Cooperative ITS hybrid services

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Thierry Ernst – CEN PT1605 for ITS Norway – January 2021
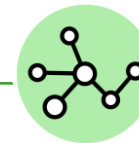
YoGoKo – IN A NUTSHELL

Y-SMART, A SOFTWARE PLATFORM

For secure data collection & transmission using a combination of access technologies & protocols

OFFERS

Software licenses, Turn-key solutions, Engineering & Support

15 YEARS R&D BACKGROUND

Telecoms, Connectivity, Robotics, Vehicular Communications (V2X), Cooperative ITS

ONE TECHNOLOGY, MULTIPLE USAGES

Road safety, traffic efficiency, fleets management, remote driving, data collection, …

ORIGINS

Founded in 2014 Located in France (Paris & Rennes)

DEPLOYMENTS

Cooperative ITS pilots, V2X, Autonomous vehicle programs Smart Infrastructure

Hybrid vehicle ITS stations

**Hybrid communication system providing
C-ITS services to road maintenance vehicles (ITS-G5)
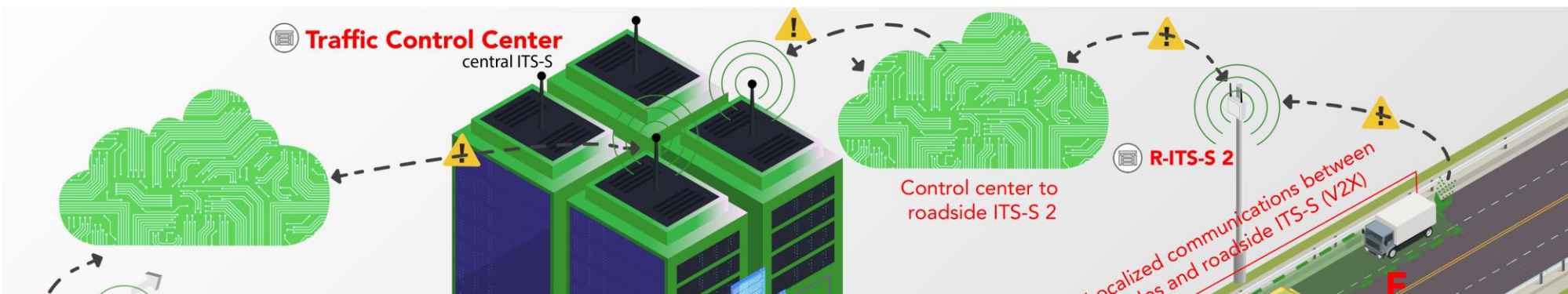and cloud connectivity (cellular)**

SCOOP: French pilot deployment of C-ITS services

Virtual roadside ITS stations

C-ITS services delivered directly from traffic control centers to vehicles using cellular

