



Vehicular Networking and Cooperative Driving [C2X]

Beaconing

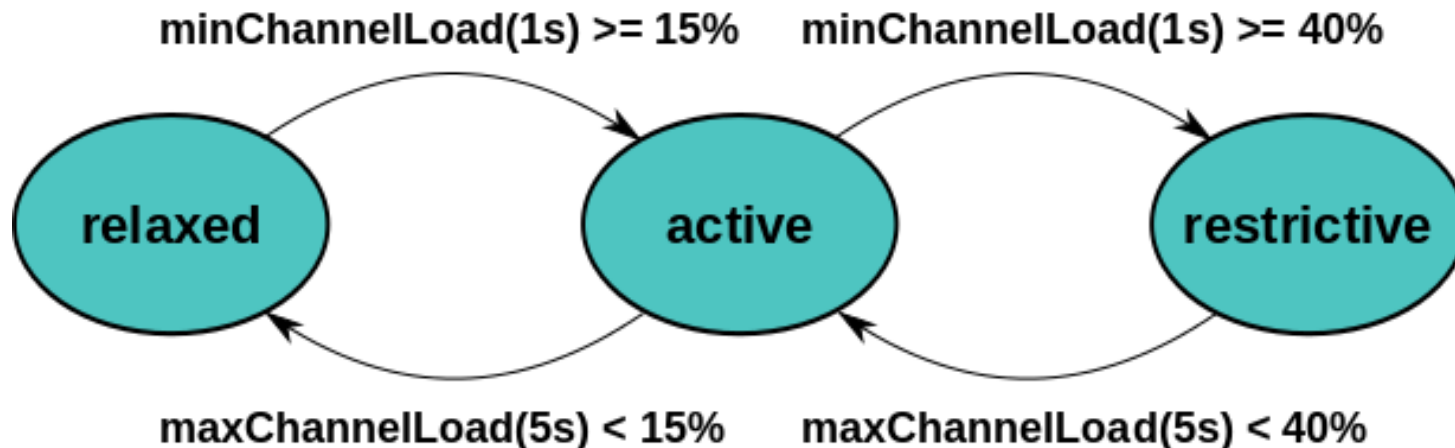
DCC

ETSI ITS G5 Decentralized Congestion Control (DCC)

- Core feature of ETSI ITS G5
- Adaptive parameterization to avoid overload
- Configurable parameters per AC:
 - TX power (Transmit Power Control, TPC)
 - Minimum packet interval (Transmit Rate Control, TRC)
 - Data rate (Transmit Datarate Control, TDC)
 - Sensitivity of Clear Channel Assessment (DCC Sensitivity Control, DSC)
- State machine determines which parameter set is selected; available states:
 - Relaxed
 - Active (multiple sub states)
 - Restrictive

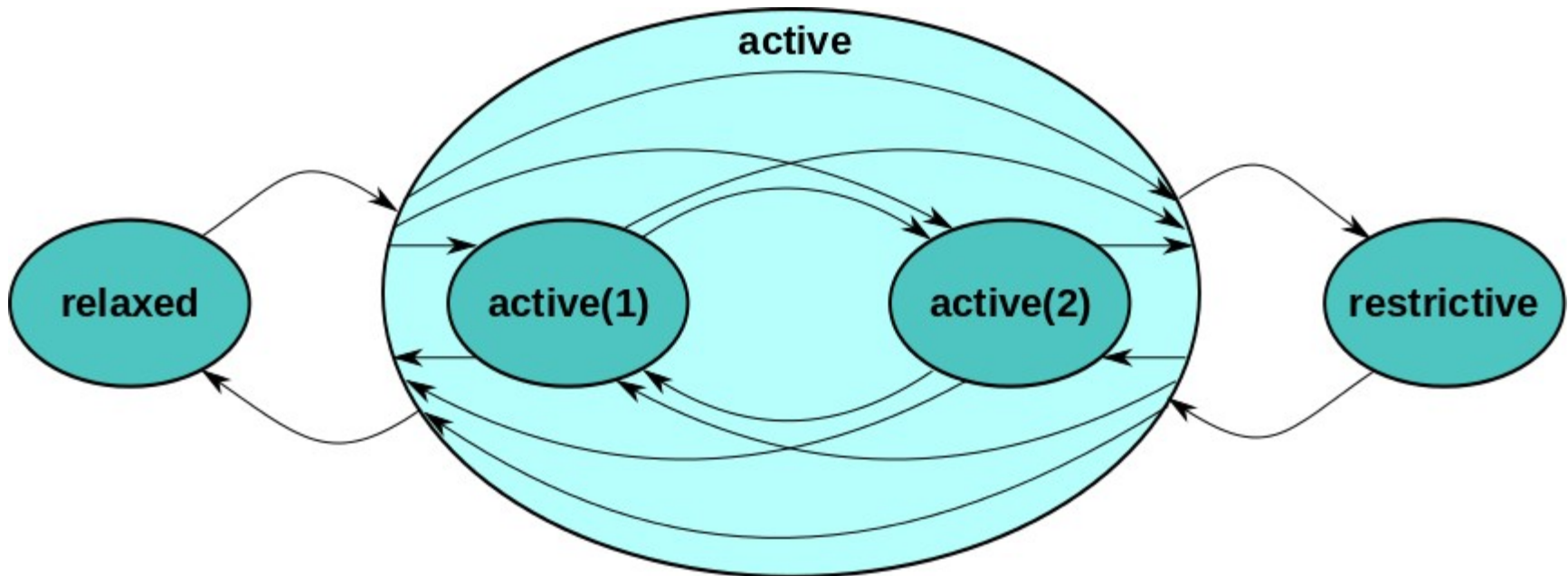
State transitions

- Measure $\text{min/maxChannelLoad}(x)$
 - Min/max *channel load* in $[t_{\text{now}} - x .. t_{\text{now}}]$
 - Channel load: fraction of time that channel was sensed *busy* during measuring interval (ex:)
 - Channel busy: Average received power (signal or noise) during probing interval (ex:) above carrier sense threshold
- State machine for Control Channel:



