Service Discovery and Access in Vehicle-to-Roadside Multi-Channel VANETs

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Service discovery and access in drive-thru scenario

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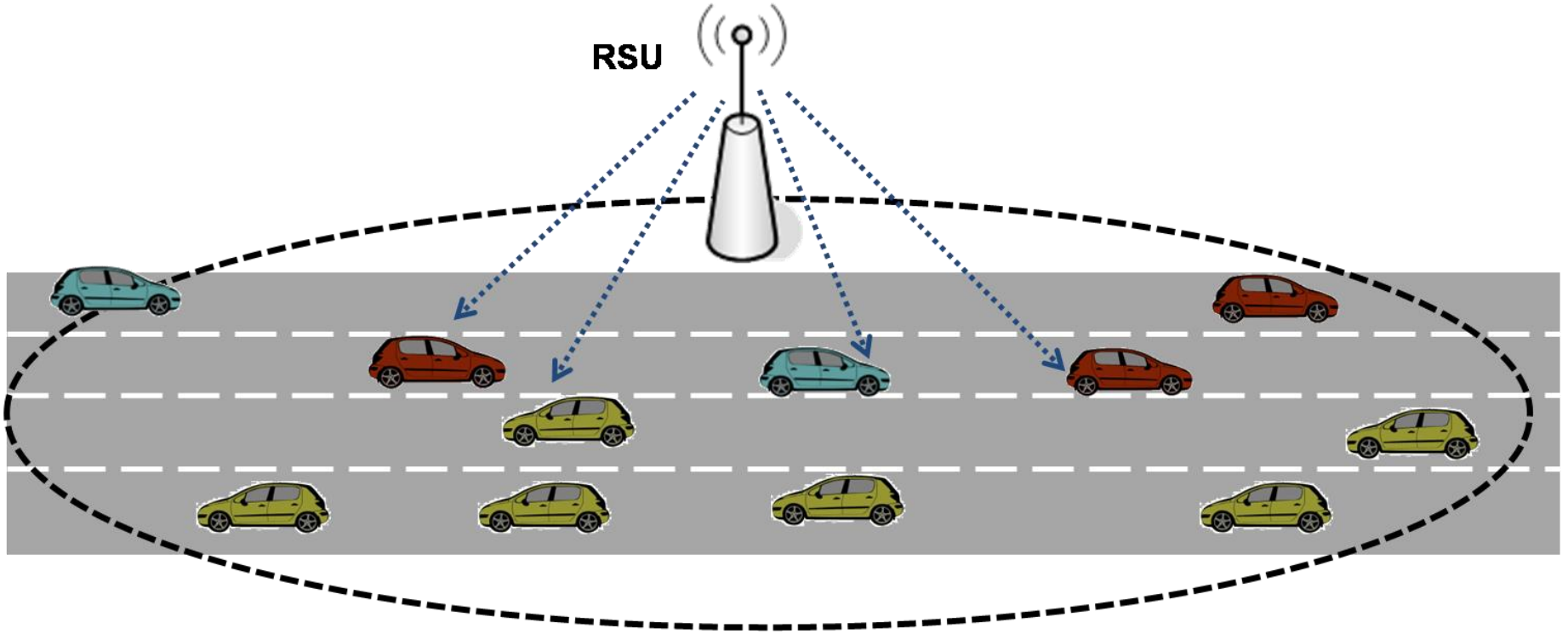
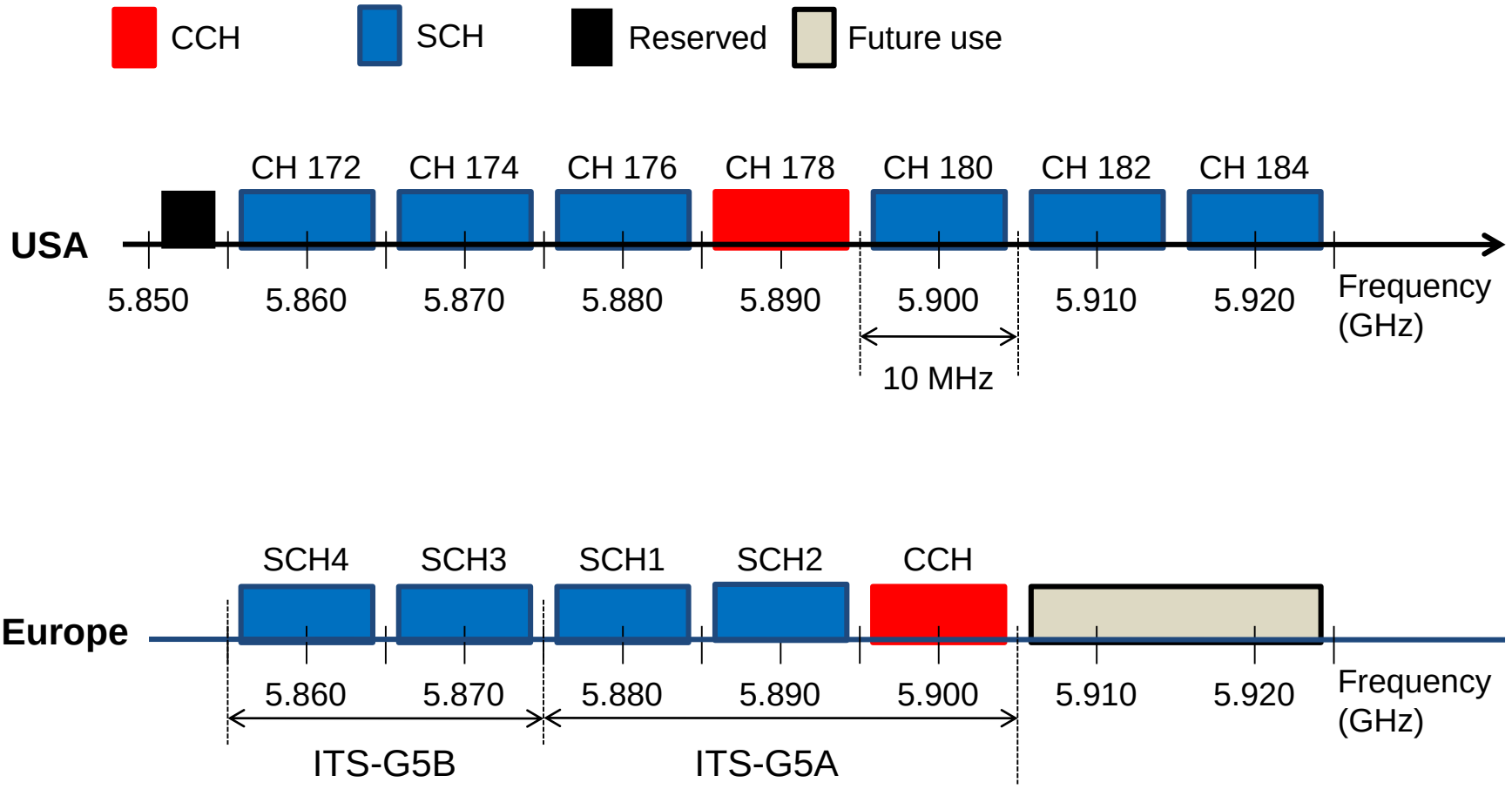


