13th ITS EUROPEAN CONGRESS

FULFILLING ITS PROMISES

Brainport Eindhoven, the Netherlands | 3-6 June 2019

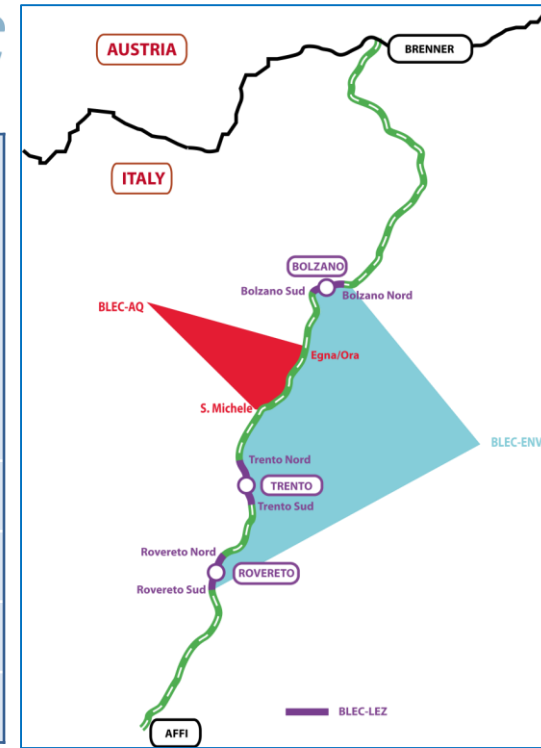**Evoluon Congress Center**
Helmond Automotive Campus

ITS-TP-1846

"About the combination of advanced logics for dynamic VSL activation: an integrated tool to improve traffic flows, control emissions and reduce air pollution"

Roberto Cavaliere, NOI Techpark

The LIFE "BrennerLEC" project

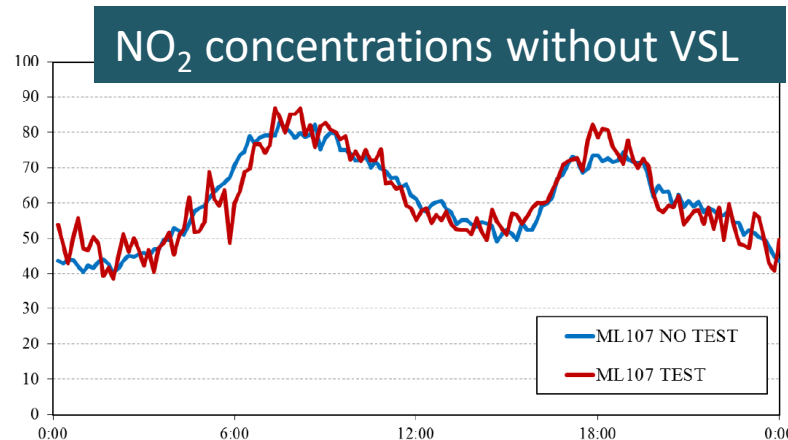| Partners	A22 (coordinator) APPA - Provincia Autonoma di Bolzano APPA - Provincia Autonoma di Trento Università degli Studi di Trento CISMA NOI Techpark (formerly IDM Südtirol / Alto Adige)
Duration	01.09.2016 – 30.04.2021
Overall budget	€ 4.018.005
Eligible budget	€ 3.311.365
LIFE co-financing	€ 1.922.772 (approx. 60% of the eligible budget)

Main objective: develop and demonstrate a **«Low Emissions Corridor»** concept to be applied on the **A22 highway** by means of an **integrated set of traffic control measures** to be activated on the basis of a **proactive logic.**

For more information about the project and first empirical results please refer to BrennerLEC papers at 12th ITS EU Congress 2017 and 25th ITS World Congress 2018.