Nordic Way: Scandinavian pilot deployment of C-ITS services

Typical example showing that different communication technologies
(localized & networked) and transmission modes (broadcast & point-to-point)
complement each other and are necessary
to ensure wider transmission reach and continuous safety
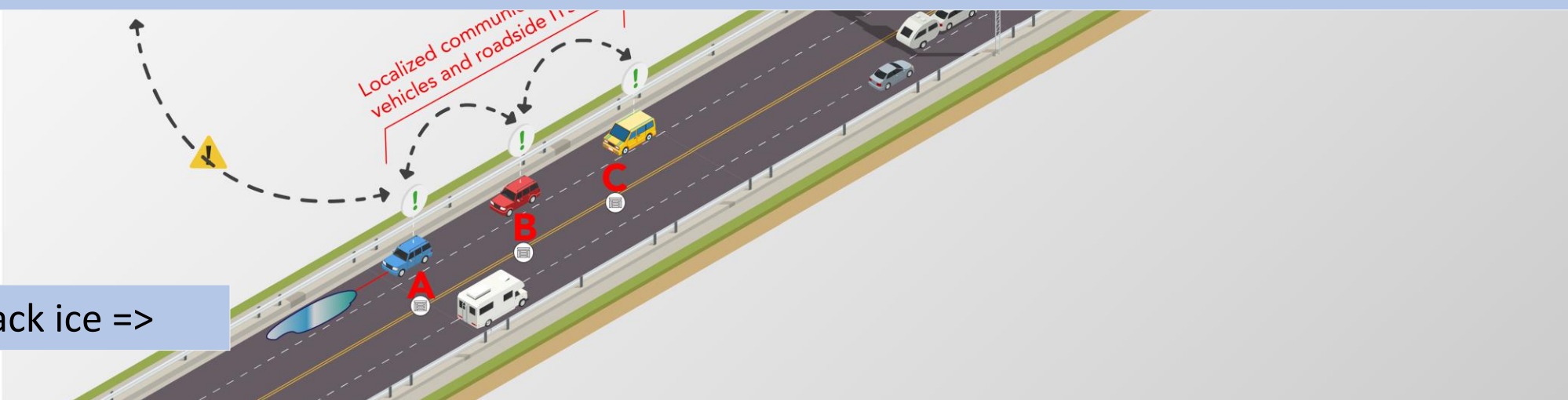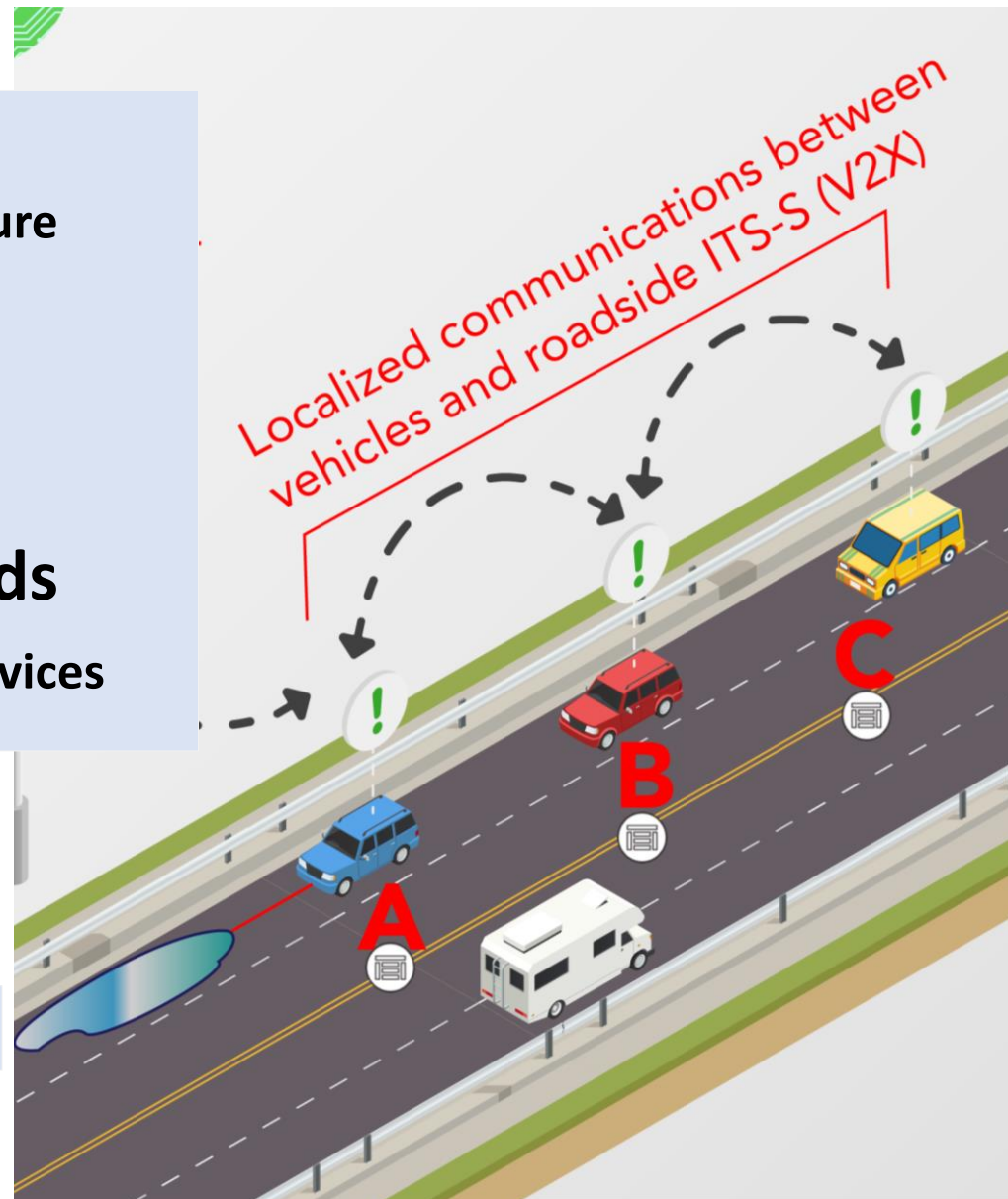
Black ice =>

