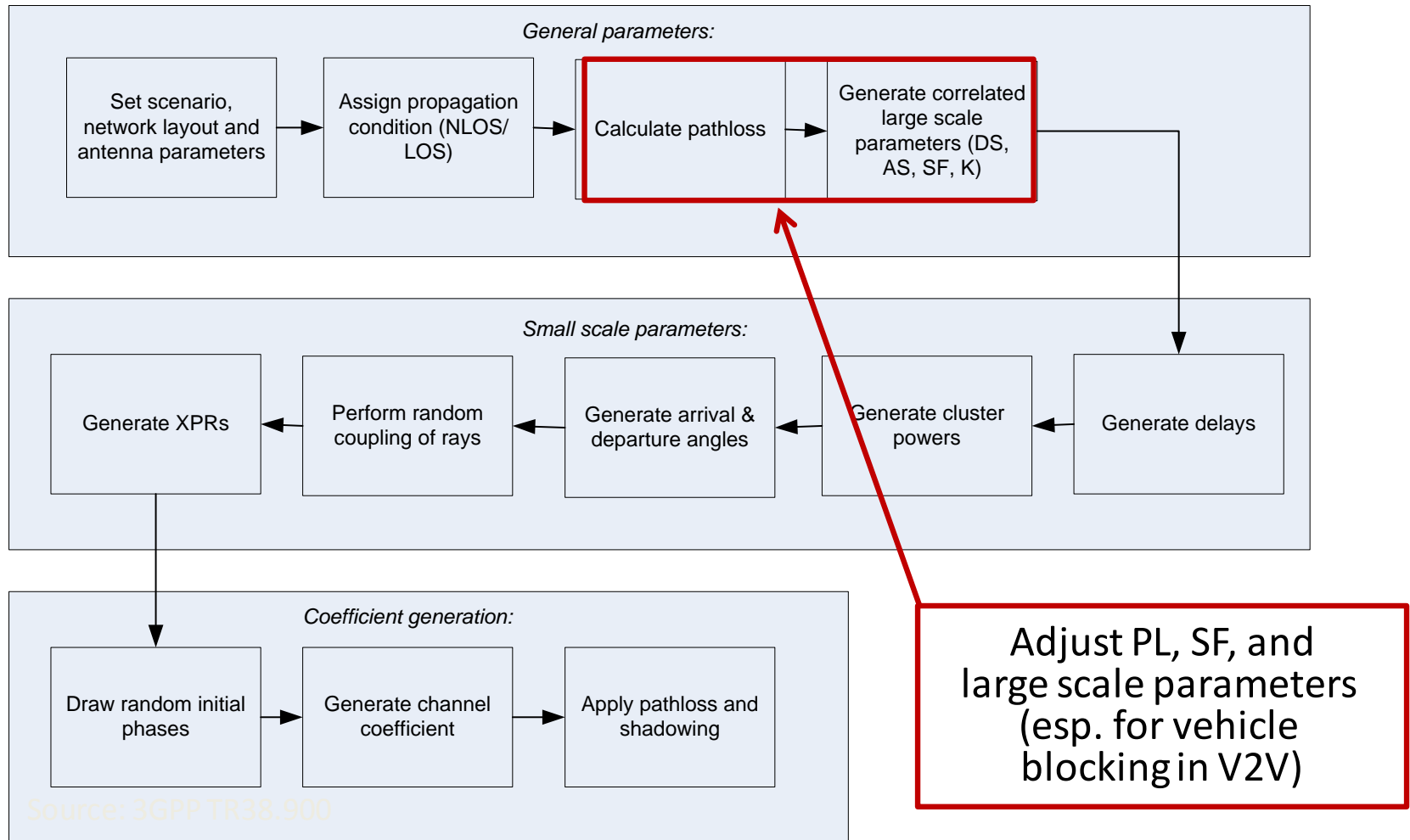


# 3GPP TR38.901: V2X-specific Considerations



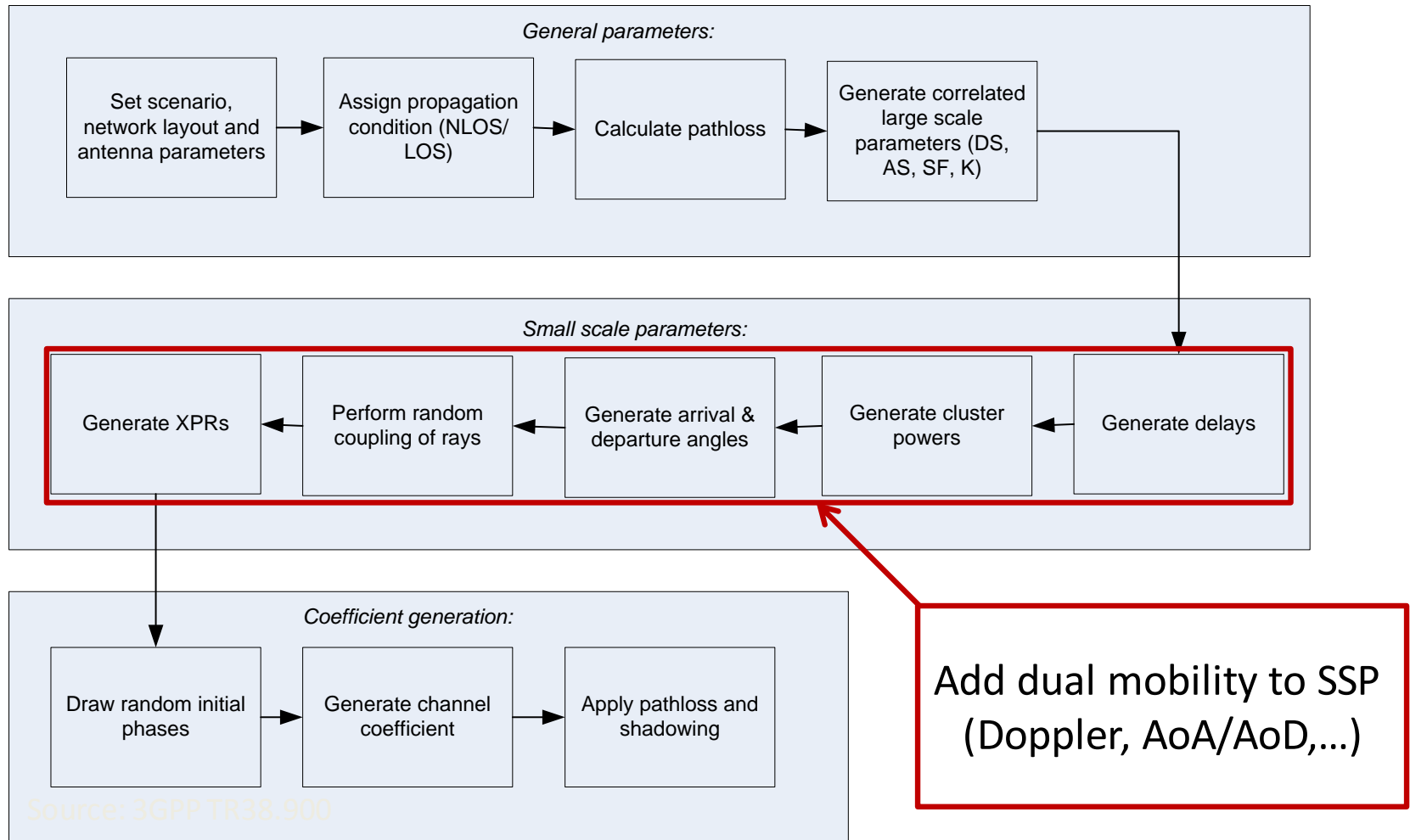
\* 3GPP TR 38.901, Study on channel model for frequencies from 0.5 to 100 GHz, March 2017

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**Thank you!**