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First empirical assessment about correlation between traffic, air quality and atmospheric stability

NO$_2$ concentrations without VSL

ML103 NO TEST
ML103 TEST

ML107 NO TEST
ML107 TEST
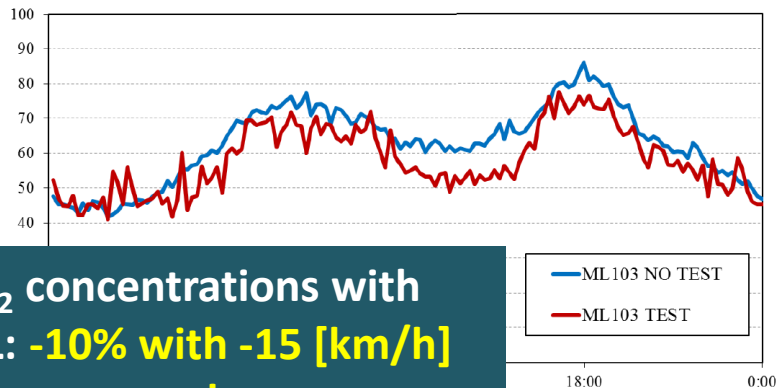
NO$_2$ concentrations with VSL: -10% with -15 [km/h] average speed

NO$_2$ differences between two monitoring sites [μg/m^3]

Vertical air temperature gradient 0 – 50 meters [°C / km]

Class	Γ ≥ 5	-5 ≤ Γ < 5	Γ < -5
N < 500	-	1.1	4.5
500 ≤ N < 1.000	-	2.5	11.2
1.000 ≤ N < 1.500	1.5	11.4	21.3
1.500 ≤ N < 2.000	10.5	13.2	26.5
2.000 ≤ N < 2.500	18.6	18.9	-
2.500 ≤ N < 3.000	13.9	9.0	-
N ≥ 3.000	7.7	10.6	-

Nr. of light vehicles on both carriageways [vehicles / hour]

Most of the benefits with thermal inversion conditions (Γ < -5) and intense (but not saturated!) traffic conditions

Estimation: 75% of the environmental benefit with 45% of the time in which VSL were active

# Logic for dynamic VSL activation triggered by air quality conditions

E.g. monthly NO_2 concentrations at target points

E.g. for exact activation of VSL based on real-time traffic data

Traffic monitoring system

Environmental target & objectives settings

E.g. traffic / atmospheric stability classes for following day

Meteorological / air quality forecasting chain

Traffic thresholds settings update

VSL activation suggestion

DSS

E.g. lower thresholds if thermal inversion conditions forecasted

Air quality / monitoring system

E.g. Can disable VSL activation in case real-time values show different conditions than forecasted
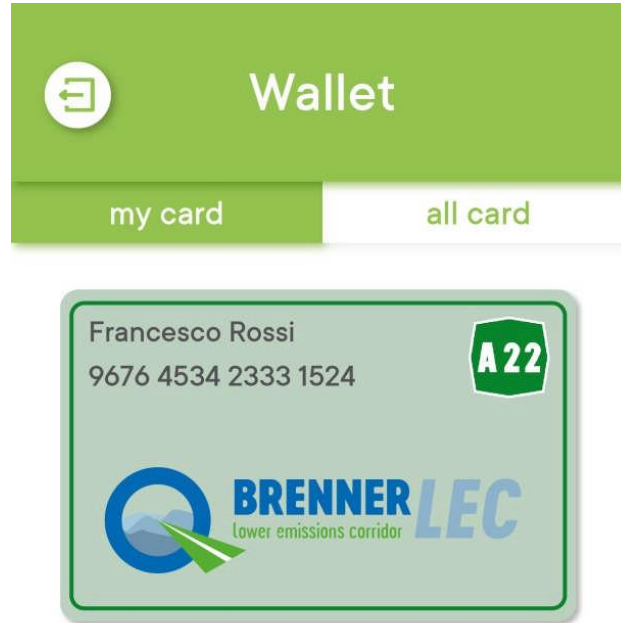
Next testing phase

