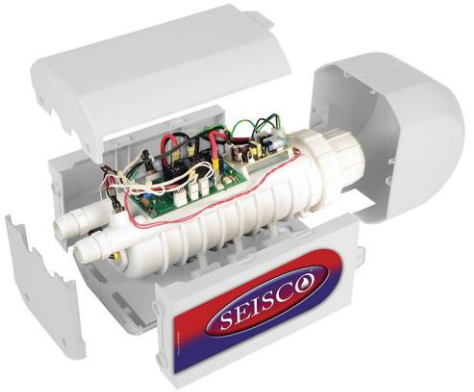
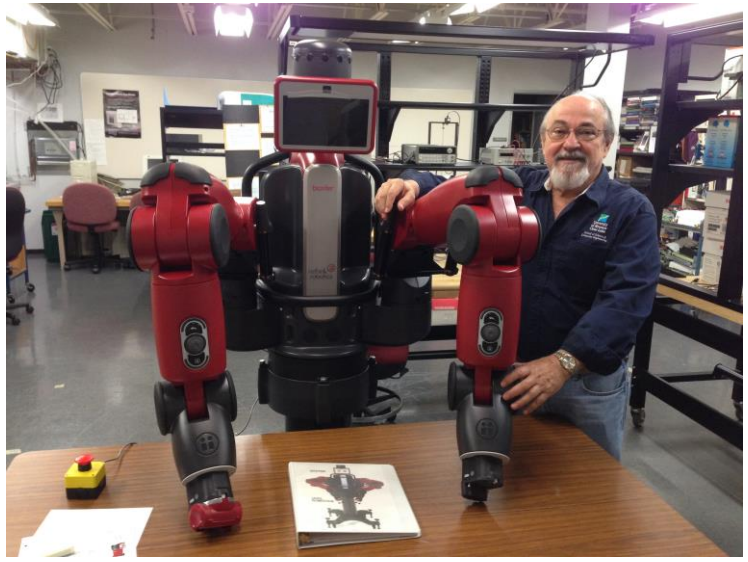


EMBEDDED SYSTEMS

EXAMPLES



An **embedded system** is a controller with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is *embedded* as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. Ninety-eight percent of all microprocessors manufactured are used in embedded systems.

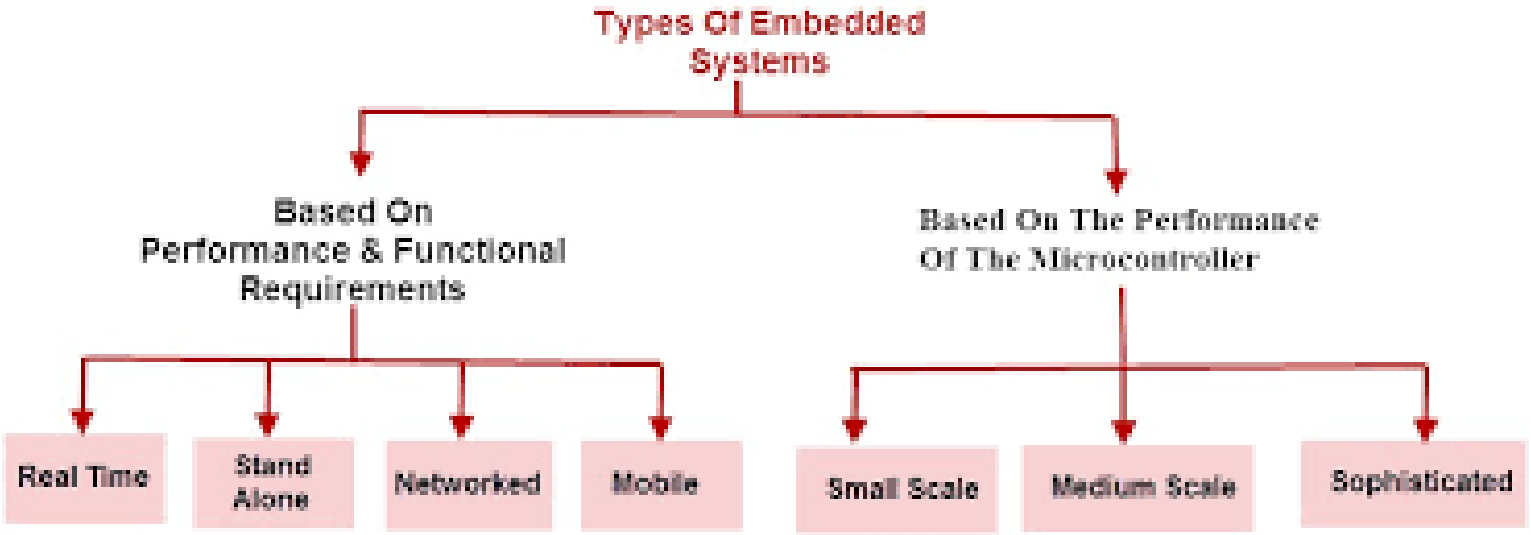
General Purpose Computers and Embedded Systems

A basic distinction

	General Purpose (GP)	Embedded System
Microprocessor-based	√	√
Microprocessor performs instructions on data	√	√
User can access + add + modify data	√	√
User can access + add + modify programs	√	
Examples	PC, workstation, file server, mainframe	Toys, toasters, phones, DVD players, car engines, cameras, medical devices
Share of microprocessors manufactured	1%	99%

A **cyber-physical** (also styled **cyberphysical**) **system** (**CPS**) is a mechanism that is controlled or monitored by computer-based algorithms, tightly integrated with the Internet and its users.