Localized communications

= communications without telecom infrastructure

V2X = localized communication
between vehicles and roadside infrastructure

What for ?: to report traffic hazards between vehicles = time-critical safety services

Black ice =>

Localized communications between vehicles and roadside ITS-S (V2X)

A

B

C

Traffic Control Center
central ITS-S

Control center to
roadside ITS-S 2

R-ITS-S 2

Localized communications between
vehicles and roadside ITS-S (V2X)

F

E

D
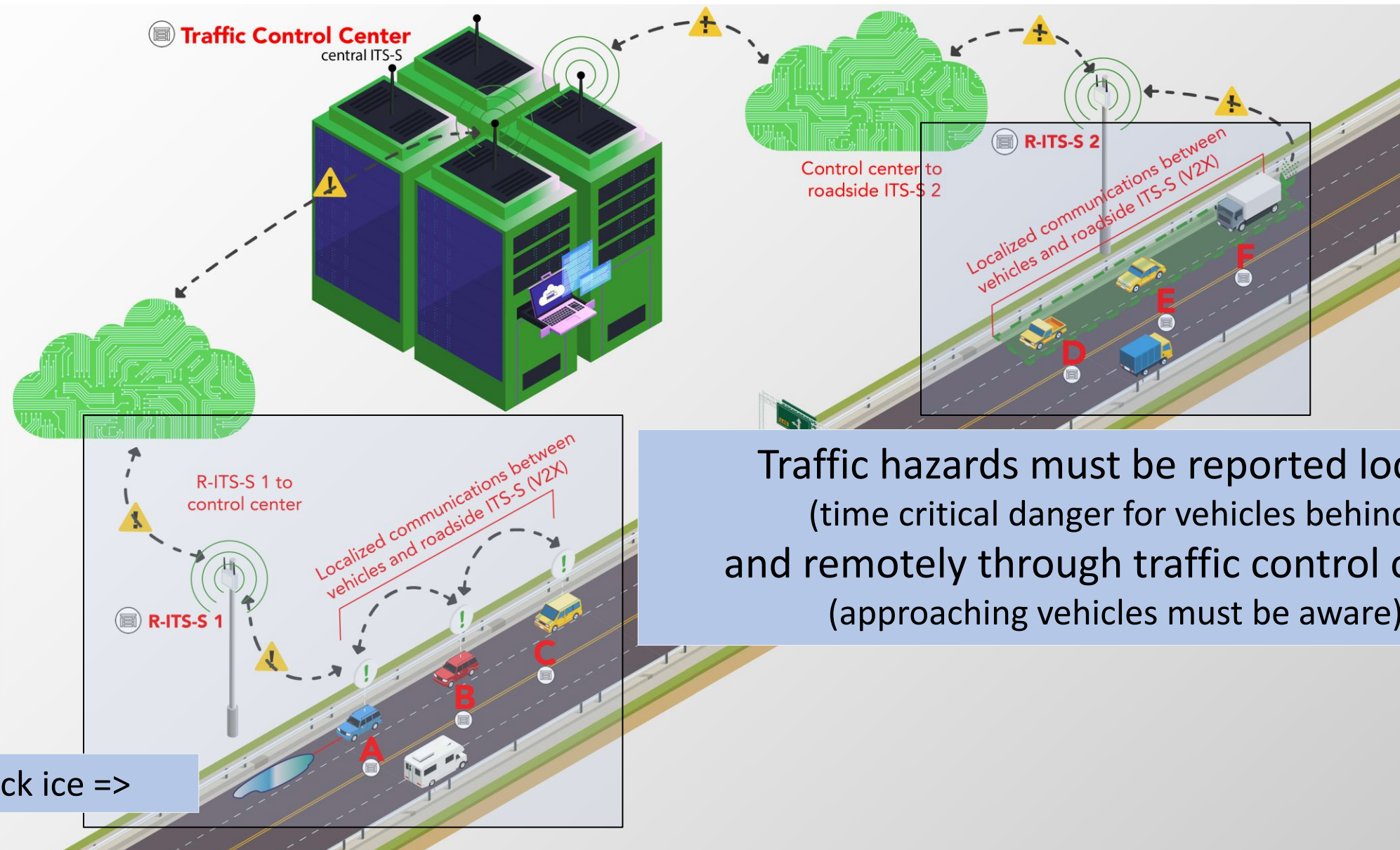
Traffic hazards must be reported locally
(time critical danger for vehicles behind)
and remotely through traffic control center
(approaching vehicles must be aware)

R-ITS-S 1 to
control center

Localized communications between
vehicles and roadside ITS-S (V2X)

