Multi-Channel Operations for ITS G5

- Status of the ETSI STF420 work -

Presented by Friedbert Berens

for ETSI ITS Work Shop 2012 Doha, Qatar

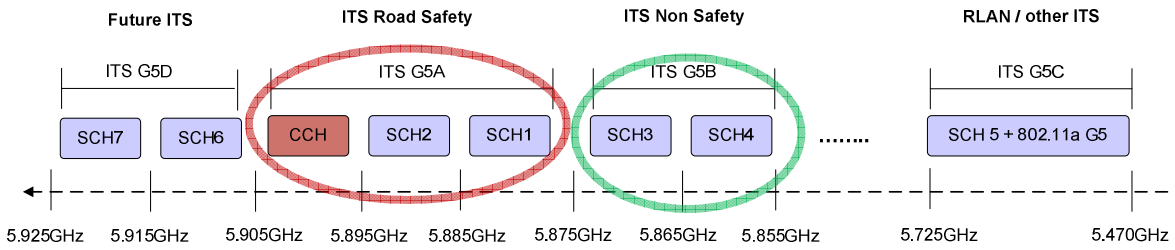
Joint work – CAR 2 CAR and ETSI

- ETSI created a Specialist Task Force STF 420 to address the aspect of multi-channel operations
  - **STF 420 Members**:
    1. Jan de Jongh – TNO
       Paul Spanderman – TNO
    2. Friedbert Berens – FBConsulting
    3. Jérôme Härri – EURECOM
    4. Fritz Kasslatter (leader) – Siemens AG
  - STF Document: **ETSI TS 102 724**

- The CAR 2 CAR WG COM also provided a Position Paper on multi-channel operations
  - **CAR 2 CAR Position Paper authors**:
    1. Achim Brakemeier – Daimler AG
    2. Christian Wewetzer – Volkswagen
    3. Andreas Kwoczek – Volkswagen
    4. Oliver Klemp – BMW

ITS Message Set and Frequency Band

- ITS G5 Frequency Band (ETSI ES 202 663)

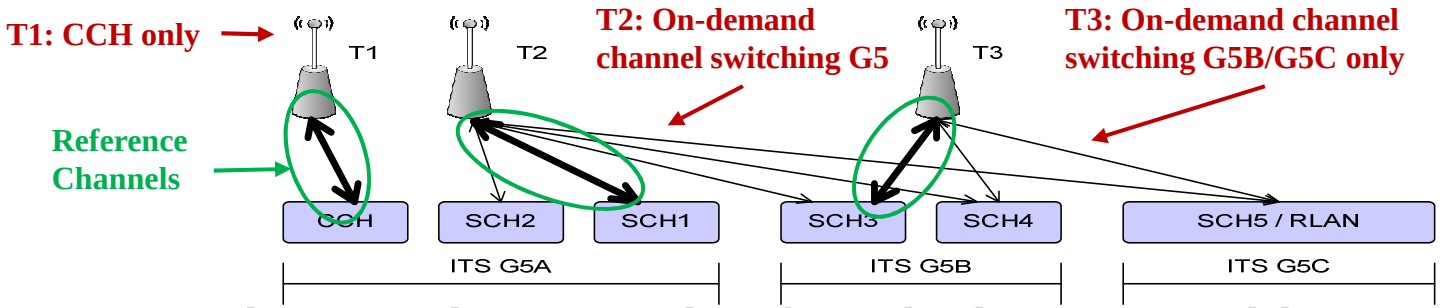


- Message Set for DAY 1 Applications
  - Cooperative Awareness Message (CAM - ETSI EN 102 637-2)
  - Decentralized Environmental Notification Message (DENM - ETSI EN 102 637-3)
  - Signal Phase and Timing Message (SPaT - SAE J2735)
  - Service Announcement Message (SAM – ETSI TS 102 890)
  - MAP - Geometric Intersection Description (MAP-SAE J2735)

ITS Non-Safety ITS Road Safety

ITS G5 Fonctional Transceiver Configuration

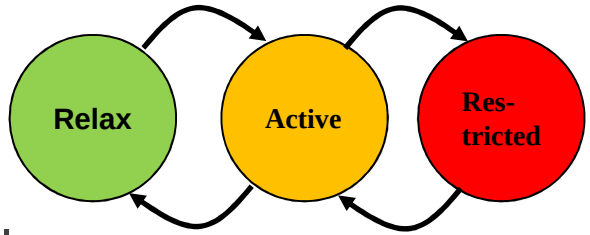
- **ITS Transceiver Multi-Channel Configuration:**
  - Single Transceiver ITS Road Safety: T1
  - Dual Transceiver ITS Road Safety: T1 + T2
  - ITS Non-safety: T2, T3 or T2+T3