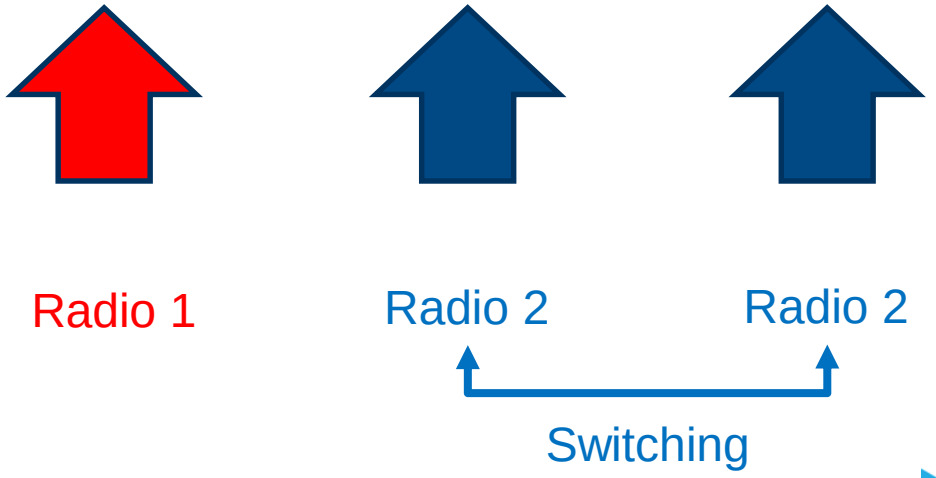
- Sparse roadside infrastructure
- High mobility of vehicles