R-ITS-S 1

C

B

A

Black ice =>

Traffic Control Center
central ITS-S

Control center to
roadside ITS-S 2

R-ITS-S 2

Localized communications between
vehicles and roadside ITS-S (V2X)

F

E

D

R-ITS-S 1 to
control center

Localized communications between
vehicles and roadside ITS-S (V2X)

R-ITS-S 1

C

B

A

Black ice =>

Approaching vehicles can be informed
using localized communications
from roadside ITS stations connected to the
traffic control center

Traffic Control Center
central ITS-S

Control center to
roadside ITS-S 2

R-ITS-S 2

Localized communications between
vehicles and roadside ITS-S (V2X)

R-ITS-S 1 to
control center

Localized communications between
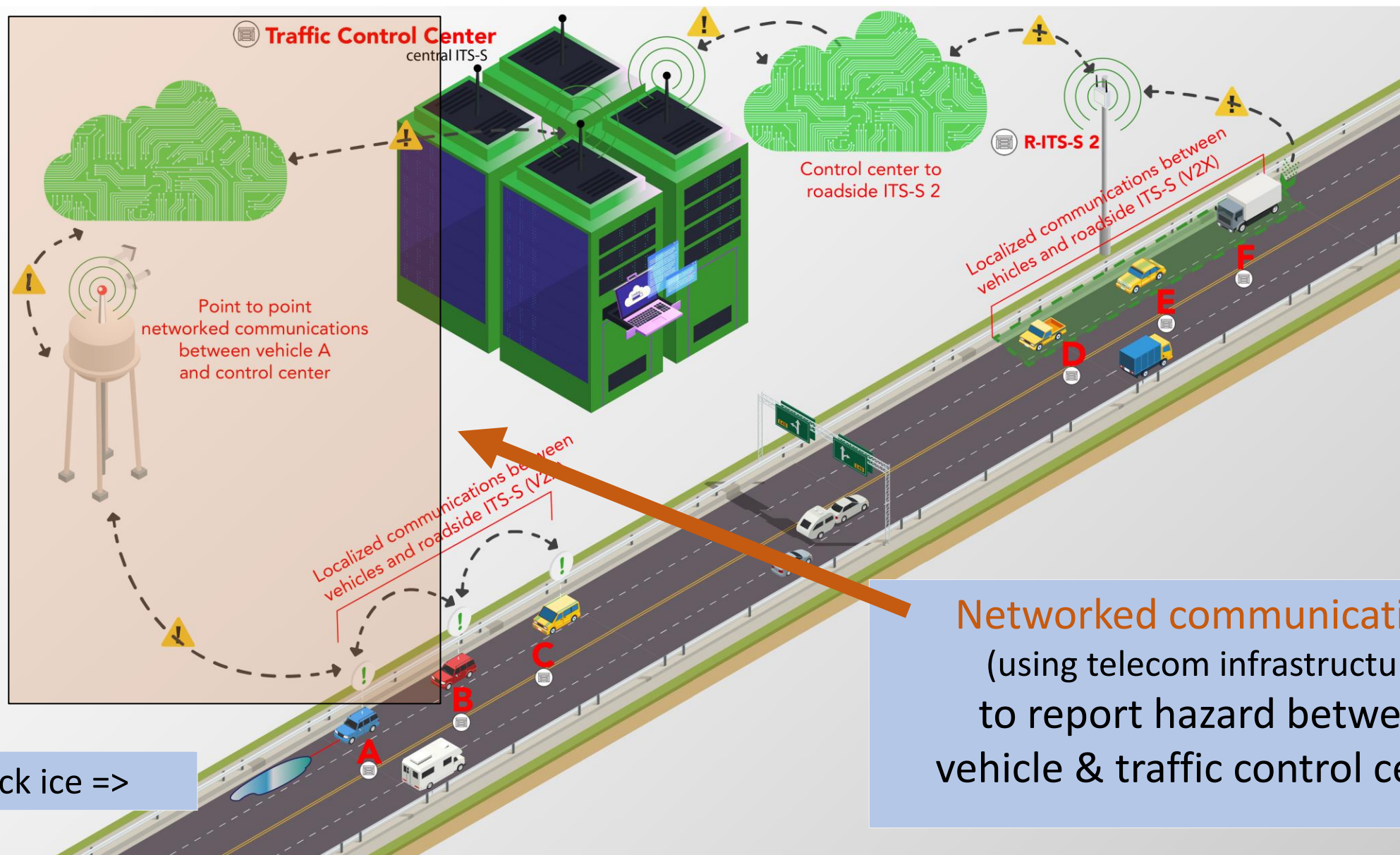vehicles and roadside ITS-S (V2X)