- Test start scheduled in **06/07-2019**

- **Additional solar flag VMS** to increase the level of information for users

- Also in «**recommended speed**» mode (in particular with low traffic volumes)
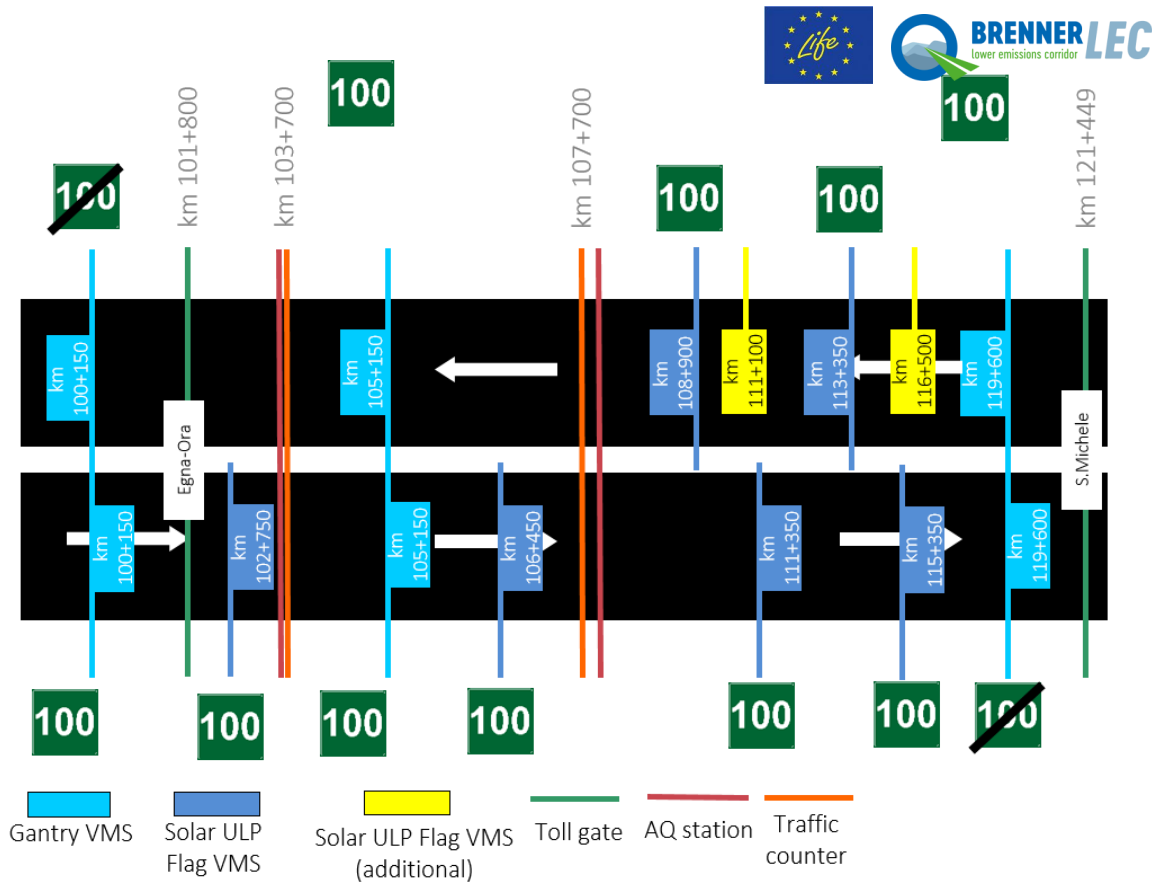
Next testing phase
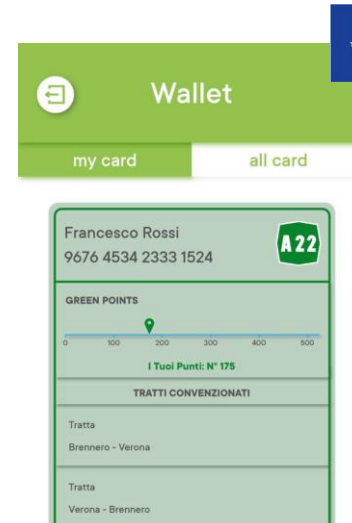
- An **audio-guide gamification app** to motivate people to comply with VSL, based on detailed **GPS tracking** within the test route.

