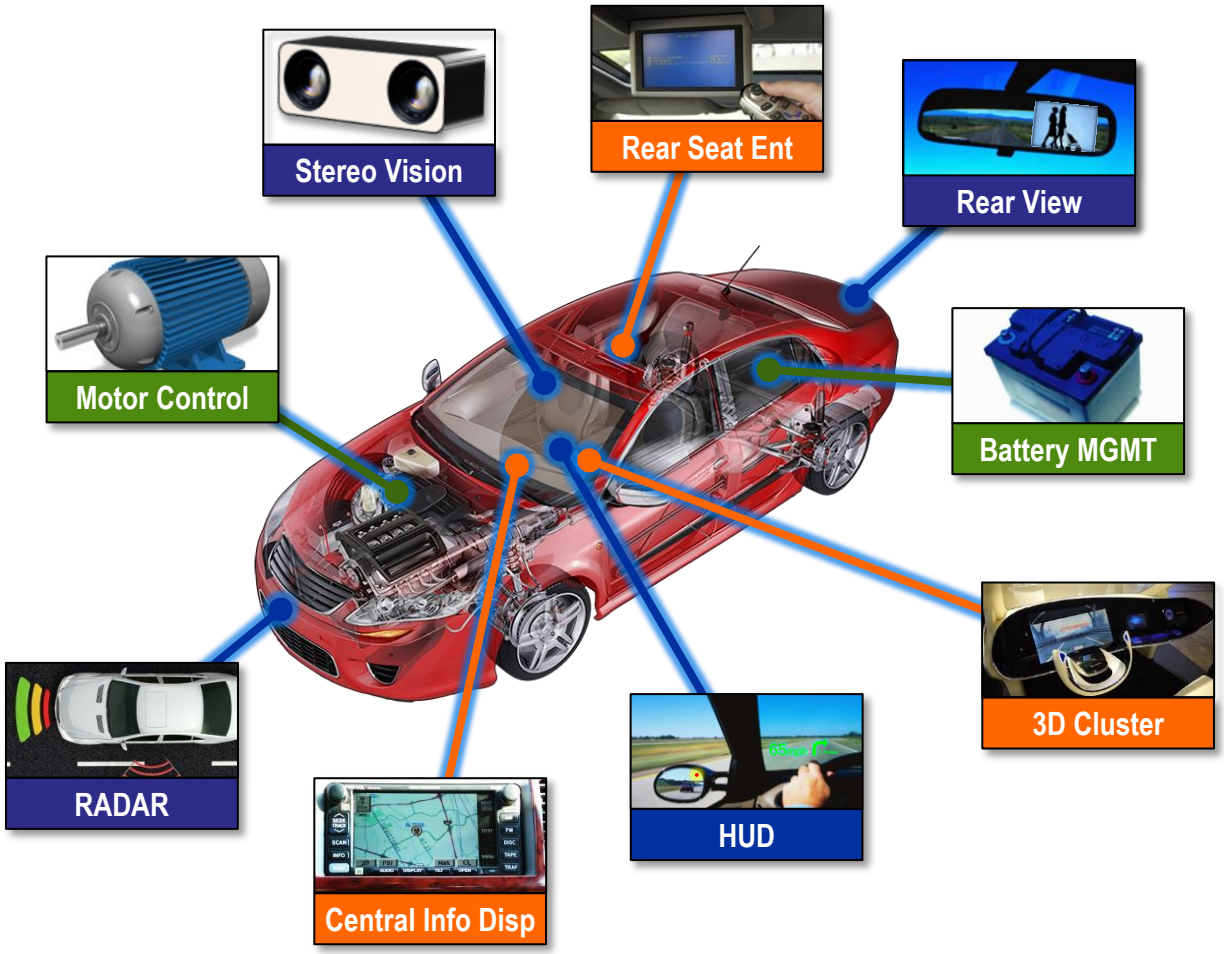
혁신을 통한 기술 격차의 해소

Altera Programmable Solution

Webinar / 2013

High Growth Auto Electronics Applications



INFO ADAS EV/HEV

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Infotainment

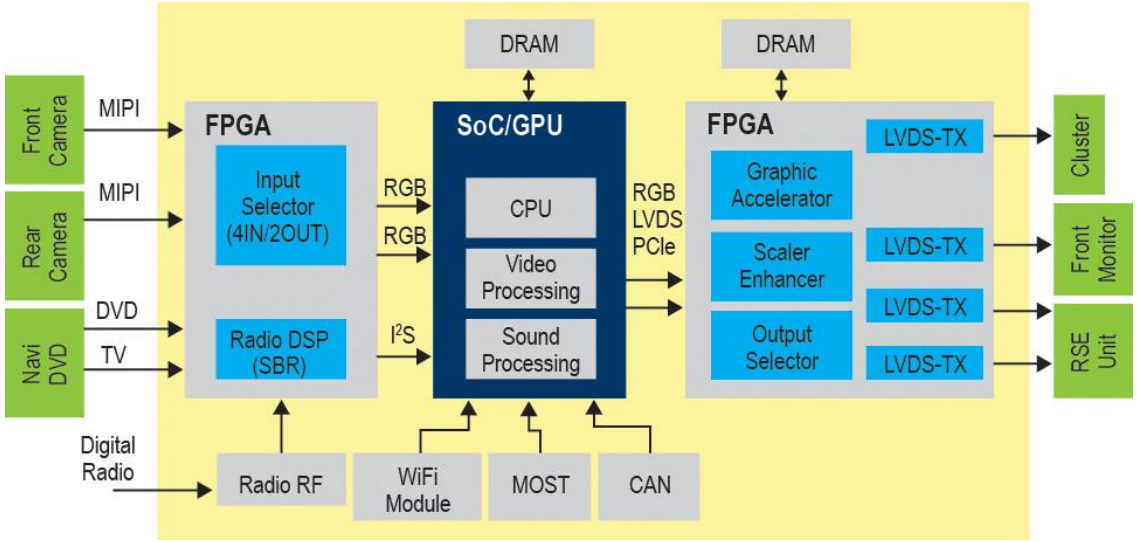
INFO

- Growing to 120Mu by 2018*
- HD displays, 3D graphics, multi-touch
- Follows consumer market & trends

Infotainment & Communications

- Telematics
- Navigation/GPS
- Multimedia Systems
- Audio Systems
- Rear Seat Entertainment
- Graphics Controller
- Display Connectivity
- HMI
- Audio Processing
- Instrument Cluster
- Gateway / Car Networking

Infotainment System I/O Companion



*Source: IMS Research , World Market for in-Car Audio, Infotainment and Driver Information / Telematics Systems 2012

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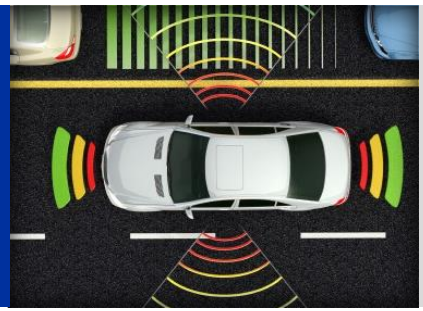
Advanced Driver Assistance Systems