R-ITS-S 1

What if there aren't
roadside ITS stations everywhere ?
(R-ITS-S = RSU)

Black ice =>

C-ITS SERVICES USING HYBRID COMMUNICATIONS TO EXTEND CONNECTIVITY REACH

Traffic Control Center
central ITS-S

Control center to roadside ITS-S 2

R-ITS-S 2

Localized communications between vehicles and roadside ITS-S (V2X)

Point to point networked communications between vehicle A and control center

Localized communications between vehicles and roadside ITS-S (V2X)

Networked communications
(using telecom infrastructure)
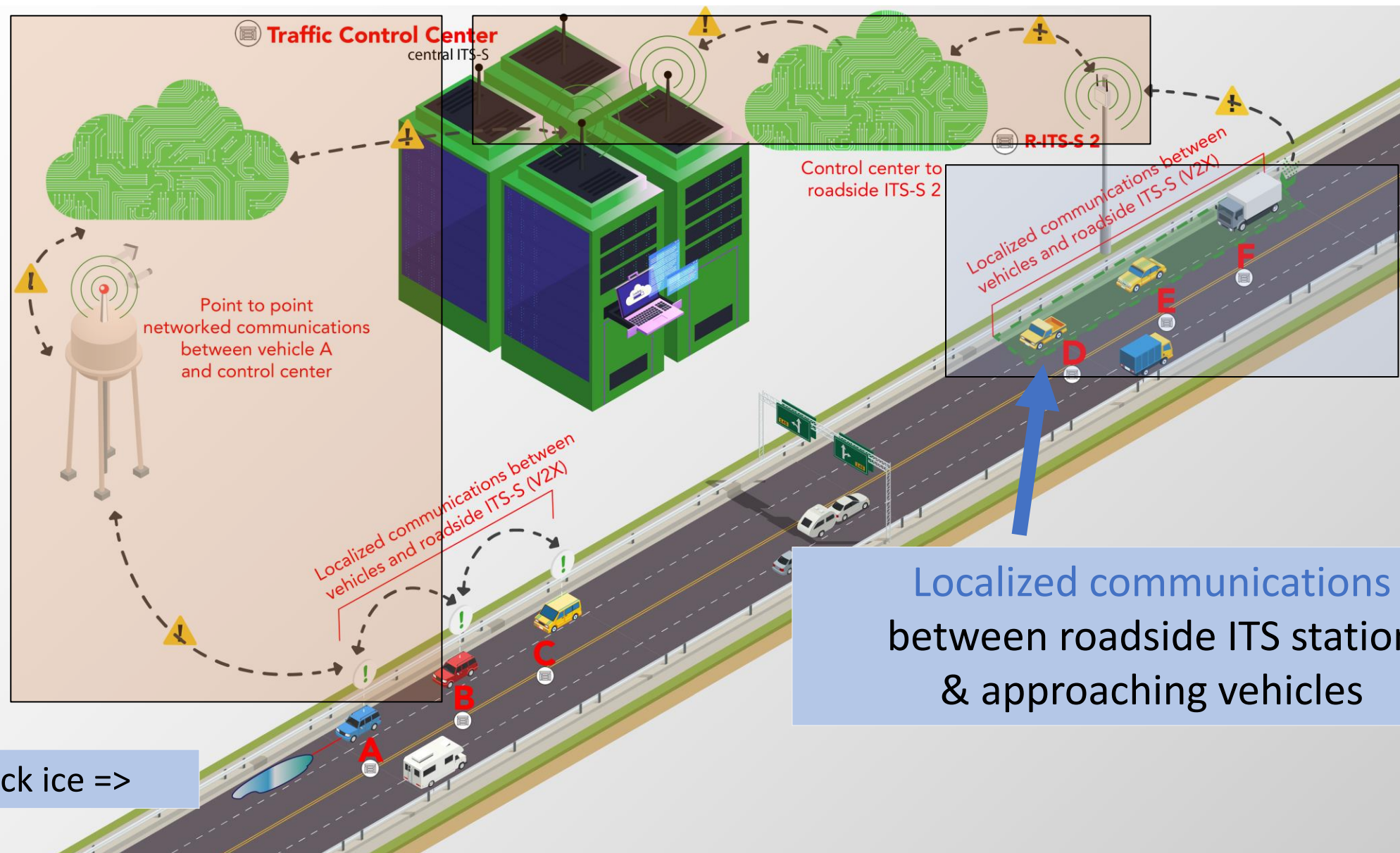to report hazard between
vehicle & traffic control center