In cyber-physical systems, physical and software components are deeply intertwined, each operating on different spatial and temporal scales, exhibiting multiple and distinct behavioral modalities, and interacting with each other in a lot of ways that change with context.[Examples of CPS include smart grid, autonomous automobile systems, medical monitoring, process control systems, robotics systems, and automatic pilot avionics.[2]


Types Of Embedded Systems
Based On Performance & Functional Requirements
Based On The Performance Of The Microcontroller
Real Time
Stand Alone
Networked
Mobile
Small Scale
Medium Scale
Sophisticated

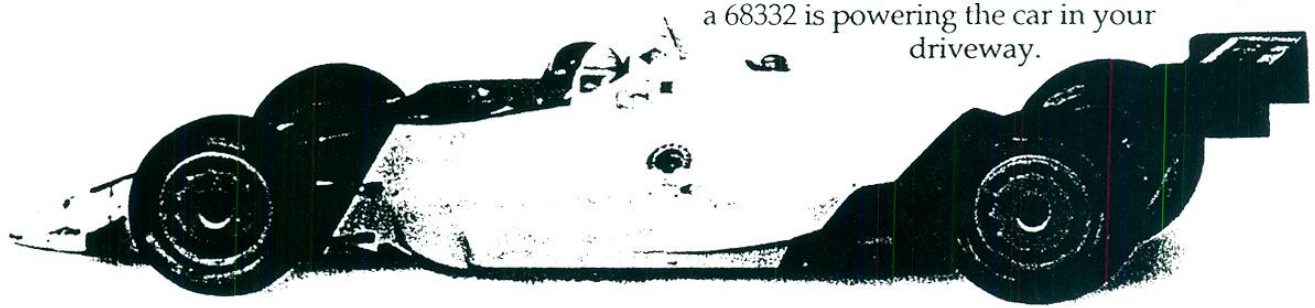
A FEW EXAMPLE AREAS

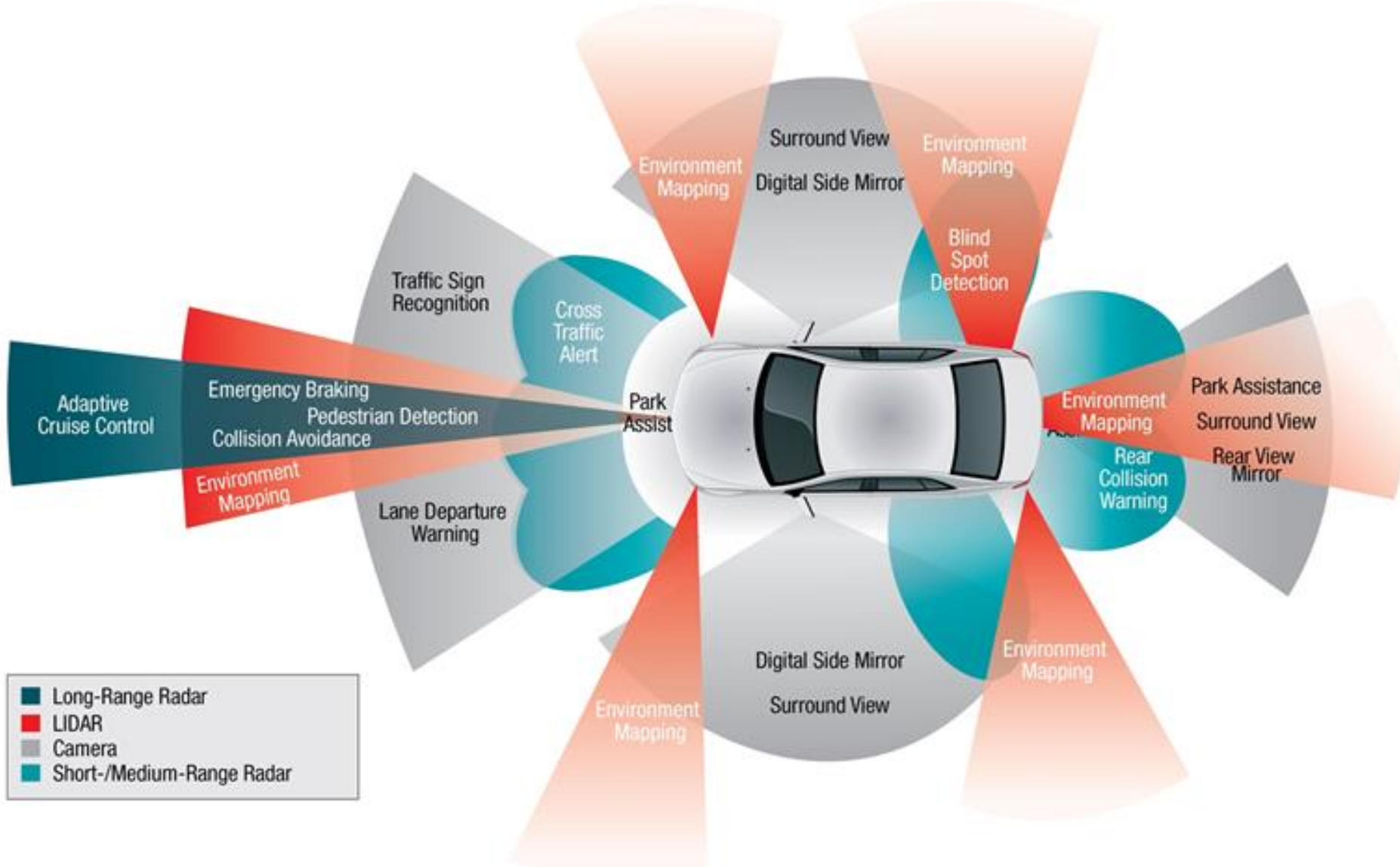
- **AUTOS**
- **MEDICAL**
- **HOME PRODUCTS**
- **IOT/WIRELESS**
- **ROBOTICS**
- **ENERGY MANAGEMENT/MOTOR CONTROL**

