MAKING GREENTECH EVs SMART

-By Kislay Pankaj

Talk Summary

- Responsible Innovation
- Why EVs? -Evolution of Smartness in Automobiles
- Categorization of Smartness
- Current State of Smartness in 2W, 4Ws- World and India
- Way forward
- System and Component level Smartness
- Need for Standardization of Interfaces and Protocols

Responsible Innovation

▶ **Ethical**

Socially Driven

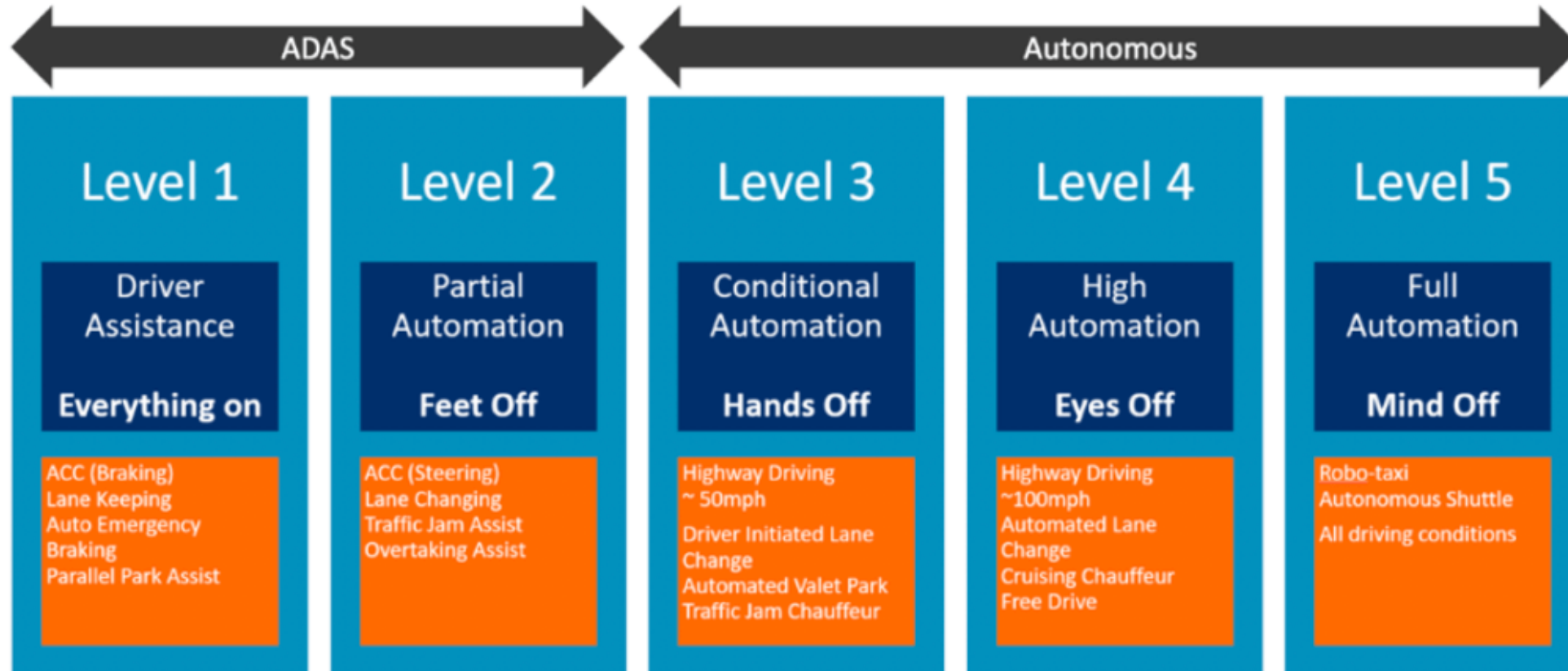**Need of the masses vs Need of the individual**