Black ice =>

A B C D E F

C-ITS SERVICES USING HYBRID COMMUNICATIONS TO EXTEND CONNECTIVITY REACH

Traffic Control Center
central ITS-S

R-ITS-S 2

Control center to roadside ITS-S 2

Localized communications between vehicles and roadside ITS-S (V2X)

Point to point networked communications between vehicle A and control center

Localized communications between vehicles and roadside ITS-S (V2X)

Networked communications
(using telecom infrastructure)
between traffic control center
& roadside ITS station

Black ice =>

A B C D E F

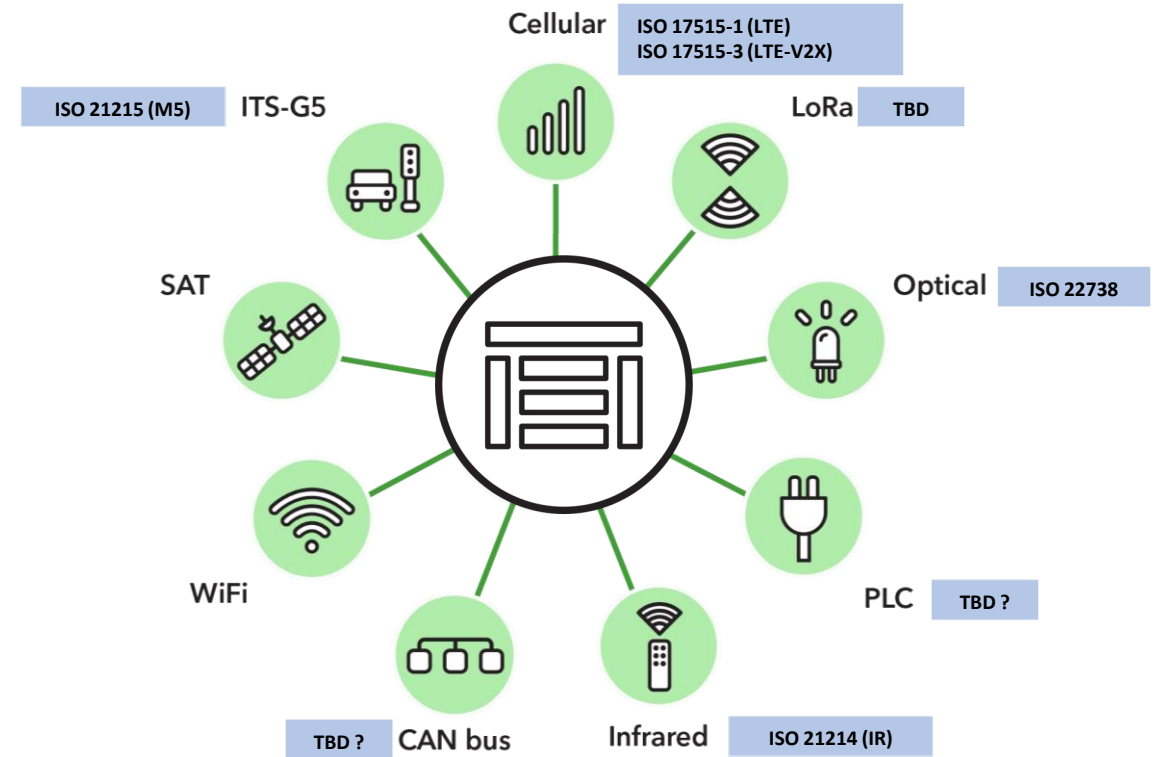C-ITS SERVICES USING HYBRID COMMUNICATIONS TO EXTEND CONNECTIVITY REACH

ITS Station

Functional communication architecture
(ISO 21217 [2020] / ETSI EN 302 665 [2010]

Initially developed by ISO TC204 WG16
- Since 2002
- Proof of concept by CVIS (2006-2010)

ITS station architecture natively supports
hybrid communication technologies
(choice of communication profile)

- Aim: Offer the same C-ITS services everywhere but let everyone make their own deployment choices

- Standardized solution needed to provide interoperability in Europe
  - Design C-ITS services agnostically to access technologies and protocols
  - Choice of methods, protocols and communication profiles

- ISO TC204 / CEN TC278 has developed specifications that can be generally applicable to all regions, for all needs, independently of the underlying access technologies and protocols
  - The set of ISO/CEN standards 21217, 17419, 17423, 17429, 24102, 21184, 21185, 21186, 21176, 21177 together provide a toolkit
  - ISO 24102 series is defining the framework for communication management
  - ISO 17429 is defining the framework for data management
    - Will soon be revised into a multi-part standard is in progress
 - MQTT and/or similar protocols will be added