Multi-channel allocation

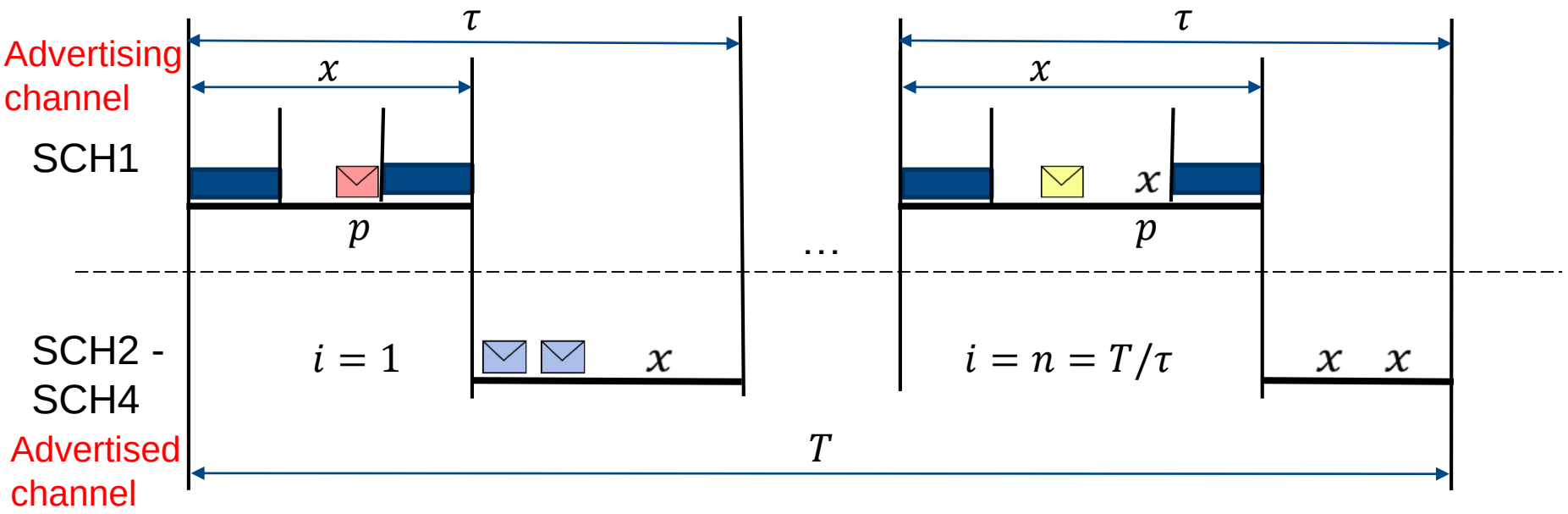


Channel allocation for dual radio devices

Region	Safety Channel	Advertising Channel	Advertised Channel
US	CH 172	CCH	Any SCH (except CH 172)
Europe	CCH	SCH1 (or SCH3)	SCH2-SCH4