Sustainable

Why Evs....Evolution of Smartness in Automobiles

- Instant torque
- No transmission Required. Almost
- No idling....No Power loss..Efficient
- Green and Pollution angle
  - Distributed vs Centralized
- Smartness angle
  - Origin from Safety Systems- Human error
    - Brake Assit
    - Cruise control
    - Drag reduction system (DRS). Latest Gran prix
    - Traction control
    - Tesla Example
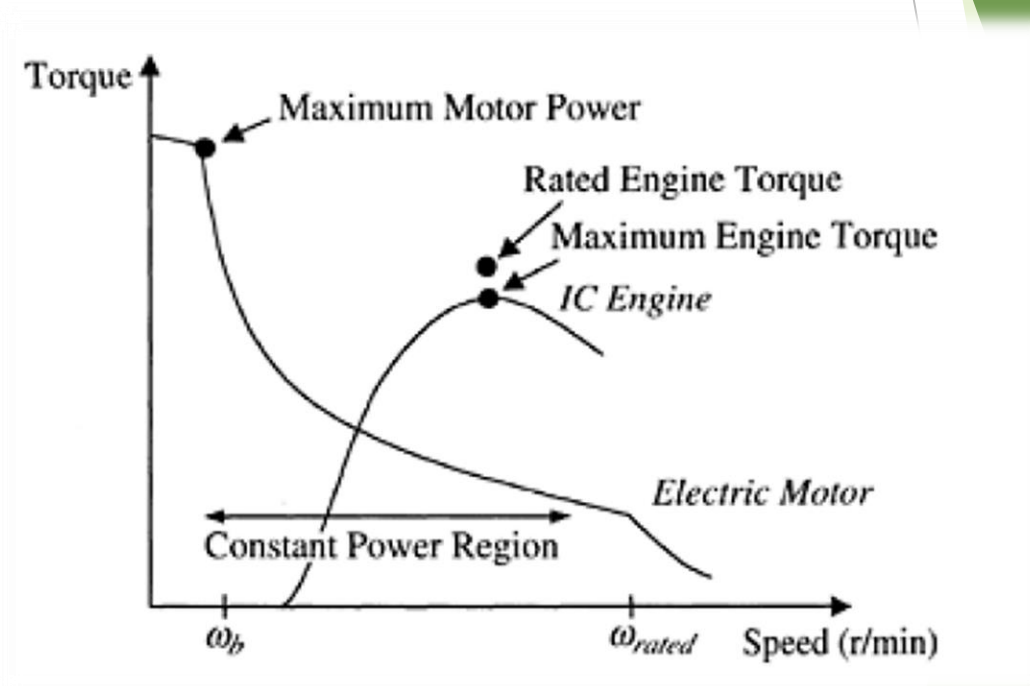
Categorization of Smartness