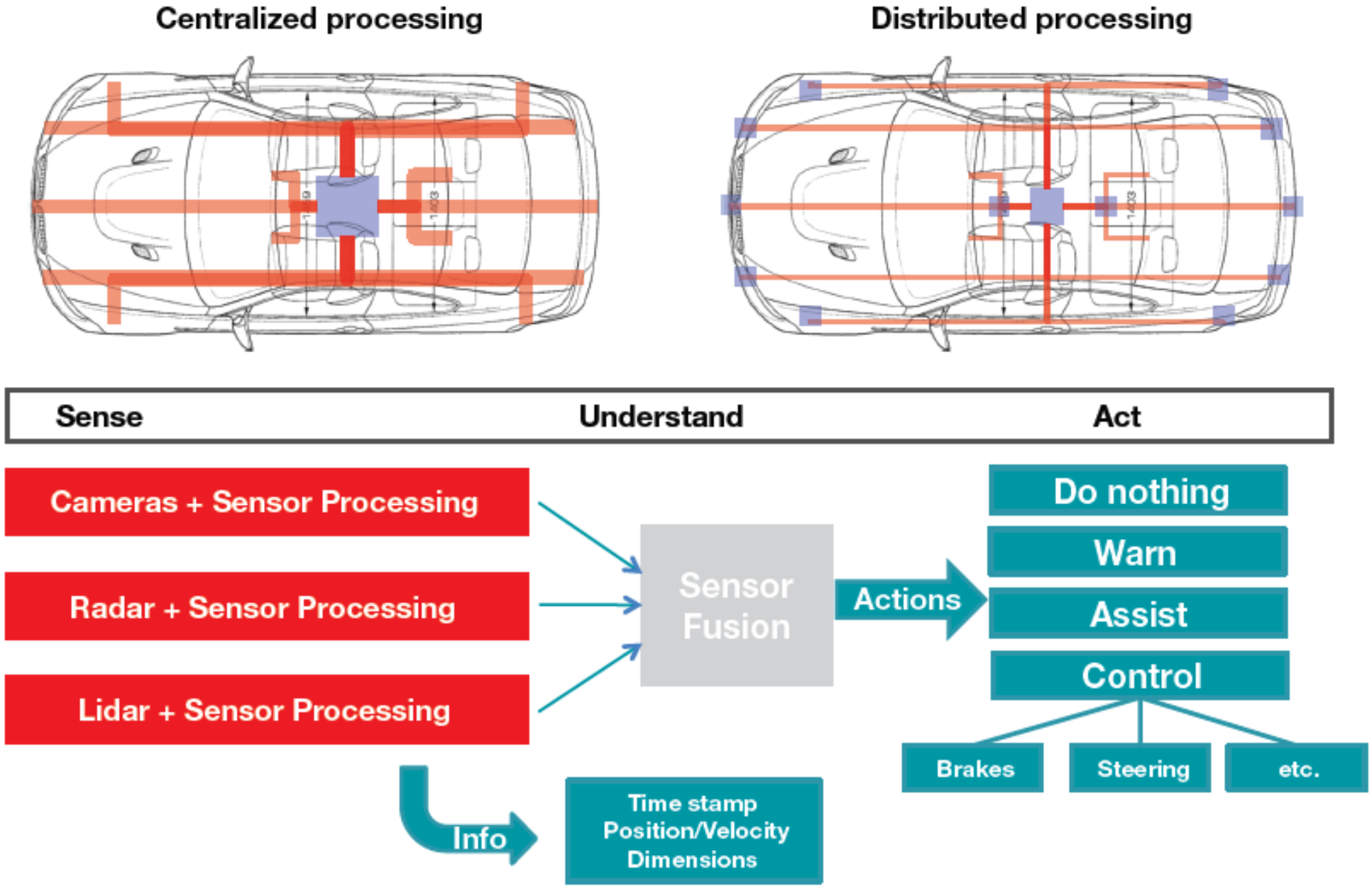
68332

Motorola Powers Winning Indianapolis 500 Car

The month of May brought the annual Indianapolis 500 speed race and simultaneously it brought another one of Motorola's microcontrollers to the winner's circle. The winning car for the fifth year in a row was a Chevrolet with its engine control module powered by Motorola's 32-bit 68332 microcontroller. Recently, it was announced that Delco Electronics Corporation (Kokomo, Ind.) has developed a new engine control module, GEN-IV, that offers a 45 percent space savings over its predecessor. Integration was the key to Delco's next-generation engine control and its solution was the 68332 microcontroller. The 68332 serves as the brain in the unit and controls critical engine functions. Use of the new GEN-IV engine control module allows Indy 500 cars to use fuel more effectively, control the temperature range more accurately and deliver better mapping of the entire system to the driver. Racing is a preferred testbed for electronics usage in cars, so it won't be long until a 68332 is powering the car in your driveway.




Adaptive Cruise Control
Emergency Braking
Pedestrian Detection
Collision Avoidance
Environment Mapping
Traffic Sign Recognition
Lane Departure Warning
Cross Traffic Alert
Park Assist
Environment Mapping
Surround View
Digital Side Mirror
Blind Spot Detection
Environment Mapping
Environment Mapping
Rear Collision Warning
Park Assistance
Surround View
Rear View Mirror
Digital Side Mirror
Surround View
Environment Mapping
Environment Mapping
Long-Range Radar
LIDAR
Camera
Short-/Medium-Range Radar



TI

Figure 1. Sensor fusion technology

What's All This About a **Computer** In My Car?

Oxygen Sensor/EGO Sensor
Measures the percentage of oxygen in the exhaust, and tells the computer whether the fuel/air mixture is too lean or too rich.

Crankshaft or Camshaft Position Sensor/CPS
Monitors the rotation of the engine and tells the computer exactly when to trigger the fuel injectors or the ignition spark.

Ignition Wires
Carries the spark voltage to the spark plugs. Faulty wires can drain off the voltage to the spark plug and cause misfiring.