- **Bigger and smaller rewards** (e.g. fuel discounts, e-bikes, etc.) for commuters and occasional users.
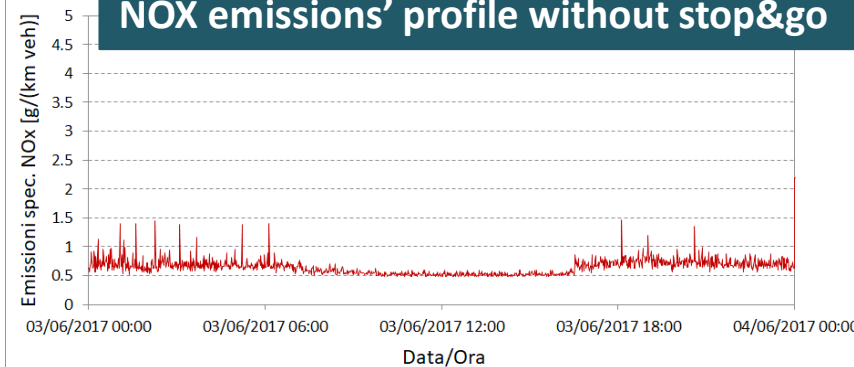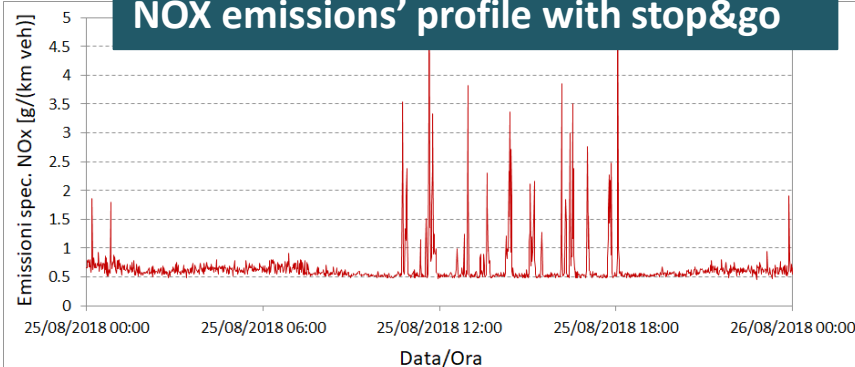
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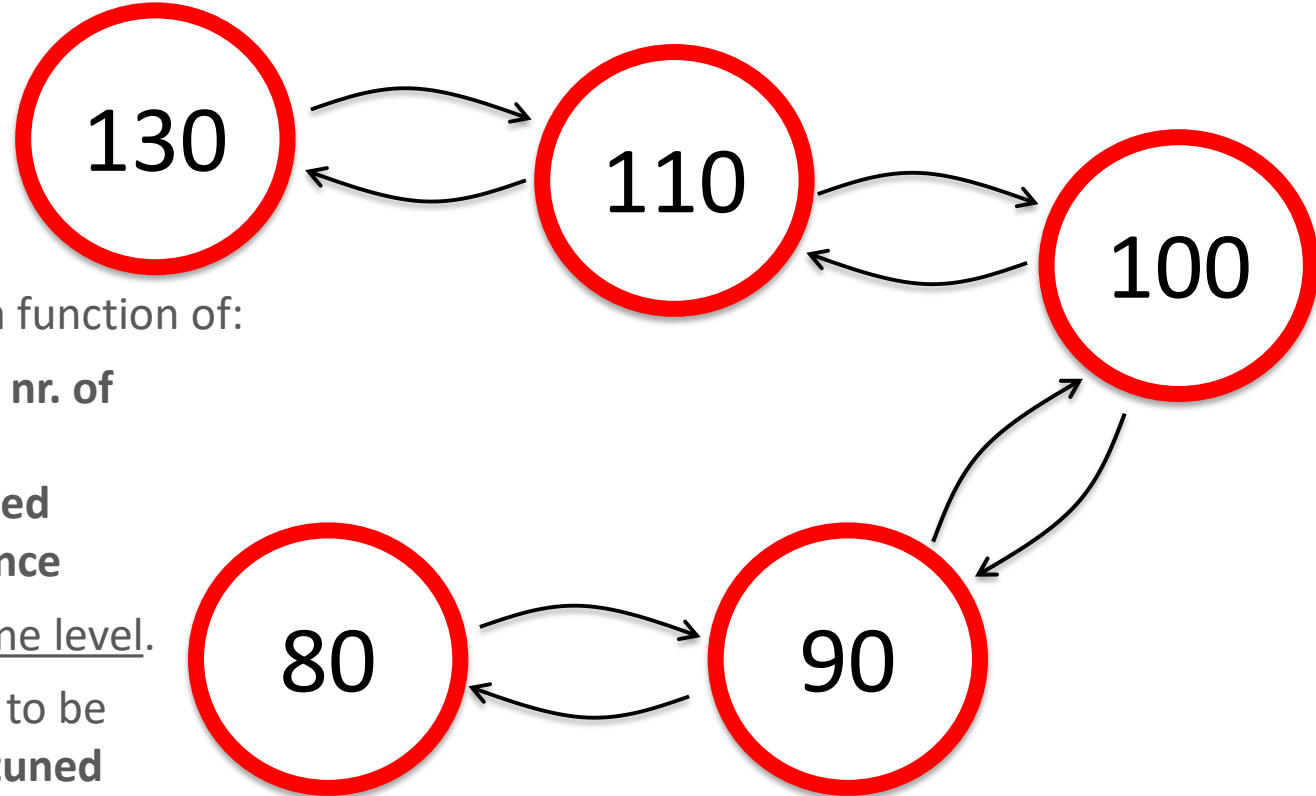# First