

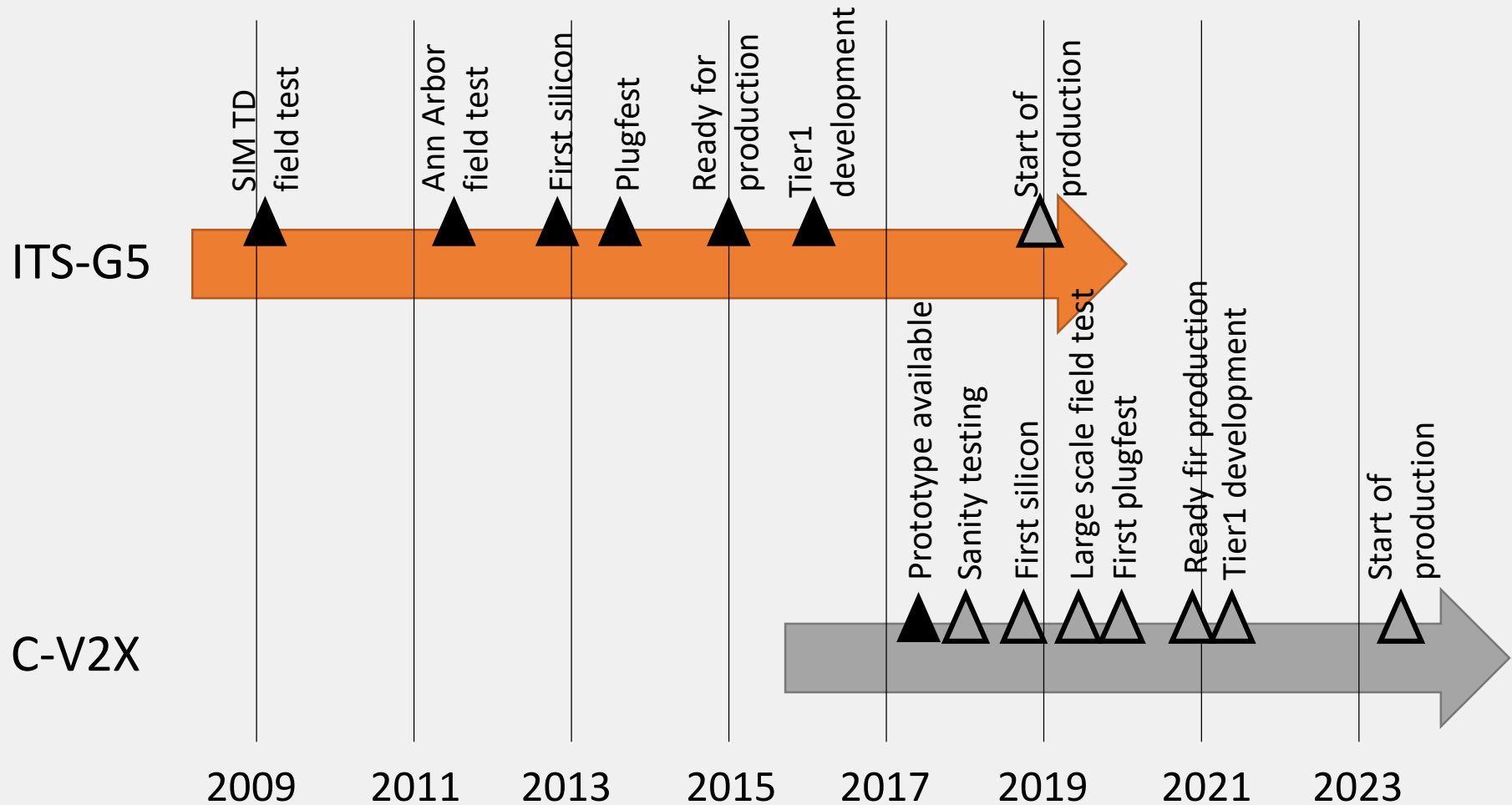


C-ITS Technologies Readiness

Stakeholder workshop, Brussels

February 9th, 2018

ITS-G5 is Heading to Production



Accelerated schedule is assumed for C-V2X

Approval of a safety technology with significant known limitations can't be taken lightly

Safety-Critical Communication: Dice Cannot be Rolled for Saving Lives

- Technology can be promoted only after showing results from large-scale testing, involving different chipsets, at diverse scenarios
 - Testing two vehicles in a controlled environment is not more than a sanity check
 - Results and limitations should be clearly explained to stakeholders
- Safety-critical communication can't occasionally or statistically fail. C-V2X limitations need to be properly addressed, namely:**
 - Clock synchronization problems:** tunnels, urban canyon, cross operator
 - Persistent undetected collisions:** no receive while transmit, far vehicle overshadows important near one, transmit slot collisions (random selection or outdated sensing)
- Promoting untested technology for safety usage is irresponsible**
- Ignoring the known limitations is even worse**



Testing isn't Completed Before Achieving Interoperability and Compliance

- Interoperability and compliance assure all suppliers have identical understanding of the standard
 - Plugfest is a common practice in the industry. C-V2X can't be different, especially considering its high complexity
 - ITS-G5 conducted 5 plugfest events, starting from 2013
 - More than a single plugfest would be needed for C-V2X
- At this time, only a single C-V2X solution is available. **No interoperability** is possible with a single solution. **Compliance tests have not been performed**
 - Pushing non-interoperable solution to market might block other suppliers from bringing compliant solutions later on
 - Potentially this can create a single supplier market – a recipe for unfair and non-competitive market

Testing isn't Completed Before Scalability is Validated

- **ITS-G5 scalability is validated**
- ~4 years of DSRC congestion control development, testing and validation
 - >23 different algorithms were developed [1]
 - Leading algorithms were tested and simulated [2]

200 DSRC vehicles



400 DSRC units

[1] A Survey on How to Solve a Decentralized Congestion Control Problem for Periodic Beacon Broadcast in Vehicular Safety Communications , by Heecheol Song and Hwang Soo Lee

[2] COLLABORATIVE CONNECTED VEHICLE RESEARCH UPDATE, Mike Lukuc, NHTSA Research

Testing isn't Completed Before Scalability is Validated

- Question marks surround C-V2X scalability

How Many Vehicles in the LTE-V2V Awareness Range with Half or Full Duplex Radios?

Alessandro Bazzi, Barbara M. Masini, Alberto Zanella

CNR-IEIIT, Bologna, Italy

Email: {alessandro.bazzi, barbara.masini, alberto.zanella}@ieiit.cnr.it

The results highlight that the number of neighbors supported by LTE-V2V under normal operations with 10 beacons sent per second does not exceed 50-60 with HD radios, which might be an issue in crowded areas under heavy traffic conditions.

- Also, C-V2X defines related metrics and possible mechanisms for congestion control, but vehicles may apply different mechanisms [1]
 - C-V2X should test a single control algorithm and present scalability report

Save Lives Now Using ITS-G5

- **Safety technology** testing is a long and complex process
 - C-V2X scalability, interoperability and compliance must be assured
- **Lives can be saved now using an existing, mature and validated ITS-G5 technology**
- **Why should society wait for an unproven promise?**
 - Especially considering the known limitations of the candidate C-V2X technology (clock synchronization problems, persistent undetected collisions)