Mass Air Flow Sensor/MAF Sensor
Measures the amount of air drawn through the engine's air intake, so the computer can compensate for altitude and temperature.

MAP Sensor/BAP Sensor
Reads changes in barometric (air) pressure. The ECM uses this information to adjust timing advance and air/fuel ratio.

Distributor Cap/Rotor
Routes the ignition coil's output voltage to the correct spark plug. A faulty cap or rotor will cause the engine to misfire or refuse to start.

Detonation Sensor/Knock Sensor
Listens for engine "ping" so the ECM can retard the spark timing, and thereby reduce emissions and overheating, if the engine is knocking.

Ignition Coil
Convert's the car battery's 12 volts to the thousands of volts needed to fire the spark plugs.

Air Pump Check Valve
One-way valve that prevents hot exhaust gases from recalculating back through the air pump, protecting the air bypass system.

Fuel Pump
Feeds fuel from the gastank to the carburetor or fuel injection system. Most fuel-injected cars have electric fuel pumps.

EGR Valve Position Sensor
Detects the opening of the EGR valve, so the ECM can make adjustments to optimize performance.

EGR Valve
Recalculates a measured amount of exhaust gas into the engine's air intake, to lower combustion temperatures and reduce emissions, especially NOx.

Air Cleaner Temperature Sensor
Prevents cold outside air from entering the air intake until the engine warms up. This limits emissions and improves cold-engine performance.

Mixture Control Solenoid
Used on computer-controlled carburetors. Controls the blend of air and fuel to produce the needed amount of power and minimize emissions.

Control Module/Igniter
Regulates and times the spark signal to the ignition coil, for correct ignition without misfiring.

Throttle Position Sensor/TPS
Monitors the position of the accelerator pedal and the throttle linkage, so the ECM can make accurate air/fuel mixture adjustments.

PCV Valve/Positive Crankcase Ventilation Valve
Recalculates partially-burned gases from the crankcase to the combustion chamber, to improve economy and reduce emissions while preventing buildup of sludge and corrosion.

Idle Speed Control Actuator
Adjusts idle speed as dictated by the ECM, to prevent idle fluctuations and keep emissions low.

Ported Vacuum Switch
Senses engine temperature, and opens or closes vacuum lines to various emissions-related components.

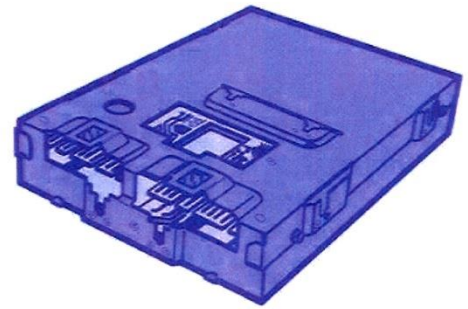
Coolant Temperature Sensor/CTS
Measures the temperature in the cooling system, so the ECM can make adjustments based on the engine's operating temperature. Can also control the dashboard warning light.

Voltage Regulator
Controls the voltage supplied to the car's electrical system, preventing overcharge, undercharge and damage to

Fuel Injector
Injects fuel into the intake manifold. The ECM tells the injector exactly when to inject, and how much to inject, to produce the needed amount of power.

electrical computers

Breather Element
Filters out contaminants from the crankcase gases that are being drawn into the intake system throughout the PCV Valve.



Computer/ECM
Controls spark timing, fuel delivery and emission controls. Continuously receives signals from sensors and input devices on or near the engine; sends control signals to valves, controllers and other output devices. Stores "trouble codes" and warns driver when service is needed.

Home || About Us || Price Quote Info || How to Kill a Cat || A Computer In My Car? || Warranty Info || Payment Policy || Core & Return Policy || Break-in and Installation Instructions || NAPA On-Line || E-mail Us

AMERICAN & IMPORT ENGINES
AMERICAN & IMPORT ENGINES

(530) 222-2550
Fax (530) 222-4810
Toll-Free 1-800-227-2844

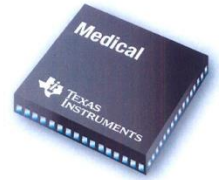
1301 E. CYPRESS AVE. #1
REDDING CA. 96002
E-Mail: engines@c-zone.net

https://microcontrollerslab.com/embedded-systems-applications-automobiles/?fbclid=IwAR21cRIsbklseSQOj8iiqg-zzKeb3KGAiDPxwS6tLMMApJdnAbQcc_qlQSU

Usually, the embedded systems used in vehicle include
- Airbags
- Drive by wire
- Adaptive cruise control
- Anti-lock braking system
- Telematics
- Automatic parking
- Satellite radio
- Tyre pressure monitor
- Traction control
- In-vehicle entertainment system
- Navigational Systems
- Night vision
- Backup collision sensors
- Heads up display
- Emission control
- Climate control

OK

Medical Applications Guide



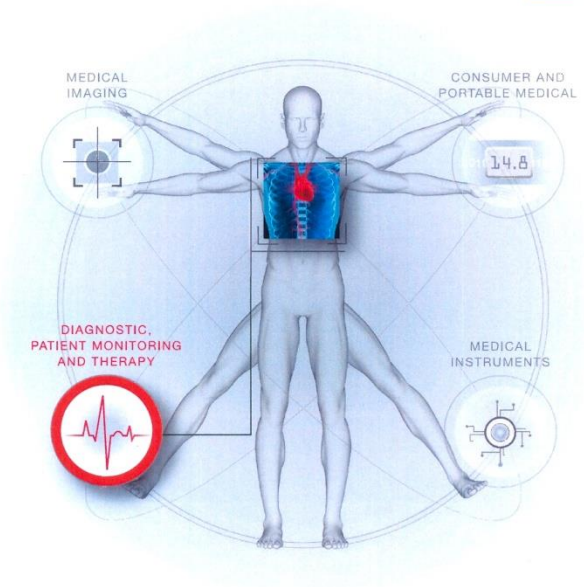
Texas Instruments

Diagnostic, Patient Monitoring and Therapy

- Digital Stethoscopes
- Patient Monitoring
- ECG and EEG
- Pulse Oximetry
- Ventilation
- CPAP
- Dialysis Machine
- Infusion Pump
- AED