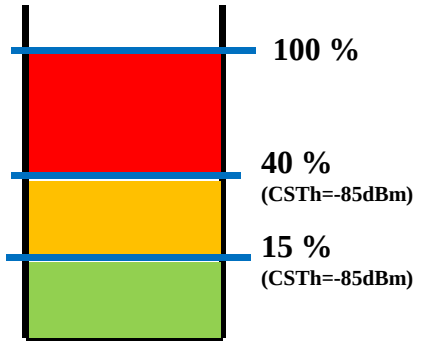


- **ITS Station Multi-Transceiver/Multi-Channel Architecture**

DCC-based Channel Access Policies (Proposal)

- Access Specifications and Restrictions are based on the DCC state of each channel
  - ETSI DCC: TS 102 687





- Per-Message Access Proposal

Message	CCH Relaxed	CCH Active	CCH Restrictive
CAM	CCH	CCH	CCH
DENM	CCH	CCH 1st hop SCH1 else	CCH 1st hop SCH1 else
SPaT/MAP	CCH	CCH/SCH1	CCH/SCH1
SAM	*SCH1/SCH3*	*SCH1/SCH3*	*SCH1/SCH3*
IP (over geonet)	CCH	SCH1/SCH..	SCH1/SCH

Multi-transceiver required

Message on CCH	AC_VI	AC_VO	AC_BE	AC_BK
CAM		✓		
DENM	✓			
SPaT/MAP			✓	
SAM			✓	
IP (over geonet)				✓

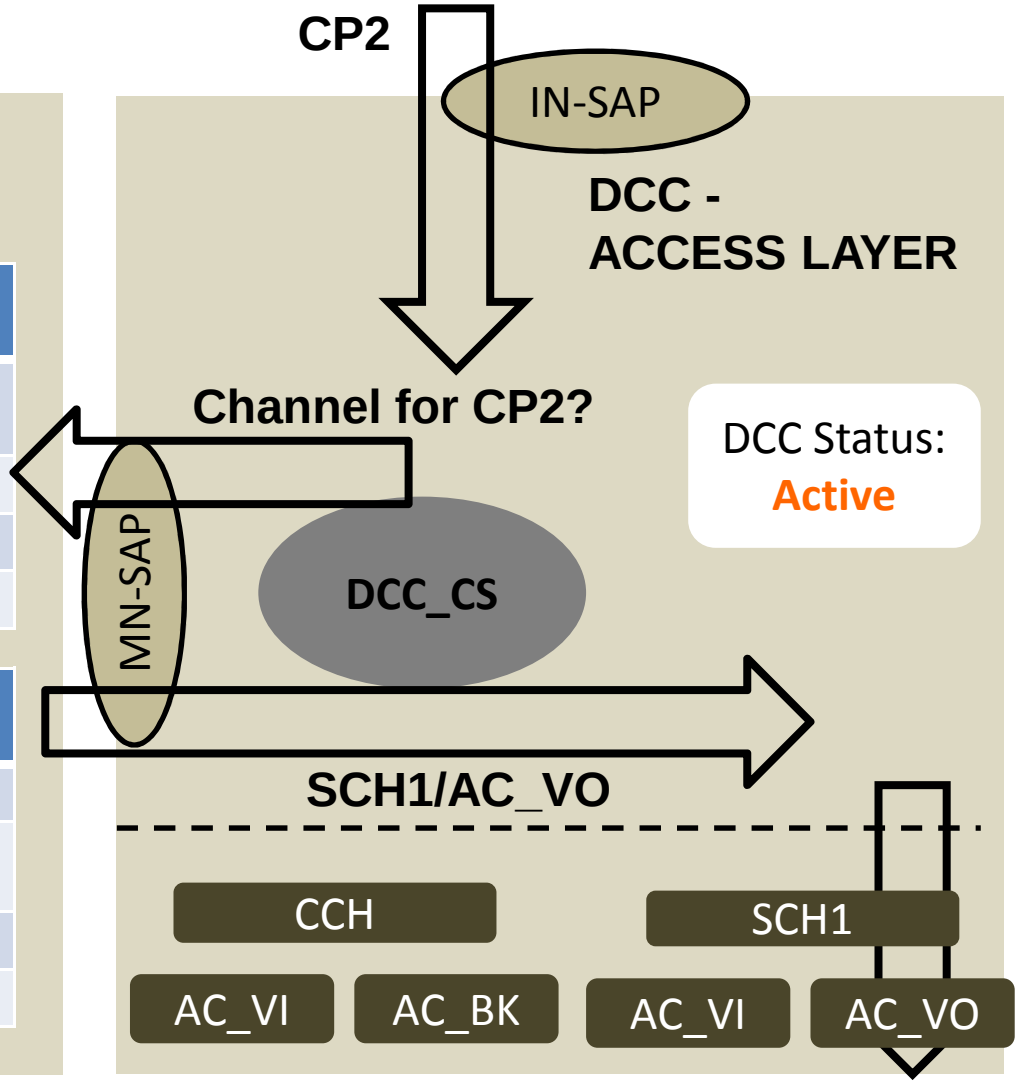
DCC-based Channel Access Policies (Proposal)