▶ Digital Mobility: *From the point of view of* **the driver**

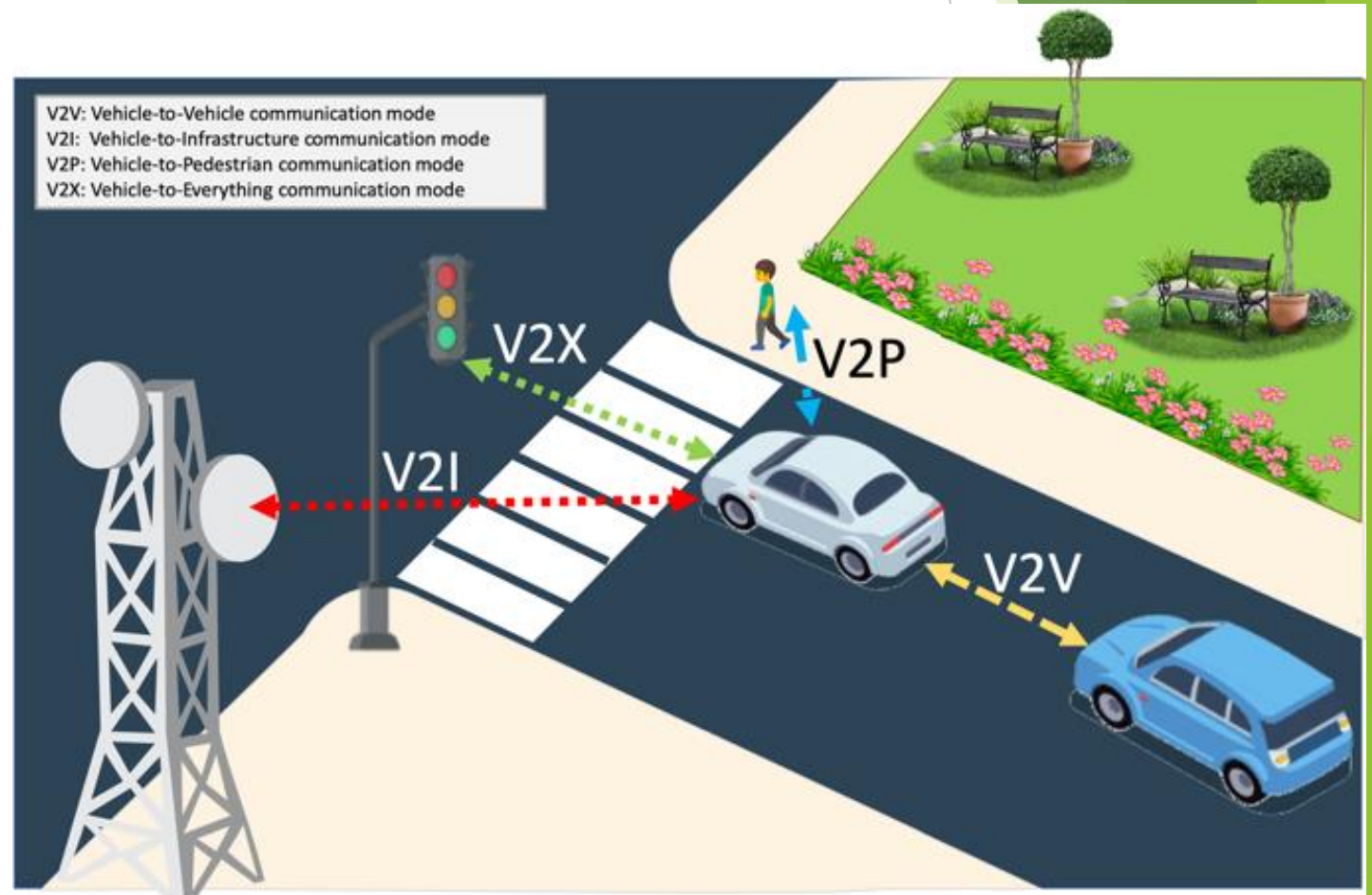 ▶ ADAS (Advanced Driving Support System) and AD (Autonomous Driving)

ADAS		Autonomous		
Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
Driver Assistance	Partial Automation	Conditional Automation	High Automation	Full Automation
Everything on	**Feet Off**	**Hands Off**	**Eyes Off**	**Mind Off**
ACC (Braking) Lane Keeping Auto Emergency Braking Parallel Park Assist	ACC (Steering) Lane Changing Traffic Jam Assist Overtaking Assist	Highway Driving ~ 50mph Driver Initiated Lane Change Automated Valet Park Traffic Jam Chauffeur	Highway Driving ~100mph Automated Lane Change Cruising Chauffeur Free Drive	Robo-taxi Autonomous Shuttle All driving conditions

https://spectrum.ieee.org/transportation/self-driving/accelerating-autonomous-vehicle-technology

Categorization of Smartness

- Digital Mobility: *From the point of view of* **Business**

  - *Business Ops requirements- Ola, Bounce etc.*
    - *GPS location, Keyless entry, Range and Battery swap indication etc.*
    - *Insurance, and second life market*

  - *Vehicle Analytics-*
    - *Preventive maintenance, vehicle status etc.*

  - *Data driven solutions-*
    - *Vehicle and battery life (Digital Twin)*
    - *Vehicle profiling*
    - *Rider profiling and guidance*

Categorization of Smartness

▶ Digital Mobility: *From the point of view of* **Connectivity**

- ▶ *Intra-vehicle communication*
- ▶ *Vehicle to Cloud (V2C)*
- ▶ *Vehicle to Vehicle (V2V)*
- ▶ *Vehicle to Anything (V2X)*

V2V: Vehicle-to-Vehicle communication mode
V2I: Vehicle-to-Infrastructure communication mode
V2P: Vehicle-to-Pedestrian communication mode
V2X: Vehicle-to-Everything communication mode

Current State of Smartness in 2W, 4Ws- World and India

▶ A few Smart Cars around the world- Tesla Roadster, Model X, Model 3, Nissan Leaf, Volvo XC 60, XC 40, Lexus LS

▶ Indian Smart cars??