Continua HEALTH ALLIANCE

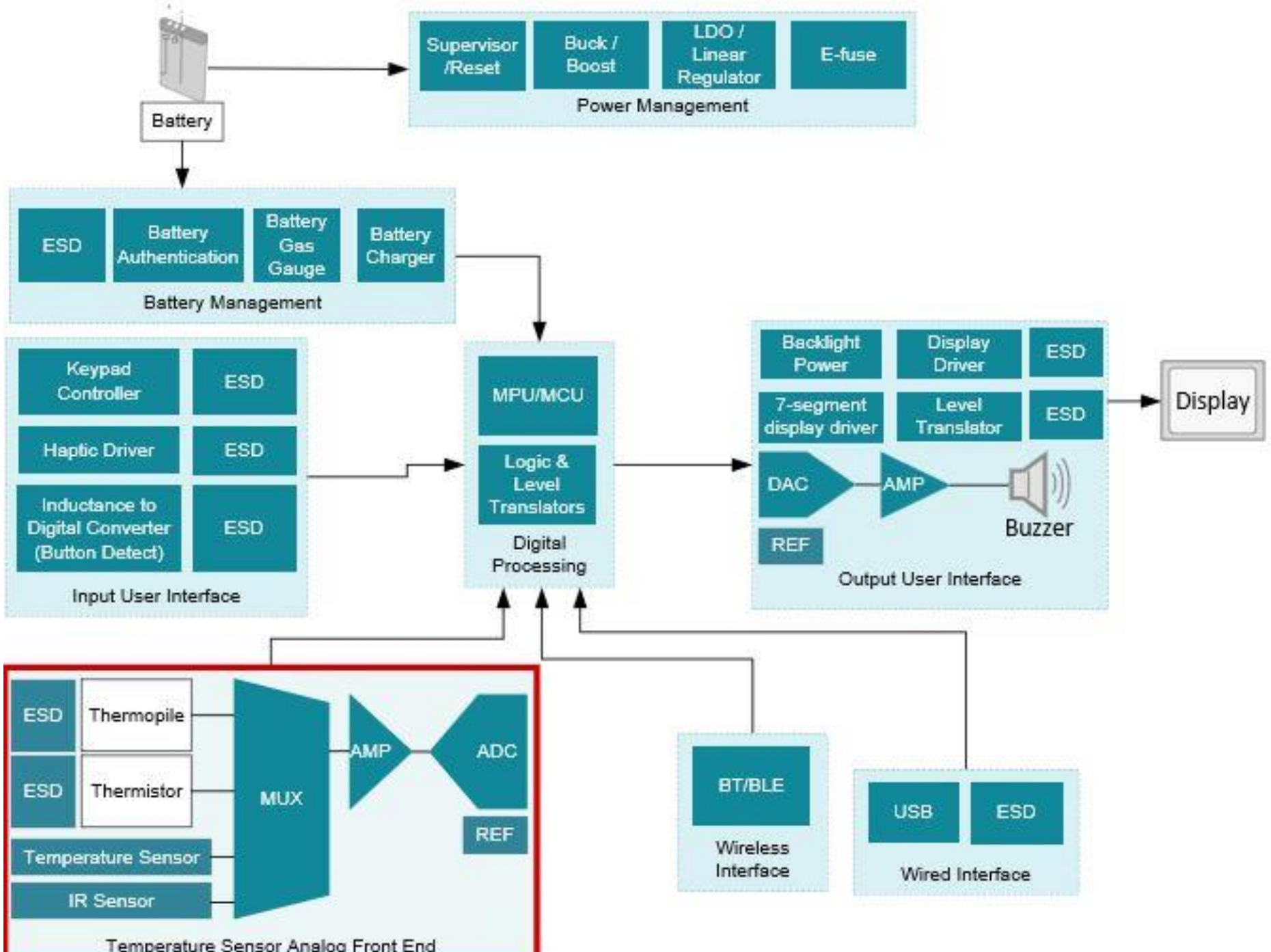
Medical Design Excellence Awards® SUPPLIER TO A 2009 WINNER



www.ti.com/medical

2Q 2009

TI Clinical digital thermometer




ring
Always Home.