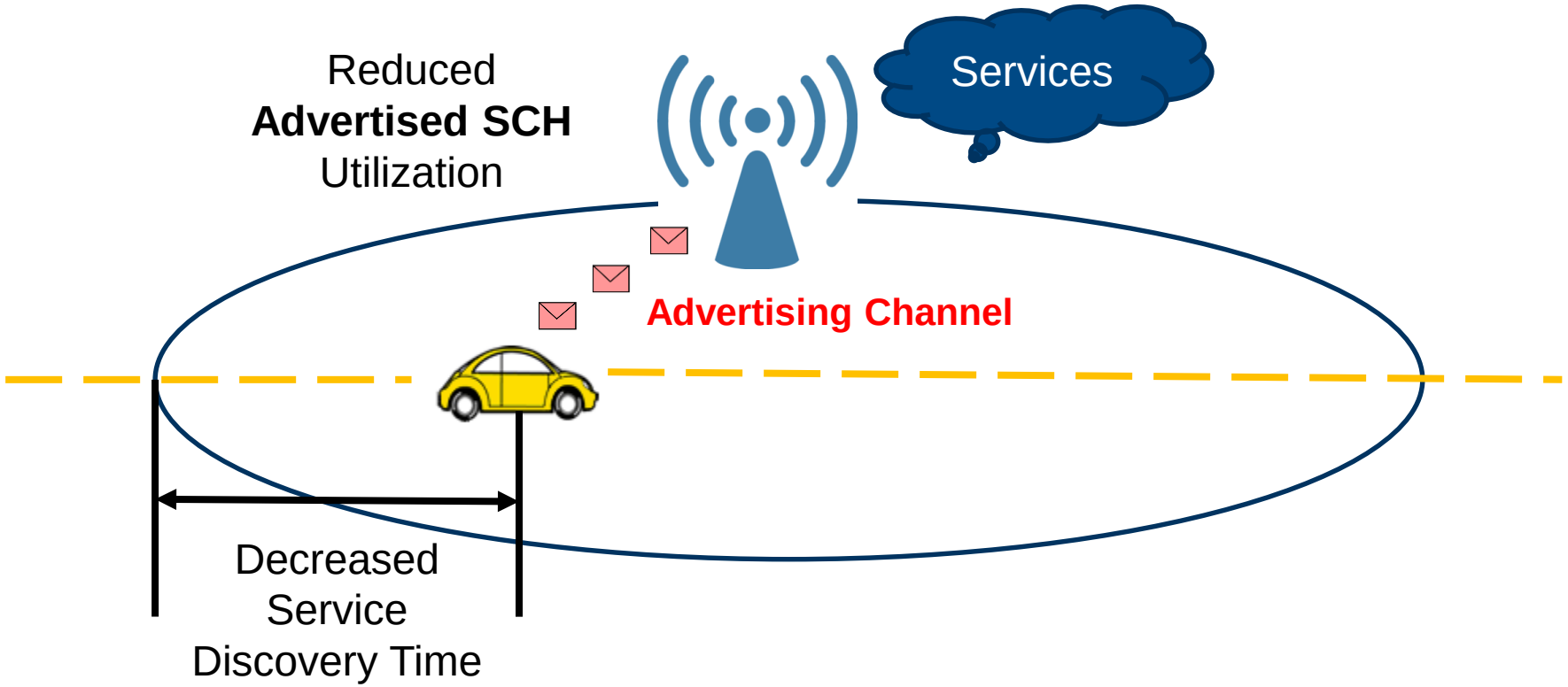
Behavior of the second switching radio interface