empirical assessment about emissions' reduction potential associated to stop&go situations (examples)
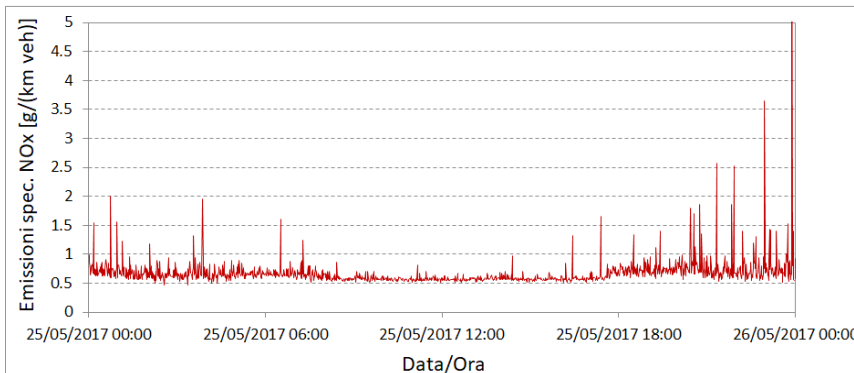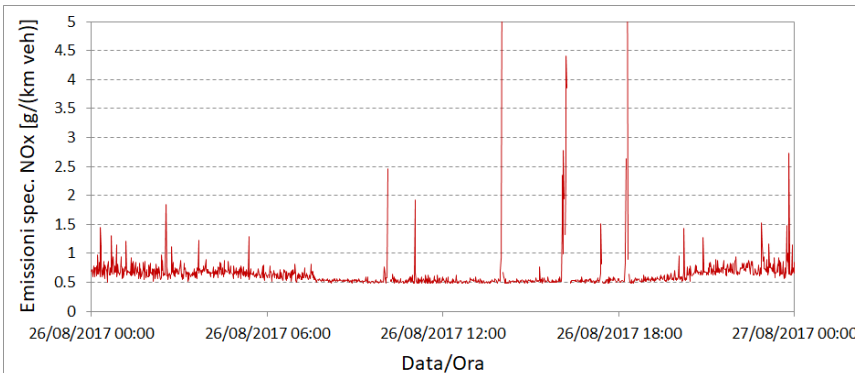
NOX emissions' profile with stop&go

