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Driver Advocate™ Update

- *A driver assistance system, in four generations, that prioritizes and adapts the presentation of information to the driver--relative to the driving situation and, ultimately, to the driver's workload.*

Goals of the system

- ***GenOne:*** *To mitigate driver distraction by*
  - Presenting information one-at-a-time
  - Using existing data on the vehicle to draw inferences about workload and to use those inferences to orchestrate the prioritization and presentation of information to the driver
- ***GenTwo:*** *To enhance the effectiveness of collision warning and other driver assistance systems*
- ***GenThree:*** *To improve the effectiveness and user acceptance of the first two generations by personalizing Driver Advocate™ to the needs, preferences, and habits of individual drivers.*
- ***GenFour:*** *To manage the hand-off to autonomous vehicle control features.*

Motorola's Approach

- *Simple-minded (Hey, it's who we are!)*
  - First do no harm
    - Design a system that will turn itself off gracefully if there is a sensor, sw, or hw failure
    - Design a system that will not interfere with the basic functioning of the vehicle
    - Do not take control of the vehicle
  - Do what we can safely do now
  - Don't wait until driver modeling is sufficiently developed and tested as a basis for workload management

Brief history of Driver Advocate™

- *We began with a collaboration between the Automotive Group and Motorola Labs*
  - Development and testing in a simulation environment
  - Lots of PowerPoint engineering to socialize the idea
    - With our own management
    - With our OEM customers

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June 2003 Prototype

- *In collaboration with one of our OEM customers, we built a prototype into a vehicle demonstrating:*
  - Handling an incoming cell phone call
  - Maneuver identification and classification
  - A Three-Button-Interface—to handle incoming wireless, navigation and vehicle condition information

Since June 2003

- *Next we developed and demonstrated the ability to retrieve and save voice mail messages*

- *Next we integrated our ViaMoto navigation-on-a-phone into the system*

Present Prototype

- *We have two algorithms working in our prototype.*
  - Expert system—it just makes sense
    - Braking
    - Turning
    - Turn indicators on
    - Gear (Reverse indicates high workload)
  - Classifier quadratic algorithm
    - Based on collected data, of which we need a great deal more

Next Steps

- *We have installed a video system in our vehicle to collect data about the driver and the driving environment.*
- *We are preparing to embark on a research initiative for testing*
  - Usability
  - User acceptance
- *We are continuing the development of GenOne features*

More Next Steps

- *Implementation of new architecture for the system, allowing*
  - Identification of system faults and graceful degradation
  - Calibration by OEM customers
  - Personalization by end users
- *Refinement of our algorithms*

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Challenges

- *Monitoring, in real time, aspects of the driving situation that are not available on the existing data streams:*
  - The roadway environment
  - The driver's activity in the cockpit
  - The vehicle's condition
  - The driver's condition
- *Quantify the driver's level of attention to the driving task*

Not a workload management system yet

- *We know much of what a driver is doing, not what s/he is about to do.*
- *We can make educated guesses about whether the driver has spare capacity, but we don't know for sure.*
- *We can't tell when the driver is experiencing too little workload to maintain alertness.*
- *One-size fits most.*

Challenges

- *Changes through time, e.g., construction zones*
- *Sensor degradation: when is a particular sensor critical, when is it dispensable?*
- *Direct measures of workload difficult*
- *Individual differences*
  - Physical and Cognitive ability
  - Experience (and judgment)
  - Attitude

What do we need to know to advance work in Adaptive Driver Assistance (ADA)?

- *Surrogates of workload*
  - Entropy measures
  - Hand position and pressure
  - Posture
  - Traffic complexity, including presence and location of other traffic, weather & time of day
  - Driving operational indices such as time duration of foot over accelerator or brake, frequency of braking or steering operations

What do we need to know to advance work in ADA?

- *Prototypes of upcoming technologies to incorporate in workload management systems, for development and testing*
  - Crash Avoidance Systems (CAS)
  - Satellite radio
  - SMS and other wireless devices
  - Dedicated Short-range Radio Communication (DSRC)

What research gaps are holding back progress in developing ADA?

- *Consumer acceptance research is vital*
  - Nanny Car or helpful assistant?
  - Snitch or Valued Aid-to-Law-Enforcement?
  - Privacy issues/Big Brother
  - Different strokes
    - Novice/elderly
    - Wo/men
    - Attitudes: aggressive, apprehensive, or addled drivers
    - Good drivers/bad drivers

What research gaps are holding back progress in developing ADA?

- *Large-scale data gathering on the effectiveness of the systems relative to driver performance (for both systems based on maneuver detection and those based on driver modeling)*
  - Reaction time to unexpected events
  - Epidemiological evidence

Lessons Learned

- *Use of existing data streams can help mitigate workload, but cannot predict changes in workload*
- *The "simple-minded" algorithm may be more effective than the quadratic classifier because it is easier for the driver to develop an accurate mental model of it.*

Lessons Learned

- *Compromises are necessary to the one-at-a-time feature*
  - Navigation while in a cell phone call
- *Personalization is important.*
  - One person's high workload situation is another person's walk in the park!
- *The "Simple, but not simplistic" approach is valuable until complex driver models are more comprehensive and tested*
  - Attitudes, mood, skill level, habits, preferences

What are the future directions & issues for adaptive driver assistance?