- **ISO 21186-2 (2020) – Guidelines for hybrid communications support**
- ISO 21217 (2020) – ITS station architecture
- ISO 17419 – Globally unique IDs
- ISO 17423 – Communication requirements
- CEN 17496 – Communication profiles
- ISO 17429 – Enforcement of communication profile (CPH)
- ISO 21177 – Secure sessions between trusted devices
- ISO 24102-6 – Management of hybrid communications
- ISO 21184 – Configuration files for communication profiles

Unified communication architecture

Cooperative ITS standards
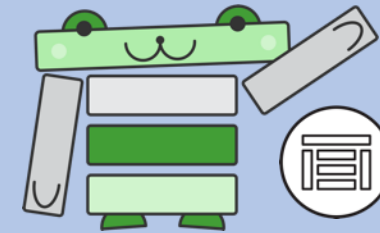
Origins of Cooperative ITS standards

- Proof of concept: European collaborative projects (2006 – 2012): CVIS
- Standardisation mandate M/453 (2006 – 2013) => Cooperative ITS Release 1 (CEN/ISO): http://release1.its-standards.eu
- C-ITS standards in Europe: https://www.itsstandards.eu/highlighted-projects/c-its-secure-communications/
- PT1605: http://its-standards.eu/PTs/PT1605/index.html
- Terminology: Other terms can be found online: https://www.iso.org/obp/ui/#iso:std:iso:21217:ed-2:v1:en
- Freely available guidelines: https://www.itsstandards.eu/app/uploads/sites/14/2020/10/C-ITS-Brochure-2020-FINAL.pdf

For more information

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- Definitions from "ITS station Architecture" – ISO 21217 (2020)
- **Hybrid communications**
  - composition of multiple access technologies and communication protocols combined to provide complementary or redundant communication channels
- **Hybrid communication support**
  - feature of an ITS station used to combine multiple access technologies and protocols
- **Hybrid communication service**
  - ITS service that relies on hybrid communications
- **Localized communication**
  - communications with nearby stations without involving support of an infrastructure network
- **Networked communications**
  - communications using support of an infrastructure network

- Other terms can be found online:
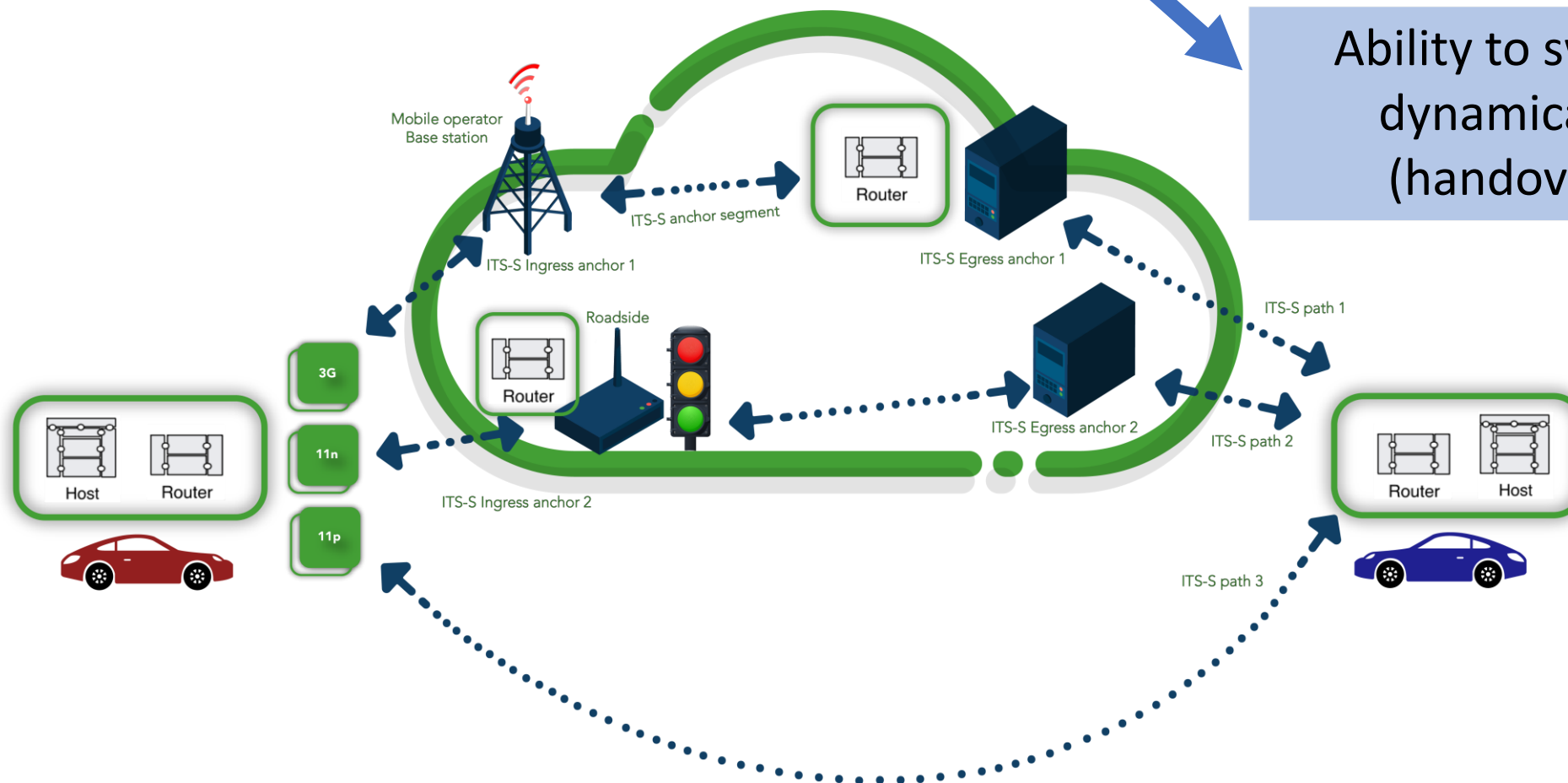 https://www.iso.org/obp/ui/#iso:std:iso:21217:ed-2:v1:en (2014 version)