Water Fountain
Humidifier
Rice Cooker
Water heater
Microwave
Air Conditioner


Remote Control
Timing Function


Smart Home Devices
Works with Alexa


2G/3G/4G/Wifi network


zmodo
amazon

Rajeswari Malladi and Dharma P. Agrawal

Current and Future Applications of Mobile and Wireless Networks

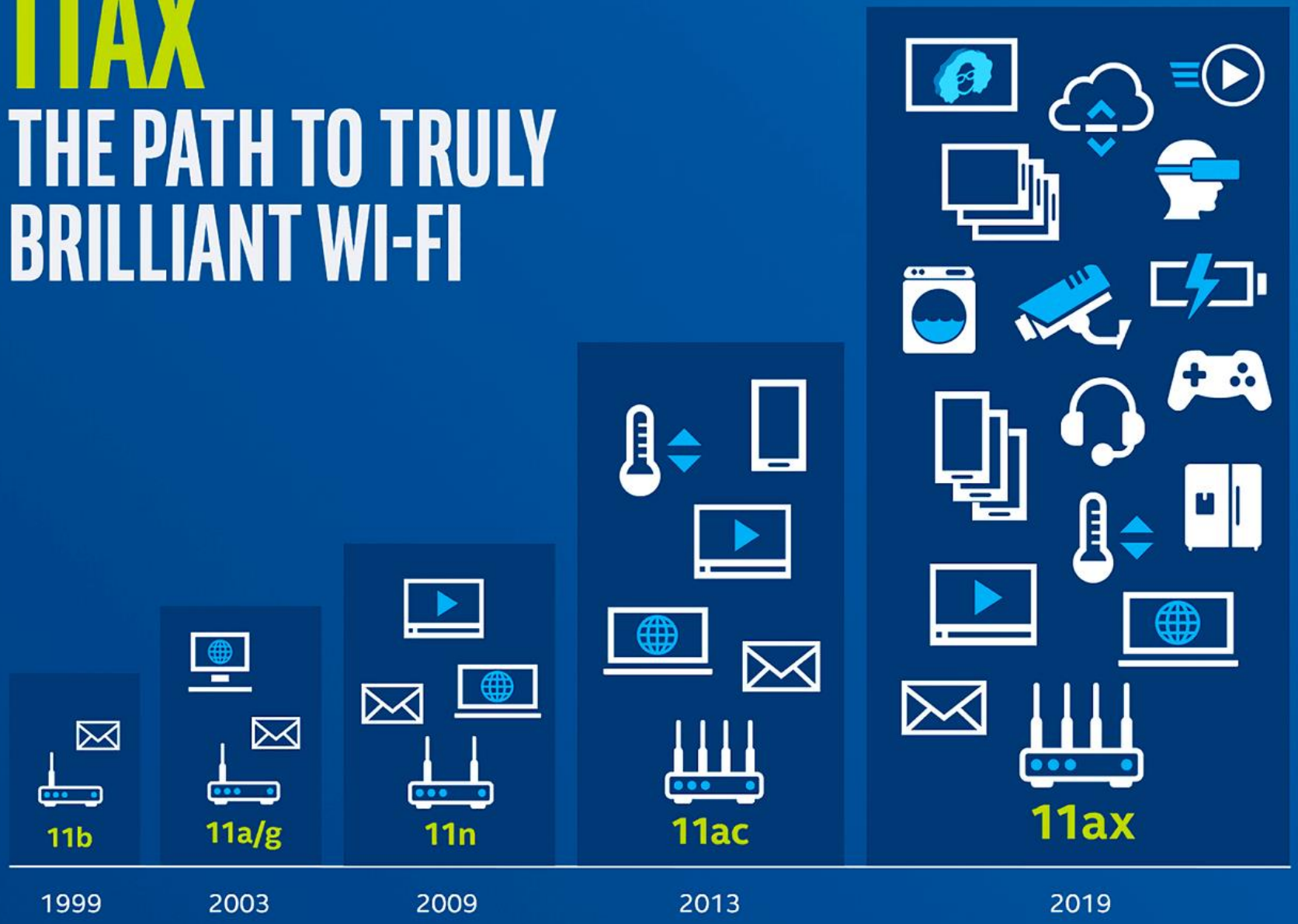
Wireless and mobile networks are being used in diverse areas such as travel, education, stock trading, military, package delivery, disaster recovery, and medical emergency care.

Technology	Services/ Features	Coverage Area	Limitations	Example Systems
Cellular	Voice and data through hand held phones	Continuous coverage	Very low bandwidth	Cellular phones, PDAs, Palm Pilots
Wireless LAN (WLAN)	Traditional LAN with wireless interface	Only in local environment	Limited range	NCR's WaveLAN, Motorola's ALTAIR
GPS	Determines three dimensional position, and velocity	Any place on Earth	Expensive	GNSS, NAVSTAR, GLONASS
Satellite-based PCS	Mainly for paging	Almost any place on Earth	Expensive	Iridium, Teledesic
Ad hoc networks	Group of people come together for short time to share data	Similar to local area networks	Very limited range	Bluetooth
Sensor networks	Tiny sensors with wireless capabilities	Small terrain	Very limited range	Defense and civilian applications

Wireless Features	Cellular	WLAN	GPS	Satellite-based PCS	Ad-hoc and Sensor Networks
Application Area	- Field Service - Sales Force - Field Audit - Vending - Public Safety - Stock Trading - Airline Activities - Bill Paying - Transportation Industry	- Retail - Warehouses - Healthcare - Telediagnostics - Students - Hospitality - Office Applications - Manufacturing Industry	- Surveying - Car Rental Agency - Robin Toll Collection - Sports	- GPS -Multimedia -Telemetry	- Battlefield Surveillance - Environmental Sensing - Machinery Prognostics - Roller Bearing Diagnostics - Roadside weather conditions - Bio-sensing - Bridge damage detection

11AX

THE PATH TO TRULY BRILLIANT WI-FI



4x **BETTER IN DENSE ENVIRONMENTS**

Improve average throughput per user by at least four times in dense or congested environments