ADAS

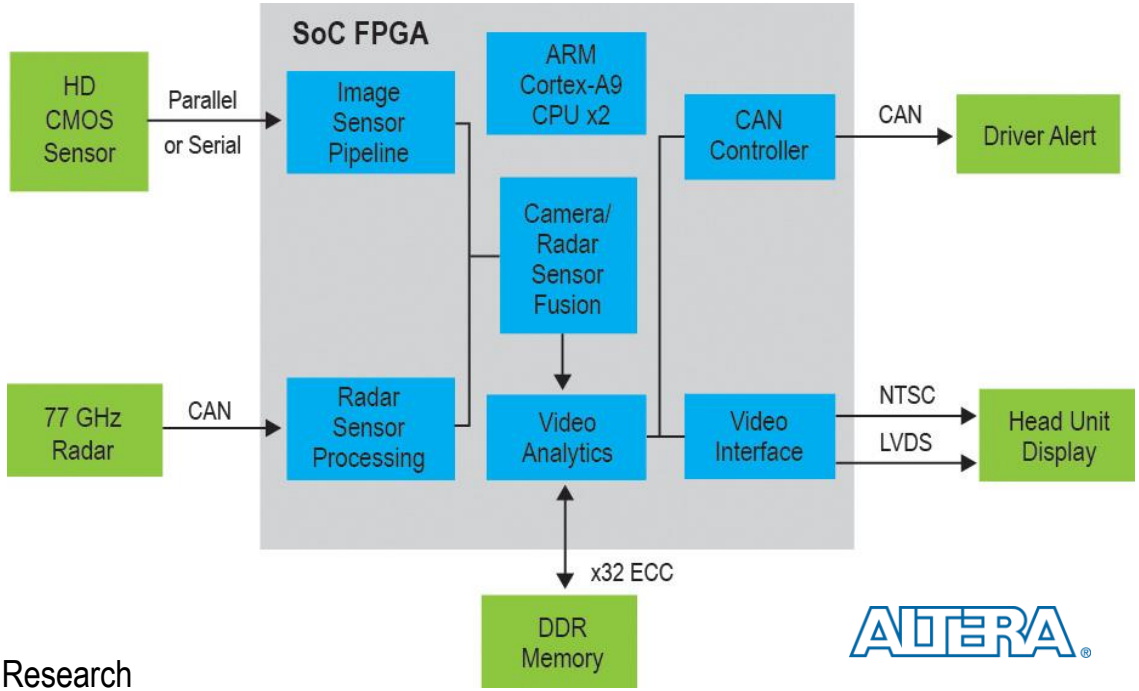


- 15Mu growing to 60Mu cameras in 2018*
- Rearview camera legislation in NA and EU
- Autonomous car legislation for testing

Driver Assistance

- Night Vision
- Lane Departure Warning
- Adaptive Cruise Control
- Collision Avoidance
- Object Detection
- Pedestrian Detection
- Surround View
- Park/Reverse Assist
- Stereo Vision
- Sensor Fusion (Radar)
- Heads Up Display (HUD)