	Switching time
x	SAM (ETSI), WSA (IEEE)
x	Interfering packet
x	DATA

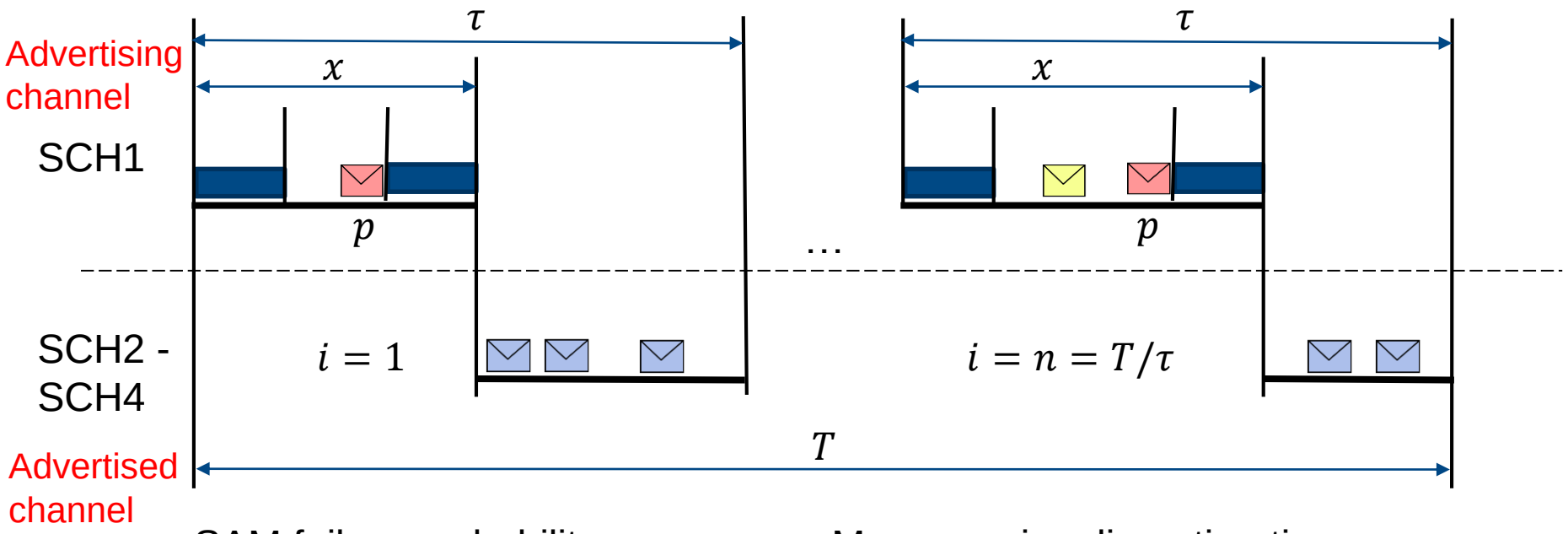
T	Residence time
τ	SAM period
x	Mean service disruption time
p	SAM failure probability

Service discovery and access: fundamental tradeoff



Decreased service discovery time comes at a cost of a reduced advertised channel utilization

Calculation of basic parameters



SAM failure probability

$$p = 1 - (1 - BER)^L (1 - p_0)$$

$$p_0 = 1 - \left(1 - \frac{2}{W+1}\right)^N$$

Mean service disruption time

$$x = B(W) + x_0 + 2T_{sw}$$

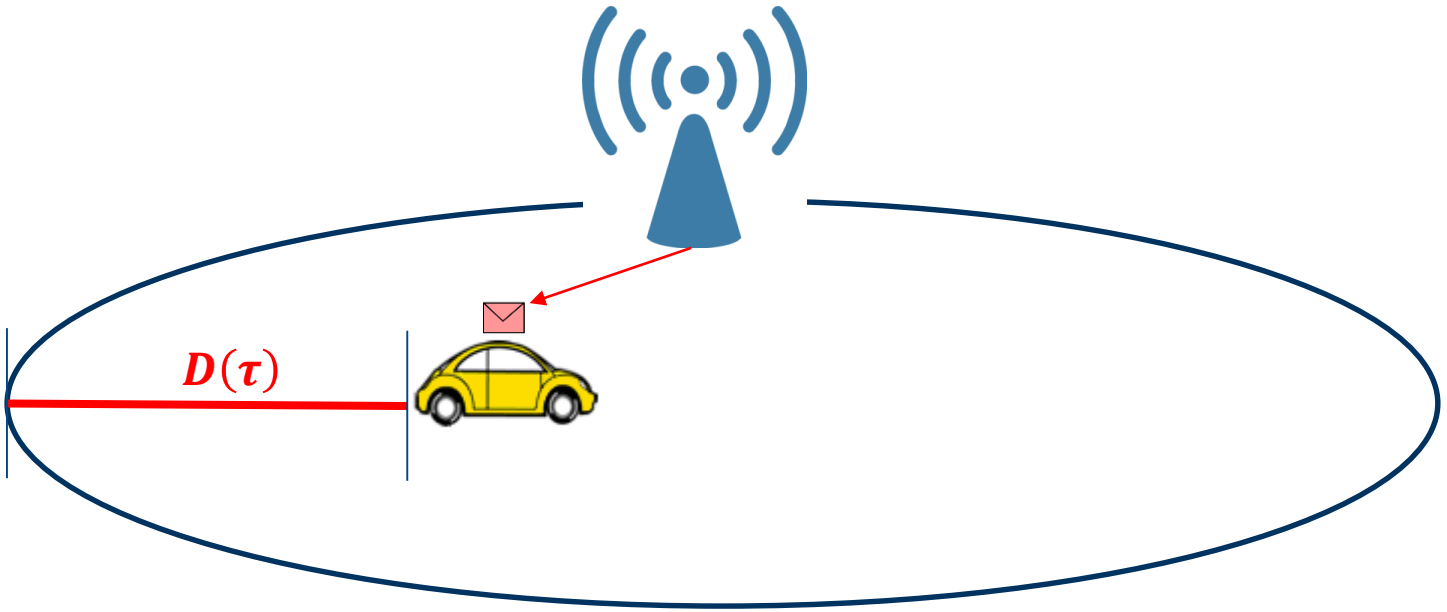
$$x_0 = T_h + \frac{L}{R} + SIFS + AIFSN \cdot \sigma$$