FASTER THROUGHPUT

Deliver up to 40 percent higher peak data rates for a single client device

INCREASE NETWORK EFFICIENCY

By more than four times

EXTEND BATTERY LIFE

Of client devices

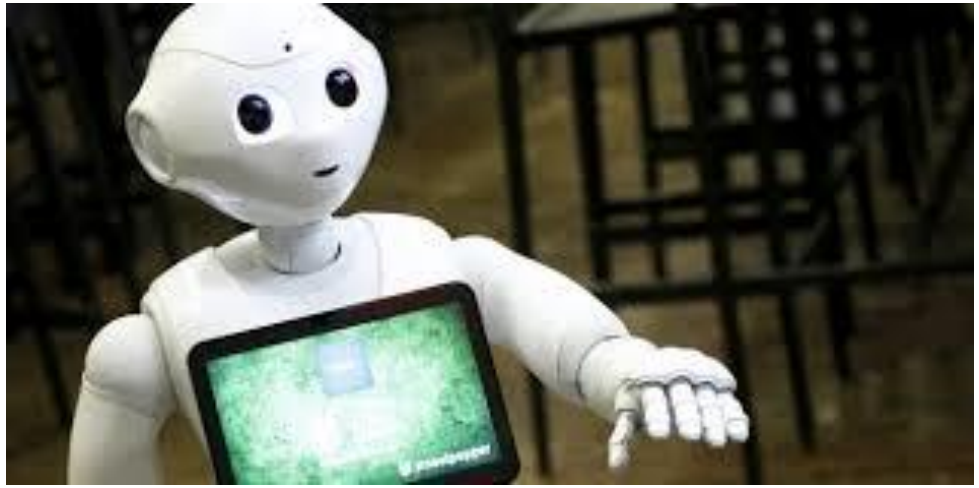
Comparison of Wireless Technologies (Bluetooth, WiFi, BLE, Zigbee, Z-Wave, 6LoWPAN, NFC, WiFi Direct, GSM, LTE, LoRa, NB-IoT, and LTE-M)

OK

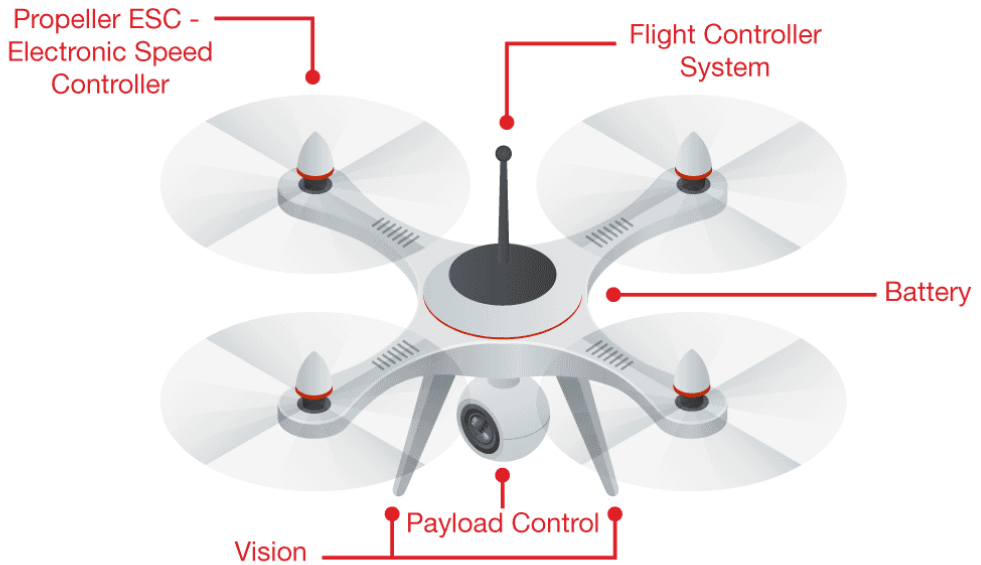
https://predictabledesigns.com/wireless_technologies_bluetooth_wifi_zigbee_gsm_lte_lora_nb-iot_lte-m/

	Power	Speed	Type	Range	Frequency	Note
Bluetooth	Low	2-3 Mbps	PAN	50m	2.4 GHz	Streaming music
Bluetooth LE	Very low	1 Mbps	PAN	50m	2.4 GHz	Ultralow power, intermitten small data
ZigBee	Very low	250 kbps	PAN	100m	915MHz / 2.4 GHz	
Z-Wave	Very low	100 kps	PAN	150m	868/908 MHz	Proprietary. Up to 232 devices. Larger range than ZigBee, but slower. Less crowded RF band.
6LowPAN / Thread	Very low	Low	PAN	100m	2.4 GHz	Low power, low data
WiFi / WiFi Direct	High	100-250Mbps	LAN	100m+	2.4 GHz / 5 GHz	Requires access point. WiFi Direct is peer-to-peer similar to Bluetooth.
LoRa / LoRaWAN	Low	27 kbps	LPWAN	10km+	868 MHz / 915 MHz	Long range / low speed / low power
GSM/GPRS	Very high	Moderate	WAN	35 km	850 MHz / 1.9 GHz	Cellular voice/data. Being phased out.
LTE	Very high	High	WAN	Long	Various	Cellular highspeed data. Expensive. Overkill.
NB-IOT	Moderate	250kps	LPWAN	20km+	Various	Narrowband cellular technology. Also called LTE-NB. Latency = 1.5 to 10 seconds.
LTE-M	Moderate	1 Mbps	LPWAN	Long	Various	Lower latency than NB-IoT. Double the module cost of NB-IoT. Latency = 50 to 100 ms.