- *Personalization*
  - CAS parameters
    - Machine learning
  - Driver preferences
    - Wireless access
    - HMI modes
  - Identification of driver's habits for use in the workload classifier

What are the future directions/issues for adaptive driver assistance?

- *Workload testing of new technologies for use by drivers*
  - Telematics
    - Wireless
    - Navigation
    - Infotainment
  - ADAS
  - IVIS

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Thanks for your attention

- *Questions?*
- *Contact information*

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Back-Up Slides

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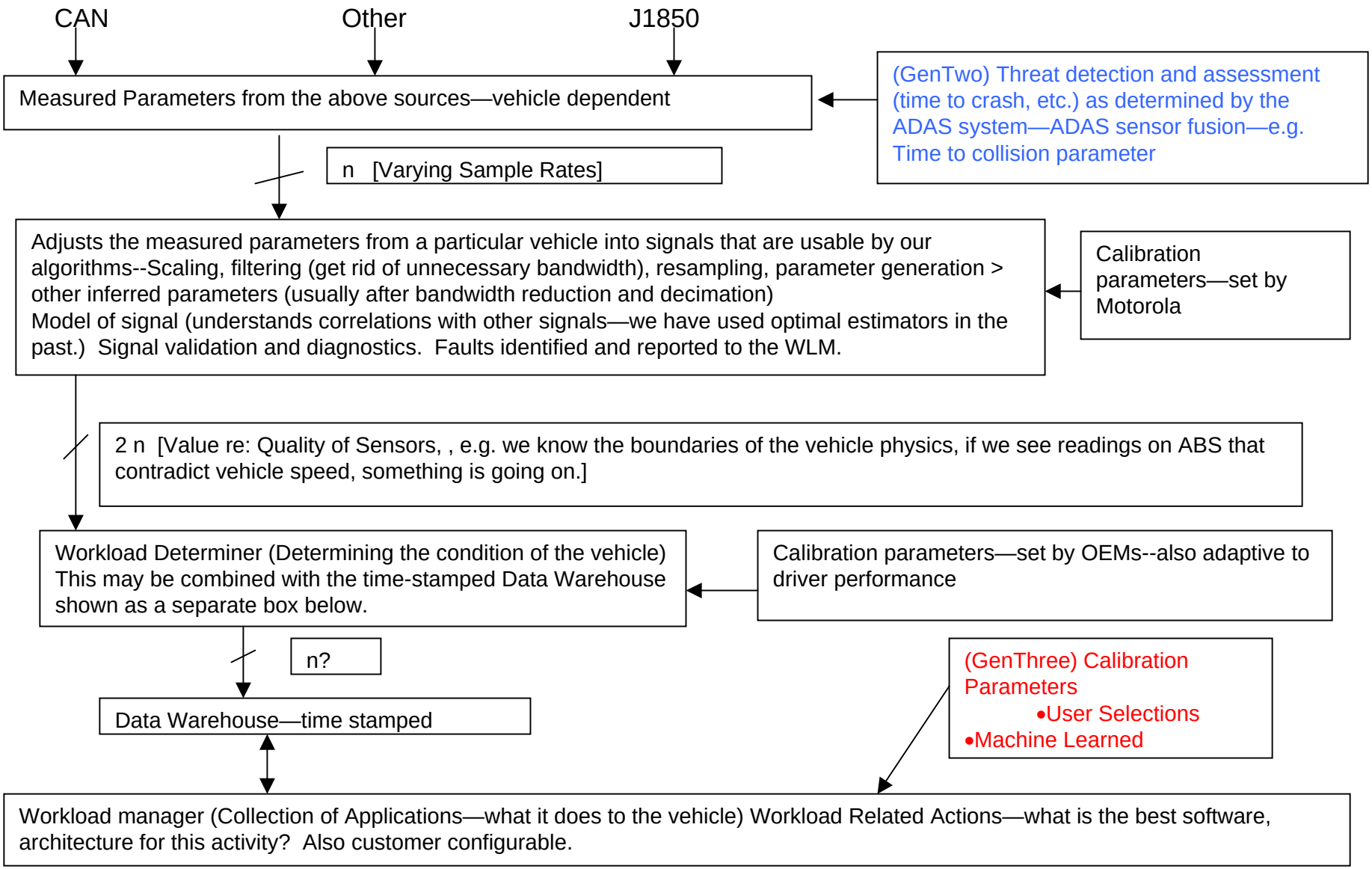
Signal Processing Flow



Three-Button Interface

- *Notify driver when non-safety critical information is available and whether or not it is time-critical*
- *Allow the driver to decide when they are ready to attend to it*
- *Enable the driver to ignore unwanted interruptions*