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Functional Architecture

- Architectural requirements of cognitive automobiles:
  - Distinct levels of information processing with specific temporal resolutions and real-time requirements
  - Extensive information needs by all software modules for subsequent data fusion and verification
  - Combination of algorithms with different approaches

  - Functional overview:

Software Architecture

- Real-time database „KogMo-RTDB“ as integration framework:
  - Central publication of relevant information (raw sensor data, tracked objects, situation and generated behavior)
  - Open access for maximum transparency between all cognitive layers
  - Unified interface also for simulation and situation replay
  - Intuitive API that provides methods to:
    - publish and update own data objects
    - search and retrieve objects from other modules
    - wait for updated data and new objects by others (trigger)
    - coherent view at the situation for slower modules

  - Seamless integration of real-time and non real-time modules
    - Hard real-time for critical control processes
    - No interference from visualisation and logging
    - Lock-less write protocol
    - Dynamic switch to real-time mode to prevent priority inversion

Hardware Architecture

- Selected multicore multiprocessor system provides:
  - Fast computation for image processing
  - I/O bandwidth for image and sensor data acquisition
  - Large memory for knowledge processing
  - Parallel execution of cognitive functions
  - Low latencies for interprocess communication
  - Powerful storage for logging (RAID, Flash)

  - AMD Opteron regarded as „Cluster-in-a-box“:
    - CPUs linked by Hypertransport (3.2·10^8 bytes/s, latency < 1μs)
    - Communication overhead negligible
    - Easy duplication
    - Affordable price
    - Single infrastructure components
    - 160W (2x275HE)

 Experimental Results

- Comprehensive architecture used in several vehicles
- Powerful integration platform for tight cooperation of all cognitive modules

- Measurement results of key operations show:
  - Low overhead
  - Fast response
  - Guaranteed real-time