▶ Smart 2 Wheelers-

  ▶ Ather, Etergo, Gogoro- V2C

▶ Barely connected systems

  ▶ Only battery packs are smart these days (50% pack manufacturers have CAN)

  ▶ Retrofit telematics i.e. GPS, accelerometer

Way forward

- Need smart components
  - Controllers
  - Chargers
  - Motors
  - Dashboard/ Infotainment systems
  - Battery packs
  - Smart Dynamics elements- Tyres, brakes, suspension, steering etc.

- Need for Cloud Infrastructure for Smart vehicles
  - Edge Computing requirements
  - Vehicle analytics
  - Driver analytics
  - Data Visualization
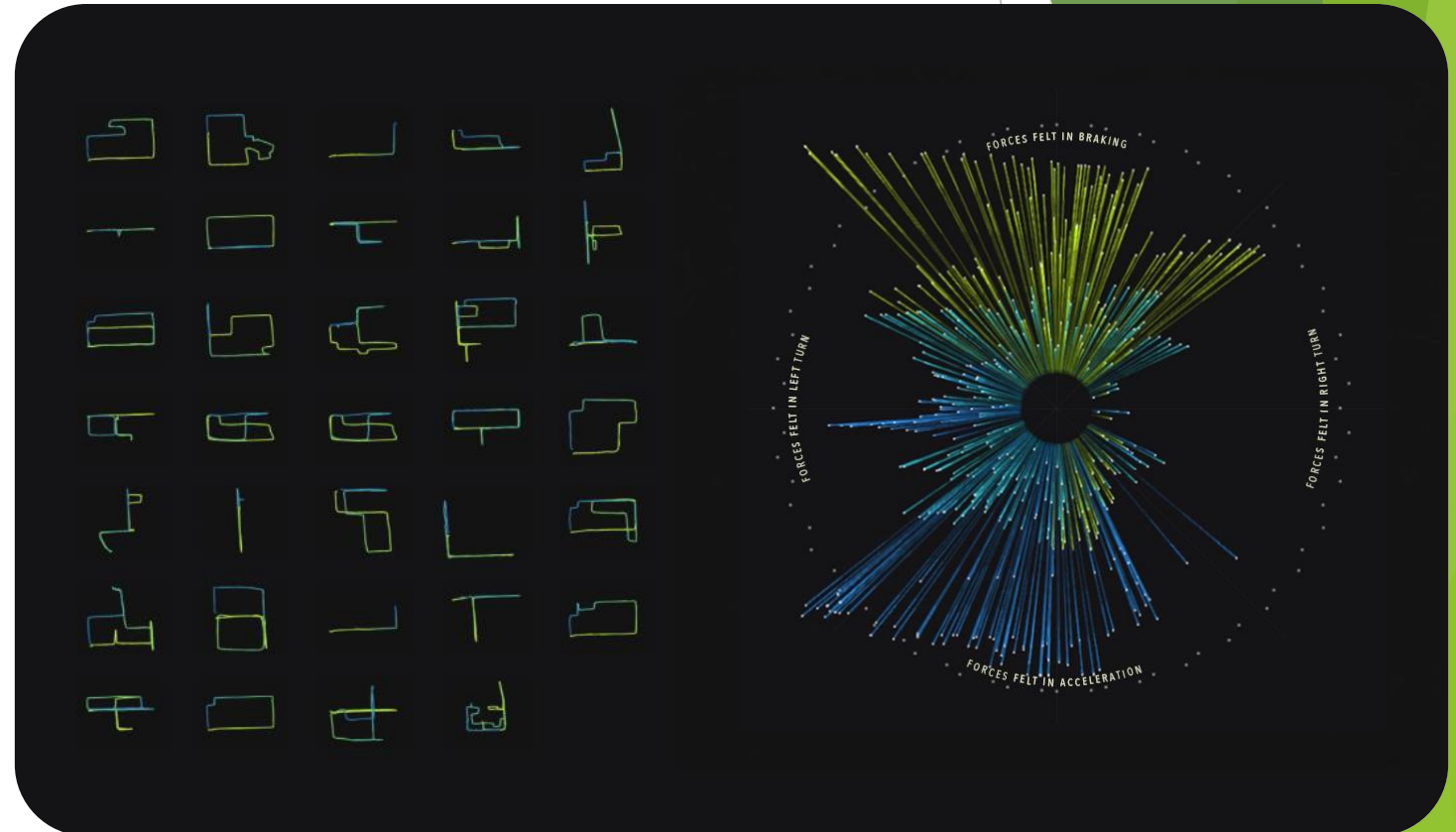
Ather's Data Visualization Example