Forward-Looking Sensor Fusion ECU



*Source: IMS Research

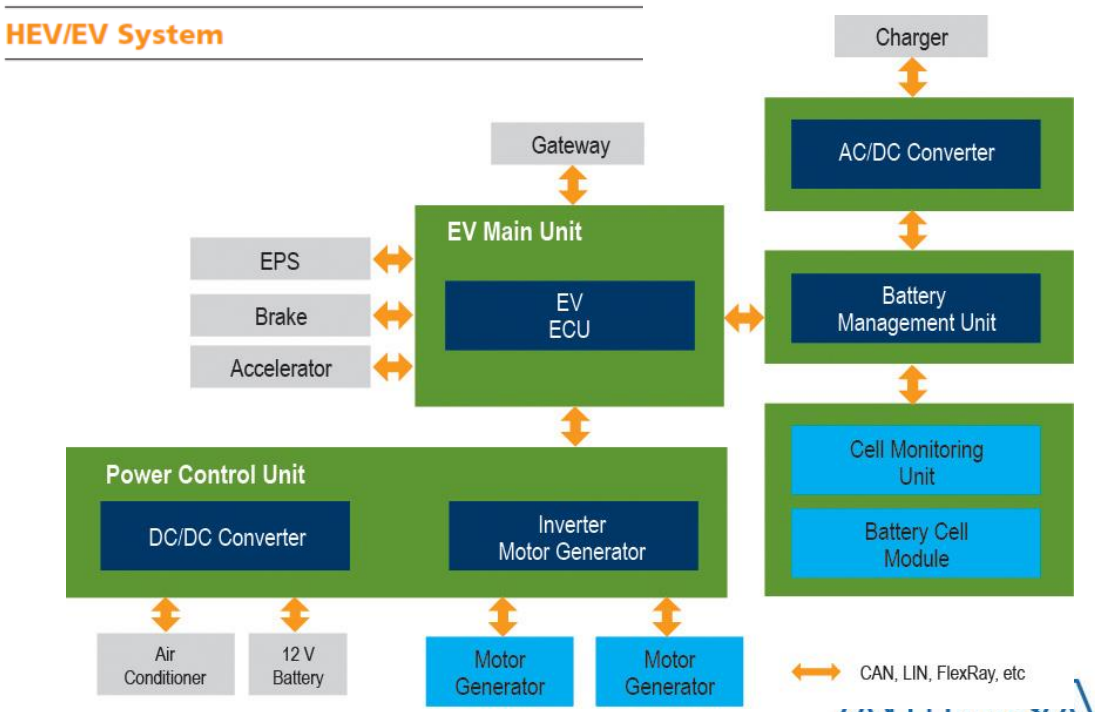
Electric and Hybrid Vehicles

EV/HEV

- Growing from 2M to 20M cars in 2020*
- Emission legislation, limits tightening
- Need for functional safety (ISO 26262)

Powertrain & Safety

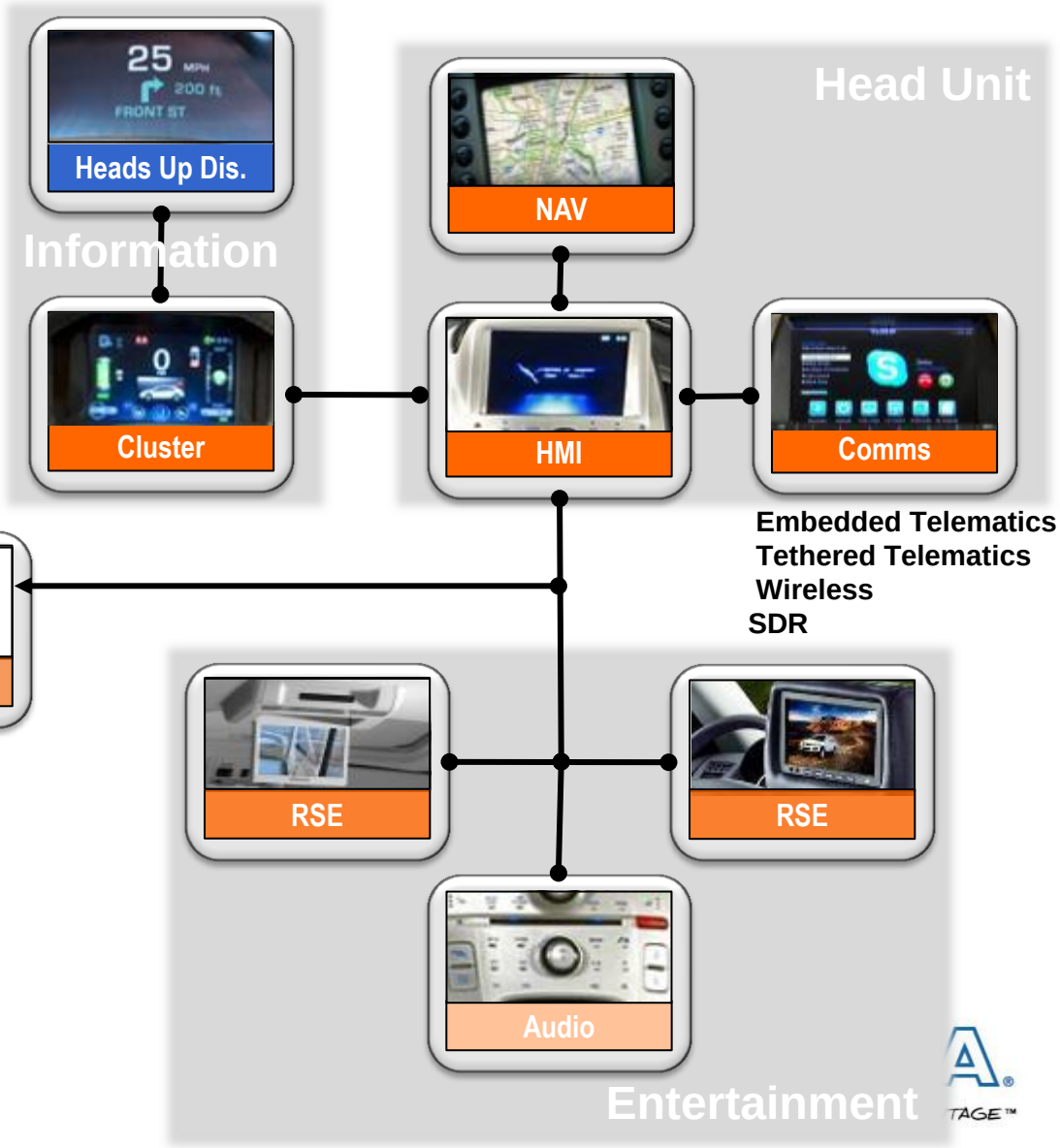
- Electric Vehicle
- Electric Motor Control
- Battery Management
- Engine Management
- DC/DC Conversion
- AC/DC Conversion
- Inverters
- Drive by wire