HYBRID COMMUNICATIONS: COMMUNICATION PROFILE SELECTION

- Communication requirements / flow
- Available technologies and protocols
- Radio access availability

Choice of communication profile

Ability to switch dynamically (handover)

Mobile operator Base station

Router

ITS-S anchor segment

ITS-S Ingress anchor 1

ITS-S Egress anchor 1

Roadside

Router

ITS-S Egress anchor 2

ITS-S path 1

ITS-S path 2

3G

11n

11p

Host   Router

ITS-S Ingress anchor 2

Router   Host

ITS-S path 3

ISO 21217

ISO 17423

ISO 24102-6

ISO 17429

CEN 17496

Table 12 — ITS-SCPS "Secure broadcast of messages with the ETSI ITS-G5 Release 1 stack"

ITS communication protocol		Comments
OID	**Standard reference**	
{iso (1) standard (0) cptd21185 (21185) commProtocol (2) acLayer (1) itsProtocolIdentifier-7 (**7**)}	EN 302 663 V1.2.1 [31]	Localised communications using microwaves at 5,9 GHz in OCB mode with LPD (ITS-G5 Release 1)
{iso (1) standard (0) cptd21185 (21185) commProtocol (2) ntLayer (2) itsProtocolIdentifier-4 (**4**)}	EN 302 636-4-1 V1.3.1 [33]	Geo-location-based communications messaging protocol (GeoNetworking).
{iso (1) standard (0) cptd21185 (21185) commProtocol (2) ntLayer (2) itsProtocolIdentifier-5 (**5**)}	ETSI EN 302 636-5-1 V2.1.1 [34]	Basic Transport Protocol (BTP).
{iso (1) standard (0) cptd21185 (21185) commProtocol (2) scEntity (16) itsProtocolIdentifier-3 (**3**)}	ETSI TS 103 097 V1.3.1 [28]	Security of broadcast of road safety messages in the European Union (signing of messages)

Table 11 — Profile "General secured sessions involving Internet "

ication protocol		Comments
	Standard reference	
ard (0) cptd21185 (21185) commProtocol (2) acLayer (1) itsProtocolIdentifier-1 (**1**)}	none	Any technology providing access to Internet
{iso (1) standard (0) cptd21185 (21185) commProtocol (2) ntLayer (2) itsProtocolIdentifier-3 (**3**)}	ISO 21210 [15]	Internet Protocol version 6 (IPv6)
{iso (1) standard (0) cptd21185 (21185) commProtocol (2) ntLayer (2) itsProtocolIdentifier-7 (**7**)}	RFC 793 [37]	Transmission Control Protocol (TCP)
{iso (1) standard (0) cptd21185 (21185) commProtocol (2) scEntity (16) itsProtocolIdentifier-2 (**2**)}	ISO 21177 [13]	Manages secure sessions