$$B(w) = 1/w \cdot 0 + (1 - 1/w) \cdot \cdot \{(1 - p_0)[\sigma + B(w-1)] + p_0[x_0 + B(w-1)]\}$$

Performance metric I

The mean service discovery time: the expected time that elapse from the moment a vehicle enters the RSU coverage until the moment it successfully receives the SAM.

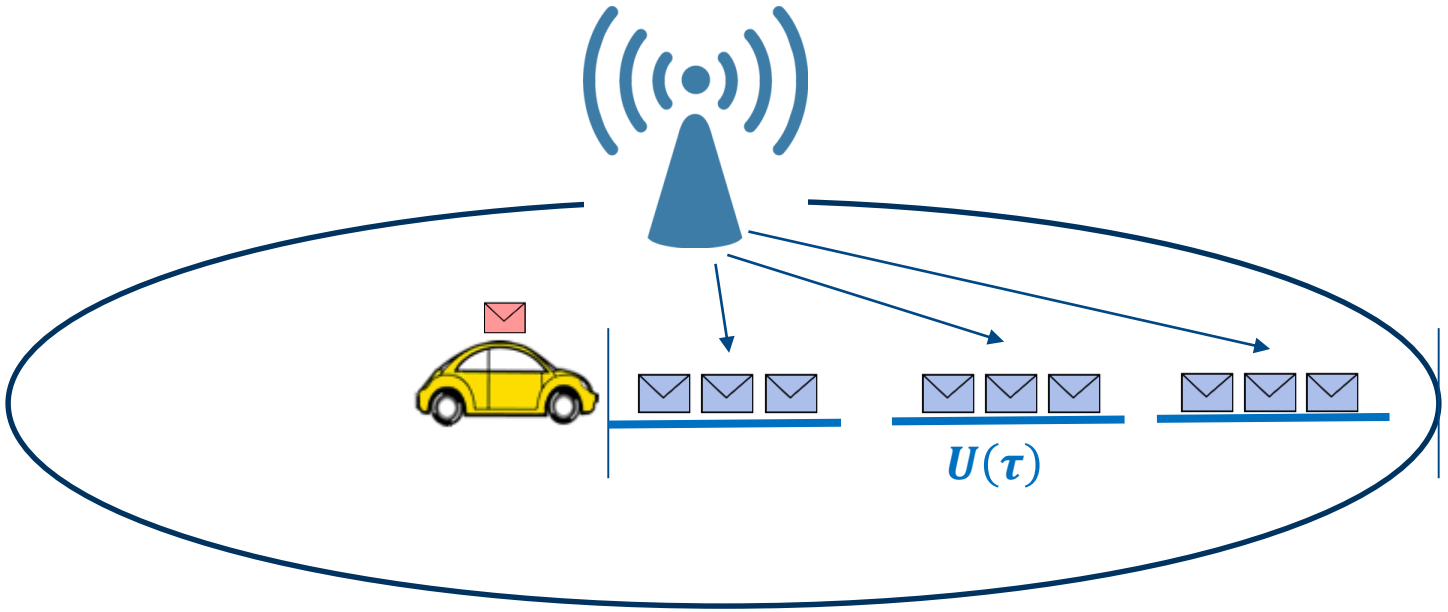
$$D(\tau) = \tau \cdot \frac{np^{n+1} - np^n - p^n + 1}{(1-p)(1-p^n)} + (x - \tau)$$