* 20Mu EV and HEV by 2020 is target specified in Electric Vehicle Initiative by International Energy Agency

Altera Solutions for Infotainment

Infotainment Application Space



Infotainment Market Trends
Head Unit – Cluster – RSE - Emerging

Head Unit

- Connected / Cloud / Compelling
- Beyond Audio/Video & NAV, Social media
- Multi Disp. / Upgradeable / Refresh stream

Cluster

- Increasing resolutions, full LCD
- Shifting towards 2D and 3D displays
- Reconfigurable displays / cockpit style

RSE

- High-end optional fit, Media ports
- Adding Media ports, 720p to 1080p

New & Emerging

- Communications / Smart Phone apps
- Gesture recognition, Networked ECUs

(Source: IMS)

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Head Unit / Center Stack HMI Segmentation

Basic

AM/FM Radio
Satellite radio opt (NA)
Digital radio opt (HD, DAB)
Segment / dot matrix display
2 ch audio output
Basic AMP

- IO Expansion

MID

AM/FM/Satellite radio (NA)
Digital radio
TFT display (WVGA)
2D graphics (moving to 3D)
Backup camera
2 ch & 5.1 ch audio outputs
Basic or ext. high end AMP

Leverage connected phone for connectivity & some multimedia and application computing

- Communications Port
- IO Companion
- Video Selector

High

AM/FM/Satellite radio (NA)
Digital radio
TFT display (WVGA+)
Touch/multi-touch
3D graphics, video decoding
Natural language voice rec
5.1 ch audio outputs
External high end AMP
Backup/surround view system
Cloud connectivity

- Co-processor
- IO Companion
- Video / Interface Expander

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Instrument Cluster Segmentation

Basic / Traditional

1 – 6 mechanical gauges
No display, or
Segment display, or
Dot matrix display

- ASSP

Hybrid

1 – 4 mechanical gauges
TFT display(s)
Monochrome or color
WQVGA – WVGA resolution
2D graphics

- Graphics 2D (soft)
- IO Companion
- TCON

Reconfigurable

No mechanical gauges
Large TFT display(s)
WVGA+ resolution
3D & 2D graphics
Video decoding

- Graphics system (3D)
- IO Companion
- TCON

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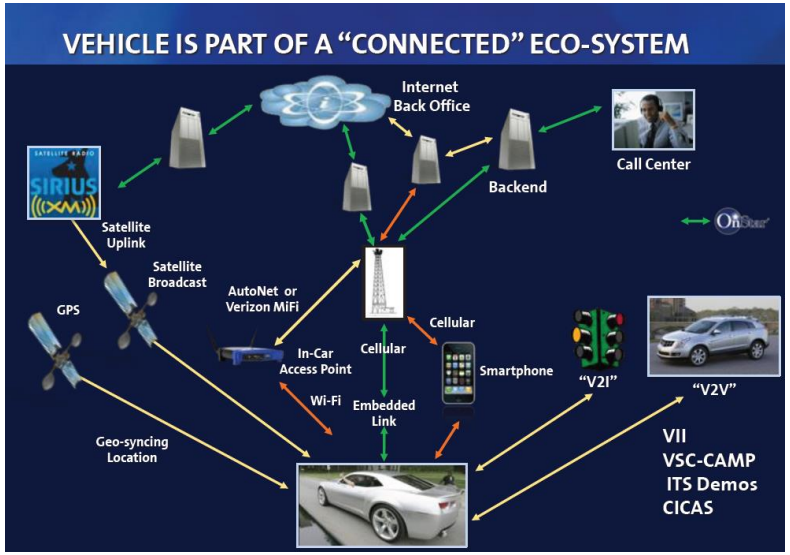
Infotainment Macro-Trends