ROBOTICS
AND EMBEDDED
SYSTEMS

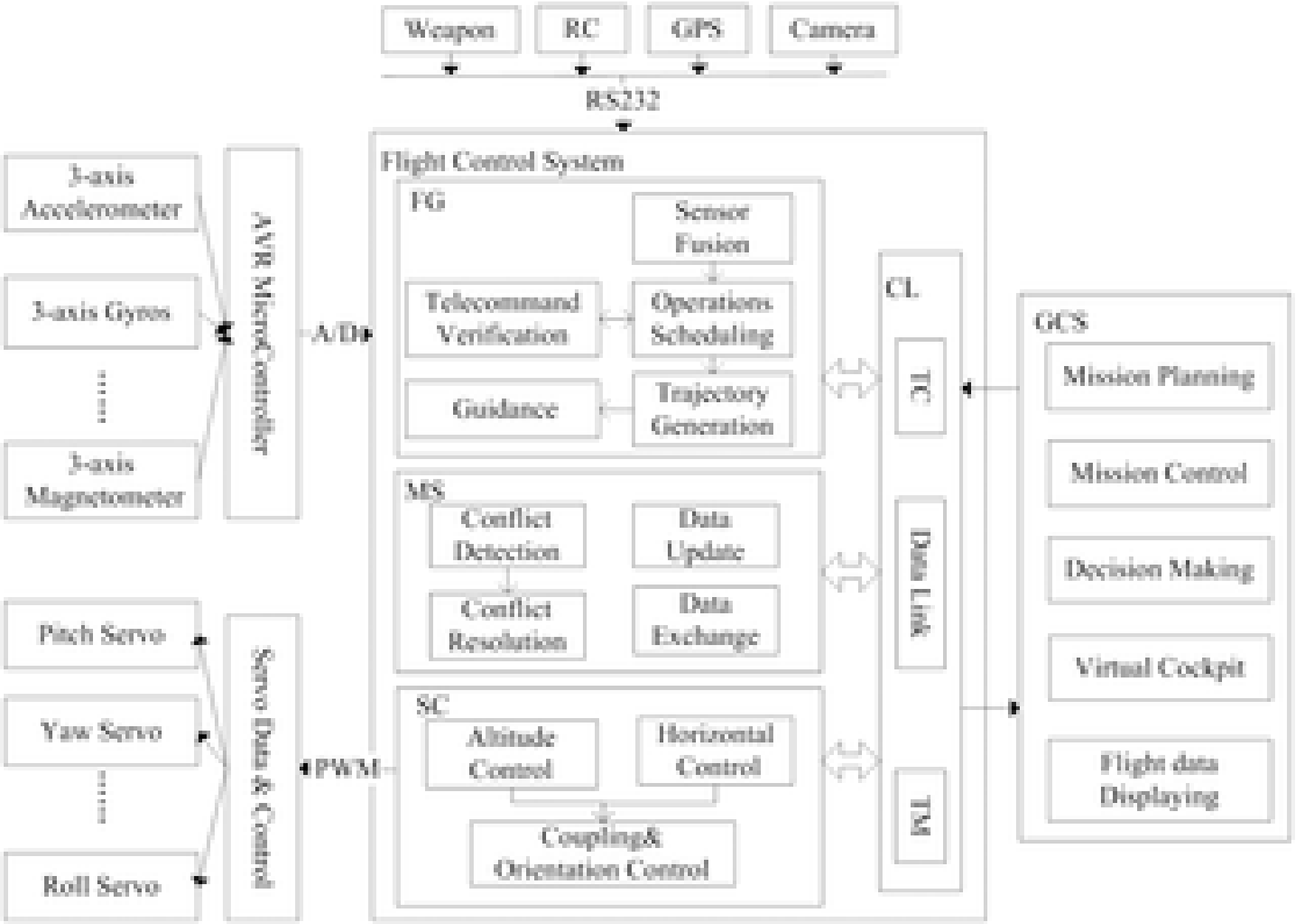


Drone



Remote Controller

Accessories

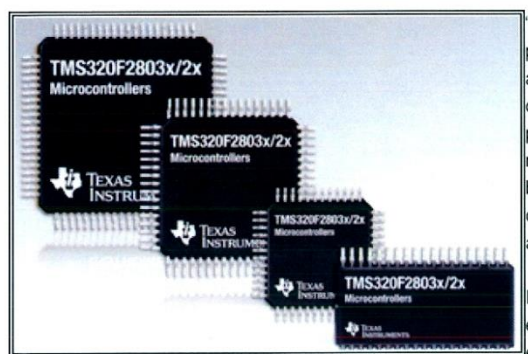

Weapon
RC
GPS
Camera
RS232
Flight Control System
FG
Sensor Fusion
Telecommand Verification
Operations Scheduling
Guidance
Trajectory Generation
MS
Conflict Detection
Data Update
Conflict Resolution
Data Exchange
SC
Altitude Control
Horizontal Control
Coupling& Orientation Control
CL
TCL
Data Link
TML
GCS
Mission Planning
Mission Control
Decision Making
Virtual Cockpit
Flight data Displaying
3-axis Accelerometer
3-axis Gyros
3-axis Magnetometer
AVR MicroController
A/D
Pitch Servo
Yaw Servo
Roll Servo
Servo Data & Control
PWM

« Back | Print

Piccolo 32-bit microcontrollers bring real-time control for greater energy efficiency

-- Control Engineering, 9/8/2008

Houston, TX – **Texas Instruments Inc. (TI)** today launches series of 32-bit TMS320F2802x/F2803x microcontrollers (MCU) starting at less than $2 in volume. The **Piccolo F2802x/F2803x microcontrollers** feature architectural advancements and enhanced peripherals in package sizes starting at 38-pins to bring 32-bit real-time control to applications typically unable to justify the cost. Real-time control offers greater system efficiency and precision through implementation of advanced algorithms for industrial, consumer, and automotive applications such as solar power micro-inverters, LED lighting, white goods appliances, and hybrid automotive batteries.



Texas Instruments Piccolo F2802x/F2803x 32-bit microcontrollers are less than $2 each in volume. Lower cost translates into more applications.

"The combination of 32-bit performance, enhanced peripherals and small package sizes allows designers to add real-time control and system management using just one microcontroller to applications that could not afford it previously," said Keith Ogboenyiya, TMS320C2000 marketing manager. "We named these devices Piccolo because of the small size and price that they offer our customers. They also double the number of C2000 options and build on TI's growing MCU portfolio."

Piccolo F2802x/F2803x controllers can replace multiple electronic components to lower overall system cost, enabling advanced power electronics management. In a variable frequency air conditioning unit, a single F2802x/F2803x controller can precisely control two electric three-phase motors and perform power factor correction (PFC) calculations. Currently required in approximately 30% of the marketplace, PFC improves efficiency of the load to make best use of the power from the utility.

For commercial and industrial lighting applications, LED technology can bring up to 50% higher energy efficiency compared to traditional high-pressure sodium lamps. F2802x/F2803x-based LED control systems offer intelligent current