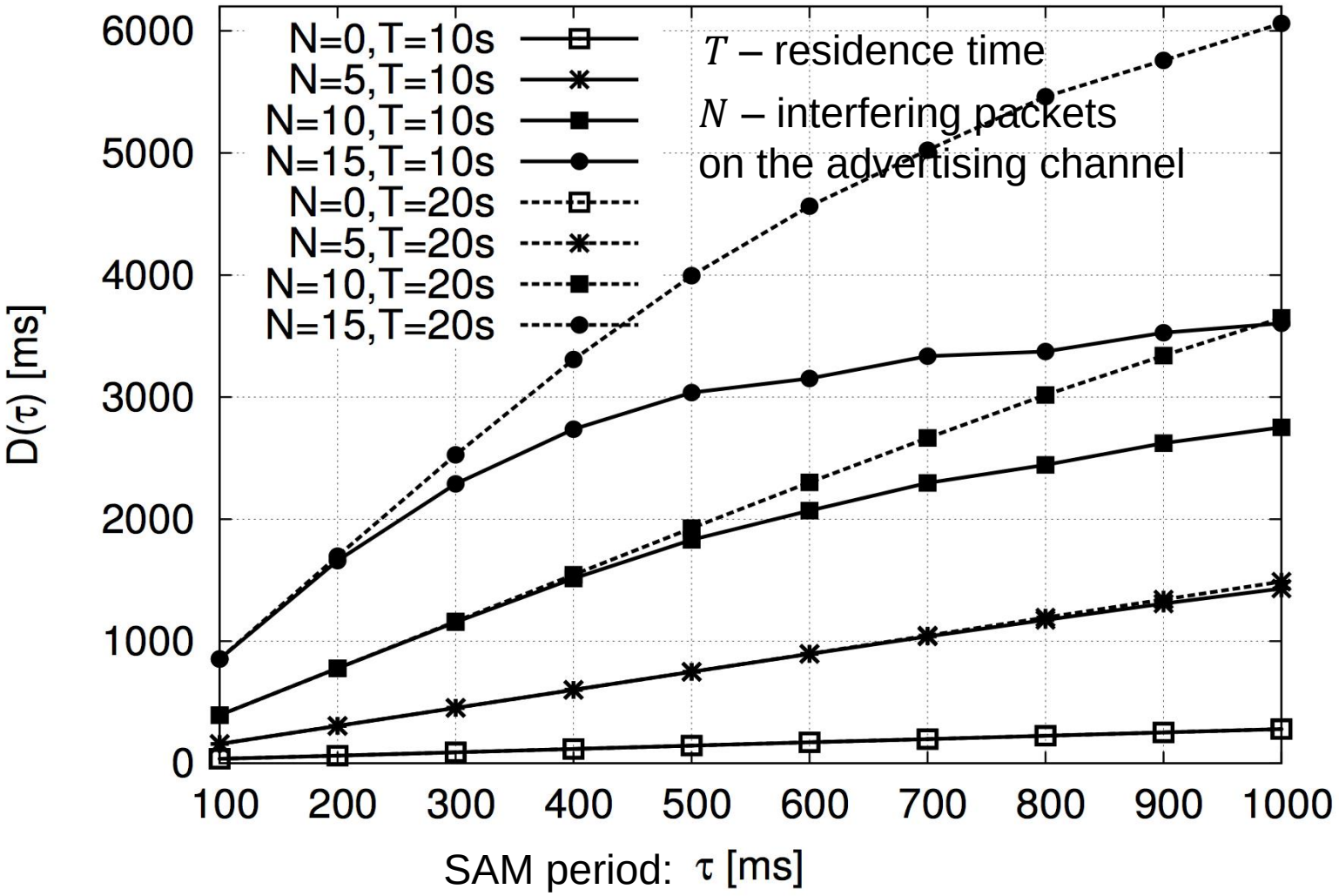
Performance metric II

The service channel utilization: fraction of the residence time available for accessing the service – it starts from the successful SAM reception and ends when vehicle goes out of the RSU's radio range, also excluding service disruption times.