- **HMI is a differentiator**
  - More displays (growing to 120 Mu by 2018)
  - Higher resolution displays
  - Distraction-free interactions
  - Heavy consumer influence
- **Always connected society**
  - High bandwidth, always-on data connections
  - Cloud-based content & applications
- **Fuel economy**
  - Power consumption does matter (EV range)

Tesla 17" 1080p HMI



Toyota Touch Life

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Infotainment Application-Specific Trends

- **HMI**
  - multi-touch / gesture recognition
  - cloud based apps (Siri, S-voice)

- **Cluster (IC)**
  - advanced graphics, Sprite to vector, HUD
  - HUD
    - growing, higher resolution & color,
    - numeric to AR(augmented reality)

- **RSE – (high end option)**
  - 720p to 1080, Blu-ray, “thinclient”
  - Adding cameras – Skype!
  - UHD (3840 x 2160), 4x1080p!
  - Competes vs. portable (Pads / Tablets)

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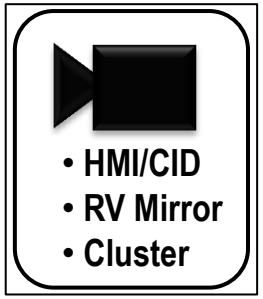
Government Legislation - *accelerating adoption*

- **Rear View camera systems in US**
  - Cameron Gulbransen Kids Transportation Safety Act of 2007 / NHTSA
    - Applies to vehicles up to 10,000 lbs
    - Fit rate metric:10% by 9/2012, 40% by 9/2013, **100% by 9/2014**
      - Today: 45% standard and ~20% optional feature
      - Camera technology best meets this requirement



- **<1s response to see camera image**
  - FPGA opportunity to switch in Camera data close to Display
  - Can not wait for Application Processor power up

REQUIRED

- **eCall – embedded / tethered - Europe**
- **Driver distraction**
  - possible future requirements for HUD
  - Color, size, font, GUI

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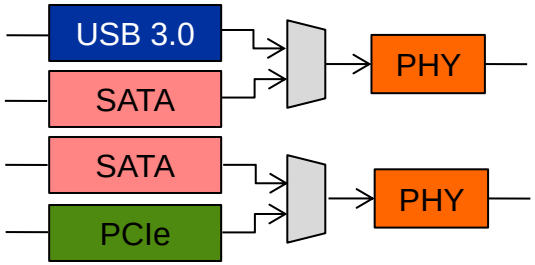
CPLD/FPGA Usage #1

- **I/O Companion**
  - ☑ Processor pin-multiplexing limits availability of required interfaces
    - ➢ Some features are blocked by selection
  - ☑ Application processor (SoC) doesn't have required interface(s)
    - ➢ USB 3.0, Ethernet AVB, CAN, MOST
  - ☑ Protect design against late developing requirements or fast changing standards – Field Upgradable



- **Multiplexer / Selector**
  - ☑ More inputs than the processor can support
    - ➢ Multiple Cameras
    - ➢ Video sources for a rear seat entertainment system (Media port / seat)
    - ➢ Many processors have only 2 video input ports, 2 display outputs

USB + SATA = No PCIe

CPLD/FPGA Usage #2

- **Image & Video Functions**
  - ☑ Image scaling, rotating, fisheye lens correction
  - ☑ Format Conversion / Interface Conversion
  - ☑ Graphics generation, alpha blending and image warping for HUD