CP: Communication Profile

DCC - MANAGEMENT

Comm. Prof.	SCH1 Relaxed	SCH1 Active	SCH1 Restrictive
CP2	-	SCH1/AC_VO	SCH1/AC_VO
CP3	-	-	SCH1/BE
CP4	*SCH1/BE*	*SCH1/BK*	*SCH/BK*
CP7	-	SCH1/VO	SCH/BK

Comm. Prof.	CCH Relaxed	CCH Active	CCH Restrictive
CP1	CCH/AC_VI	CCH/AC_VI	CCH/AC_VI
CP2	CCH/AC_VO	CCH/AC_VO	CCH/AC_VO
CP3	CCH/AC_BE	CCH/BK	-
CP7	CCH/BK	-	-



Channel Access Requirements (Proposal)

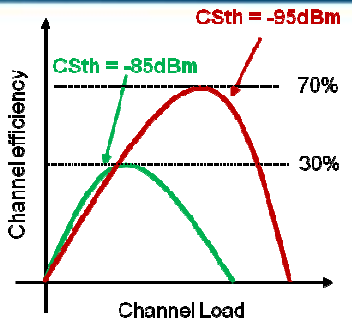
ACC_POL_000	An ITS station using ITS G5 channels MUST NOT transmit before evaluating the DCC status.
ACC_POL_001	The inter-packet spacing of messages transmitted in the CCH and the SCH1 and SCH2 SHALL NOT be smaller than [50ms].
ACC_POL_002	Awareness (e.g. CAM) messages SHALL be sent on the CCH in **ALL** CCH DCC states.
ACC_POL_003	Event-based messages (e.g. DENM) SHALL be sent on the CCH for the first hop in **ALL** CCH DCC states.
ACC_POL_004	The forwarding of a DENM message (second hop and higher) MAY be sent on the CCH in DCC state **RELAXED**.
ACC_POL_005	The forwarding of a DENM message (second hop and higher) MAY be sent on the SCH1 in **ALL** CCH DCC states.
ACC_POL_006	The forwarding of a DENM message (second hop and higher) SHALL be sent on the SCH1 in CCH DCC states **ACTIVE** and **RESTRICTIVE**.
ACC_POL_007	The [Geonetwork] Beacons SHALL be sent on the CCH at **ALL** DCC states.
ACC_POL_008 iif	Other messages (SPaT, MAP/TOPO, SAM) than CAM and DENM MAY be transmitted on CCH DCC state is RELAXED
...	...

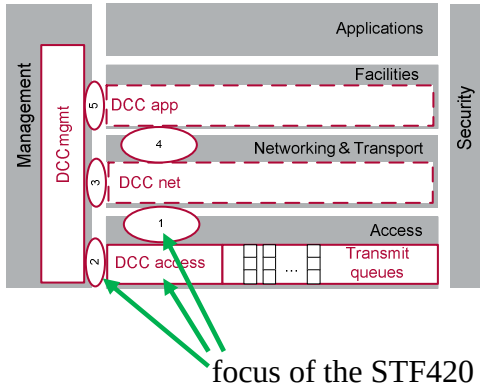
Considerations for the definition of policies

- Requirements shall be testable
- The declaration of requirements shall be as atomic as possible (unambiguous, disjoint)
- The requirements are valid for all layers

Current and Future Work

- Harmonizing load status and **$CS_{Threshold}$** for optimal channel usage
- Specification of the ***DCC Channel Switching*** *as new DCC mechanism*
- Coordination with ETSI and CAR 2 CAR WGs for the Location of DCC coordination entity
- **Communication Profiles** / Traffic Class
  - Transmit Parameters, Channel, Queue (priority)
- **Protocol Categorization**
  - **Generic**: Road Safety / Efficiency / Low Latency / ..
  - Protocol Matching and Channel-specific Access
- Implementation and Test
  - Liaison with **CAR 2 CAR WG SIM** on the iTETRIS ITS Simulation Platform





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Thank you!