NOX emissions' profile without stop&go

Comparison: +33% [g NOx /km·veh], +17% [g CO_2 /km·veh]
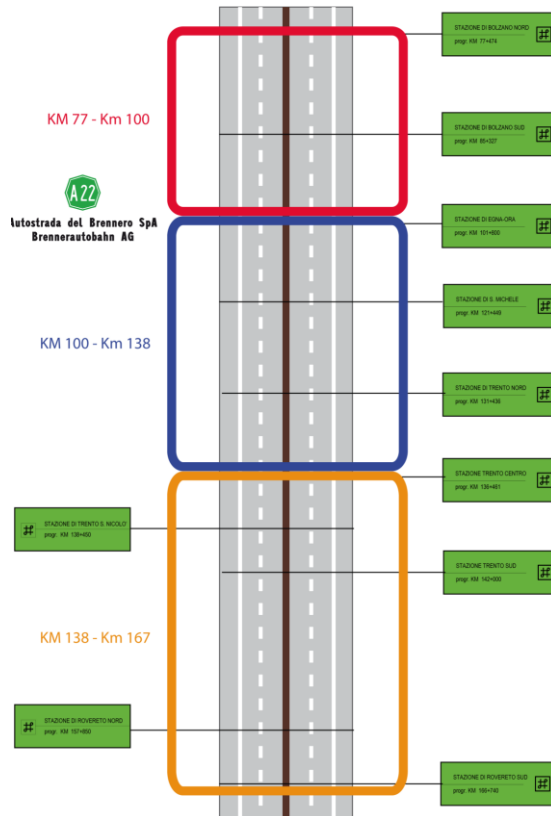
- **State change** as a function of:

  - **(Equivalent) nr. of vehicles**
  - **Average speed**
  - **Speed variance**

  evaluated on a <u>lane level</u>.

- Initial **thresholds** to be **empirically fine-tuned**

130 → 110 → 100 → 90 → 80

Next testing phase

- Test start scheduled in **06/07-2019**

- Only in "**variable speed limit**" mode

- Only in **direction south** (except for central test stretch)

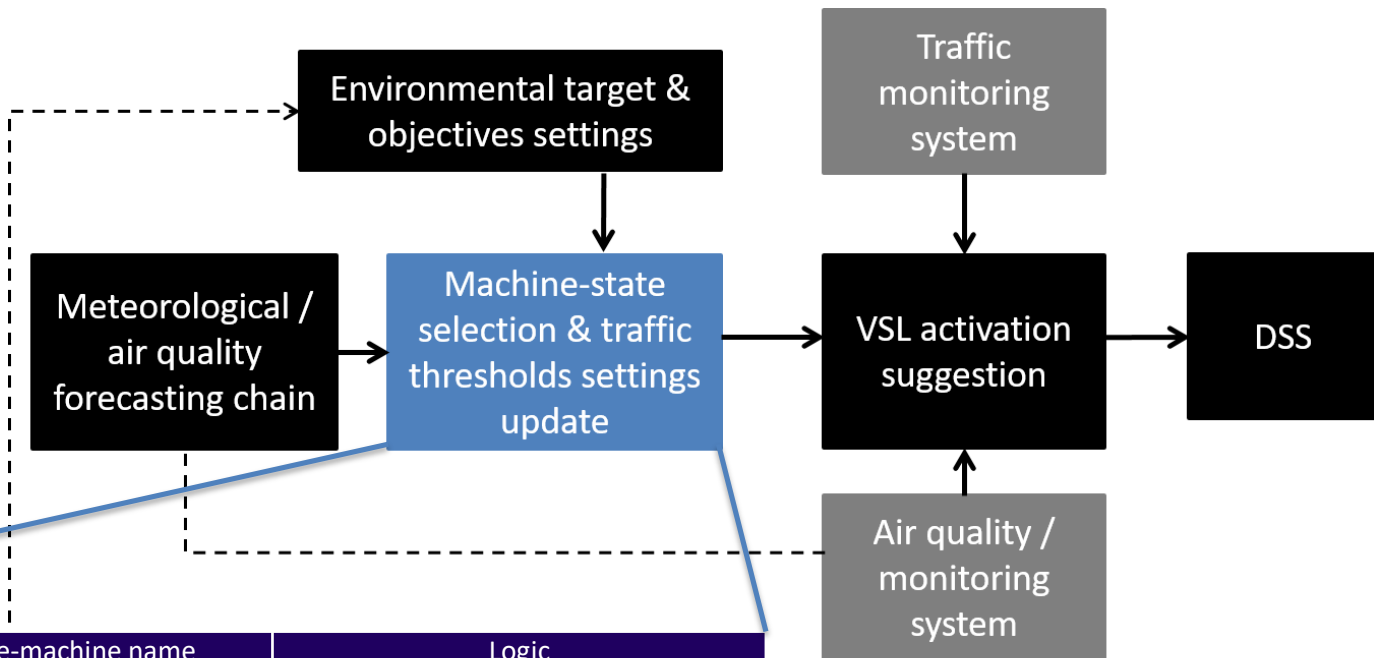- **Southern test stretch**: VSL to be combined with **hard shoulder running (HSR)**