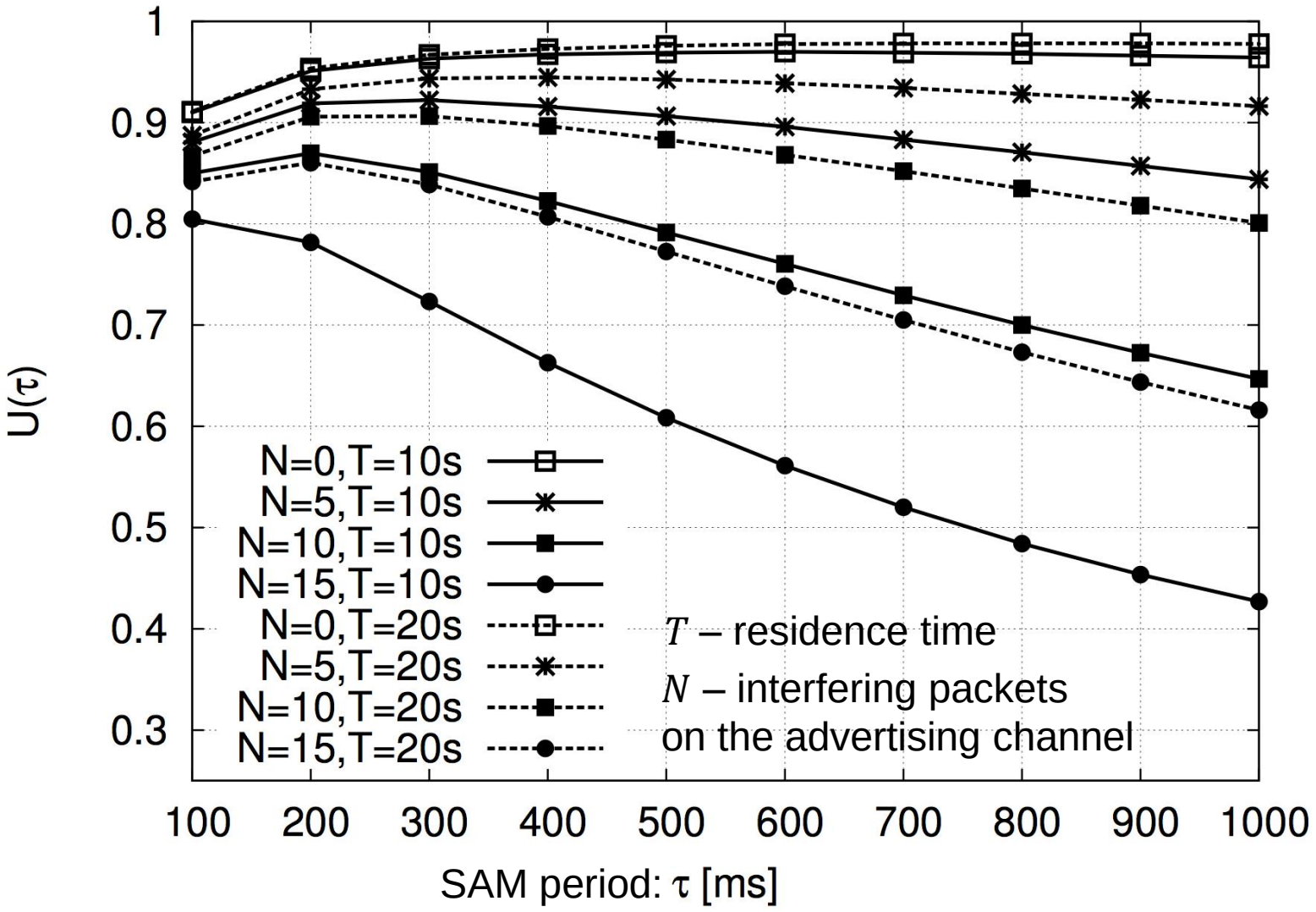
$$U(\tau) = \frac{x-\tau}{T} \cdot \frac{np^{n+1} - np^n - p^n + 1}{1-p} + \frac{T - xn - x + \tau}{T} \cdot (1 - p^n)$$



Mean service discovery time



Service channel utilization



Conclusions

Providers are recommended to set the SAM period according to the **nature of the delivered service**:

- SAM periods that privilege higher channel utilization are particularly indicated when the provider and the vehicle should exchange a large amount of data.
- On the other hand, SAM period values that provide shorter discovery time may be required when offering low-latency services and/or when a small amount of data is to be exchanged.

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