- **LCD Panel Functions**
  - ☑ LCD panel is separate unit
    - ➢ Panel interface conversion, input source selection, and timing control (TCON) may be necessary
  - ☑ Timing Controller functions
    - ➢ LVDS to RSDS
    - ➢ LVDS to miniLVDS
    - ➢ LVDS to eDP

CPLD/FPGA Usage #3

- **Communications port**
  - ☑ Consumer Device communications / input, and charge
    - ➢ Apple-iPhone, Samsung-Galaxy, and so on.
    - ➢ USB2.0-HS, USB3.0-SS, MHL, DP, HDMI, 30-pin, etc.
    - ➢ FPGA for Hub, Bridge, I/O Expansion

- **Many other applications**
  - ☑ Software Defined Radio
  - ☑ Networking / Gateway (Ethernet AVB)
  - ☑ Audio Functions
  - ☑ Telematics Functions
  - ☑ Custom Features!

Infotainment is a diverse set of applications!

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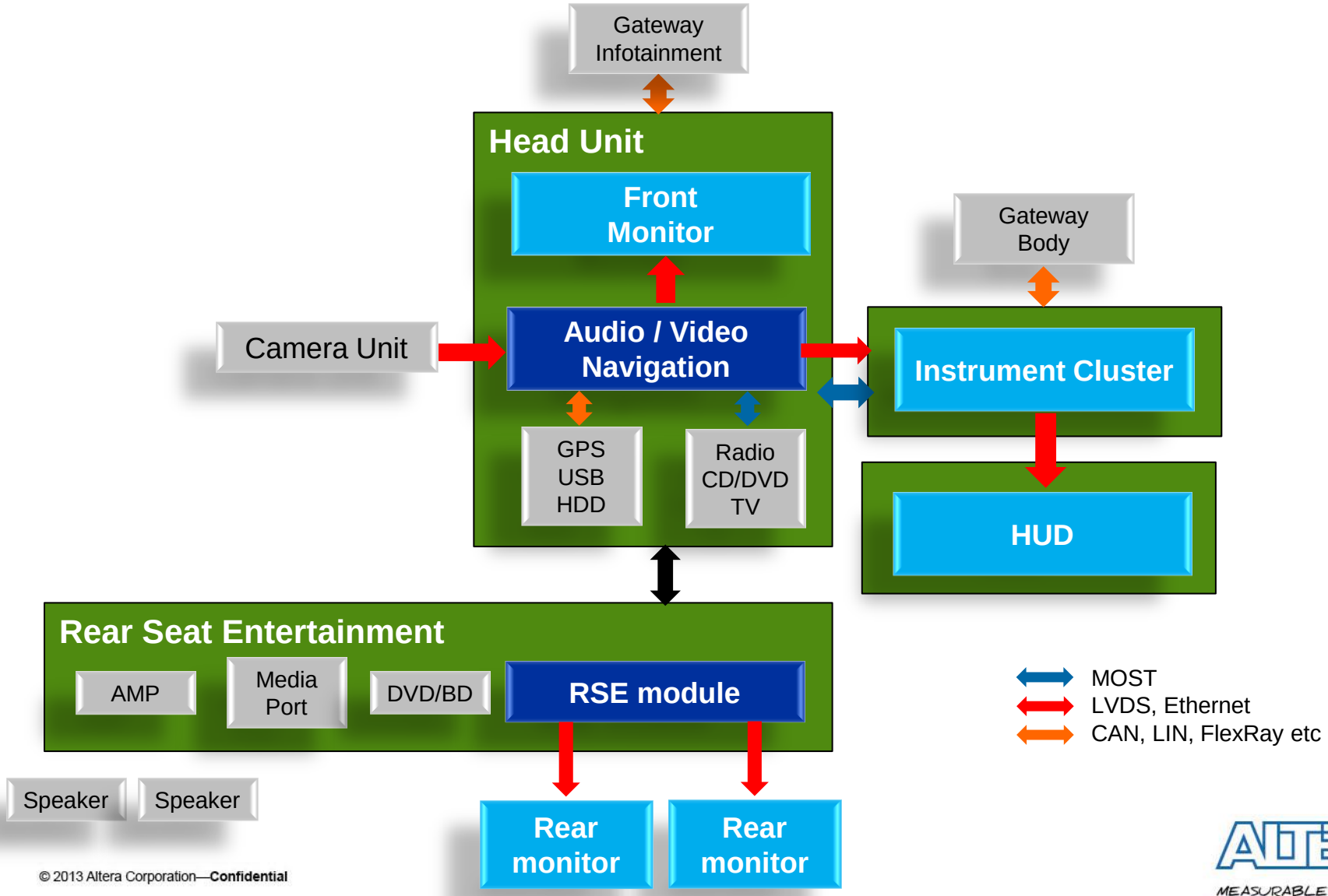
Infotainment System Block Diagrams