Integrated logic for dynamic VSL activation

One logic, different thresholds for state change depending on **meteorological conditions**

Logic to be empirically tested at project in **central test stretch**, in <u>both direction of travel</u>

Atmospheric stability class	State-machine name	Logic
Γ ≥ 5	"Full-traffic"	130 ⟷ 110 ⟷ 100 ⟷ 90 ⟷ 80
-5 ≤ Γ < 5	"Mix traffic / air quality"	130 ⟷ 110 ⟷ 100 ⟷ 90 ⟷ 80
Γ < -5	"Nearly full-air quality"	130 ⟷ 110 ⟷ 100 ⟷ 90 ⟷ 80

Preparing for the advent of CAVs
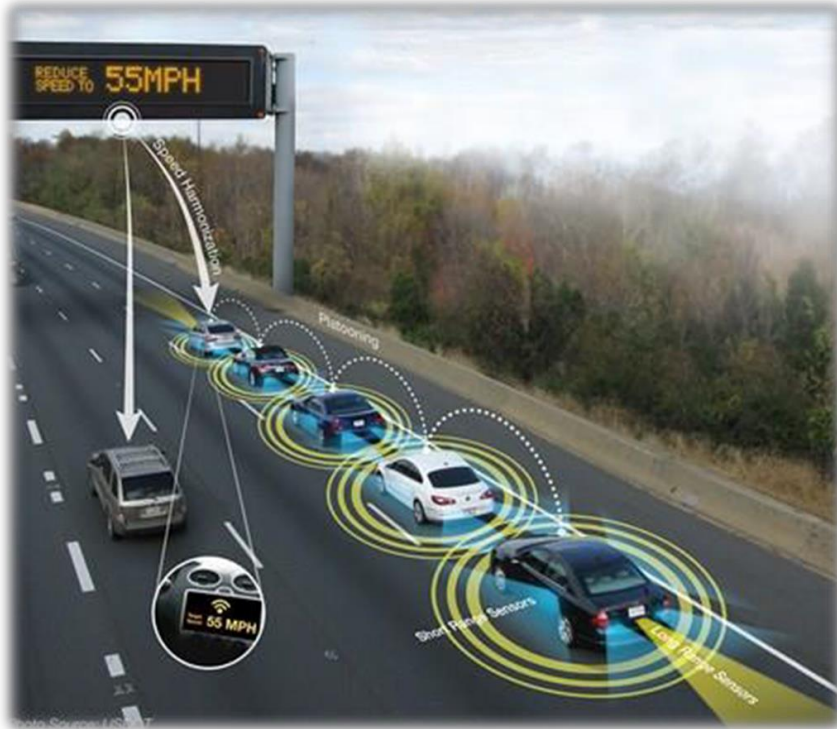
Source: US Department of Transportation

Vision: hybrid C-ITS architecture coupled with novel traffic control measures

Thanks a lot for the attention!

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