System and Component level smartness

- Smart motors and drive-
  - Will adjust for efficiency, temperature conditions, drive modes (sports, economy etc.)
  - A smart drive can change the sound and vibration patterns of the vehicle and hence the Feel of the vehicle.
  - Speed control, acceleration control
- Smart chargers-
  - Will improve life of battery.
  - Same chargers can be used for multiple battery packs with different voltages, currents and other params
  - Can use electricity when grid is less loaded.
- Dashboard-
  - Navigation
  - Ride modes
  - DTE- need for accurate prediction ; Getting away from Range anxiety

- Smart Batteries
  - Life cycle optimization
  - Charge and discharge optimization
  - Modularity and parallel operation
  - Easy Swap
- Smart dynamics
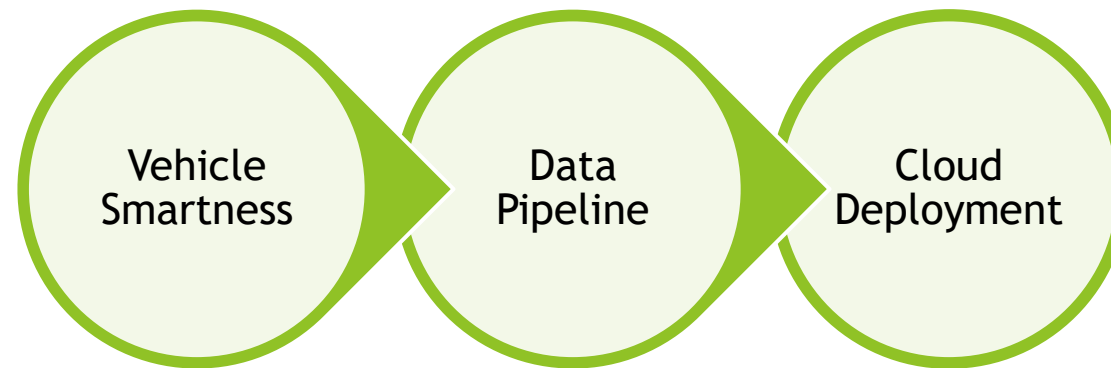 - Comfort settings
  - Brake assist
  - Navigation Haptic feedback
  - Steering control- Cruise or parking etc.
- Peripherals
  - Pollution sensors
  - Pothole and bump sensors
  - Collision control unit
  - Load detection

Need for Standardization of Interfaces and Protocols

▶ If we need to holistically move towards smarter vehicles, then Interfaces needs to be standardized e.g. UPI, GPS, GSM, SMS

Vehicle Smartness ▶ Data Pipeline ▶ Cloud Deployment

Sensor collects Data ▶ Middle Layer filters the data ▶ App layer processes data and packages it for comm. protocols ▶ Application layer send the Data to cloud ▶ Cloud stores the data in DB ▶ Analytics engines does data processing and takes a decision ▶ Data is visualized ▶ Decision are sent back to the vehicle or any other device

Need for Standardization of Interfaces and Protocols

- Standard protocol for communication between vehicle aggregates- CAN, LIN etc.

  - Common Message IDS and architecture
    - Safety Protocols (OTP, OVP, etc.)
    - Operation protocols etc.
  - Data Collection and Data filtering
    - Current, voltage,Temp data, Accelerometer Data etc.
    - EMI EMC noise filtering

Vehicle Smartness

Need for Standardization of Interfaces and Protocols

- Standard protocol for communication between vehicle aggregates- CAN, LIN etc.
  - Device to Cloud communication protocols
    - Security
    - Frequency
    - Language- TCP, HTTP, MQTT, etc.

Data Pipeline

Need for Standardization of Interfaces and Protocols

- Data Storage
- Data Analytics
- Data Visualization
- Building Interfaces- API access for various functionalities

- Need for Holistic product thinking

Cloud Deployment

Thank You

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