State transitions

- State machine for Service Channel:
 - Active state subdivided into up to 4 sub states



Parameter sets

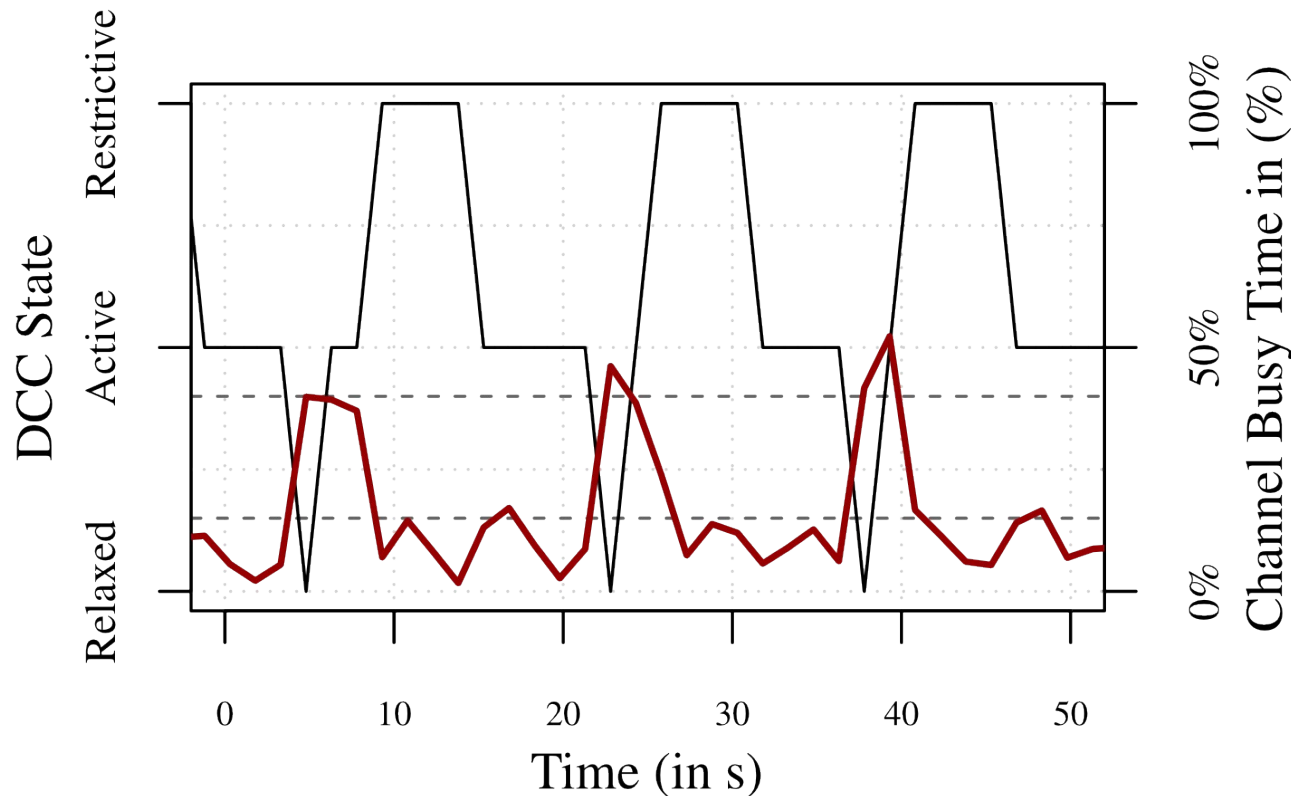
- Example: Control Channel
 - TX power: relaxed: 33 dBm \Rightarrow active: *ref* \Rightarrow restrictive: -10 dBm
 - “*ref*”: Value remains unchanged
 - Remember:
 - 33 dBm \Rightarrow mW \Rightarrow 2000 mW
 - -10 dBm \Rightarrow mW \Rightarrow 0.1 mW

	State					
	Relaxed	Active				Restrictive
		AC_VI	AC_VO	AC_BE	AC_BK	
TX power	33 dBm	ref	25dBm	20dBm	15dBm	-10 dBm
Min pkt interval	0.04 s	ref	ref	ref	ref	1 s
Data rate	3 Mbit/s	ref	ref	ref	ref	12 Mbit/s
Sensitivity	-95 dBm	ref	ref	ref	ref	-65 dBm

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Analysis and Problems

- Oscillating channel load (both local and global!)
 - ...caused by channel access being too restrictive (standard parameters)



[1] David Eckhoff, Nikolettta Sofra and Reinhard German, "A Performance Study of Cooperative Awareness in ETSI ITS G5 and IEEE WAVE," Proceedings of 10th IEEE/IFIP Conference on Wireless On demand Network Systems and Services (WONS 2013), Banff, Canada, March 2013.