Infotainment System Block Diagram



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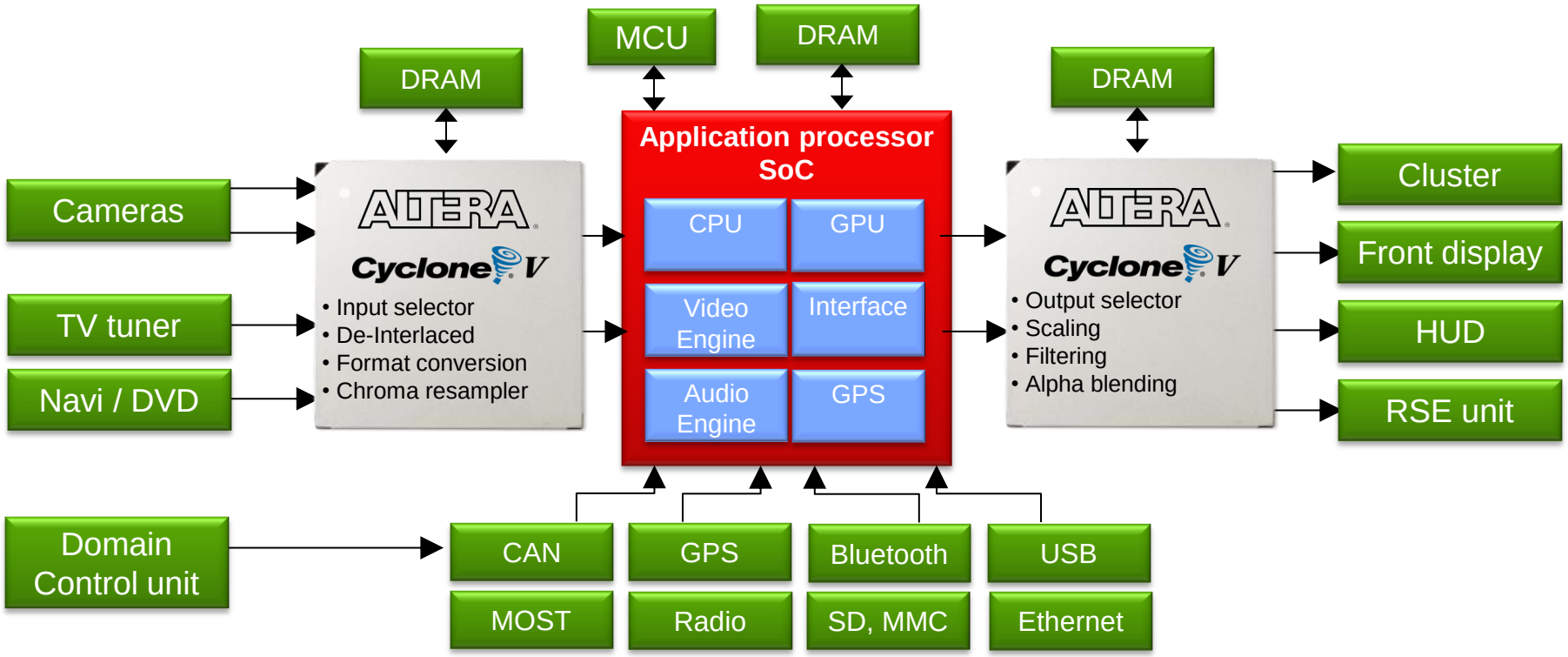
I/O Companion Concept



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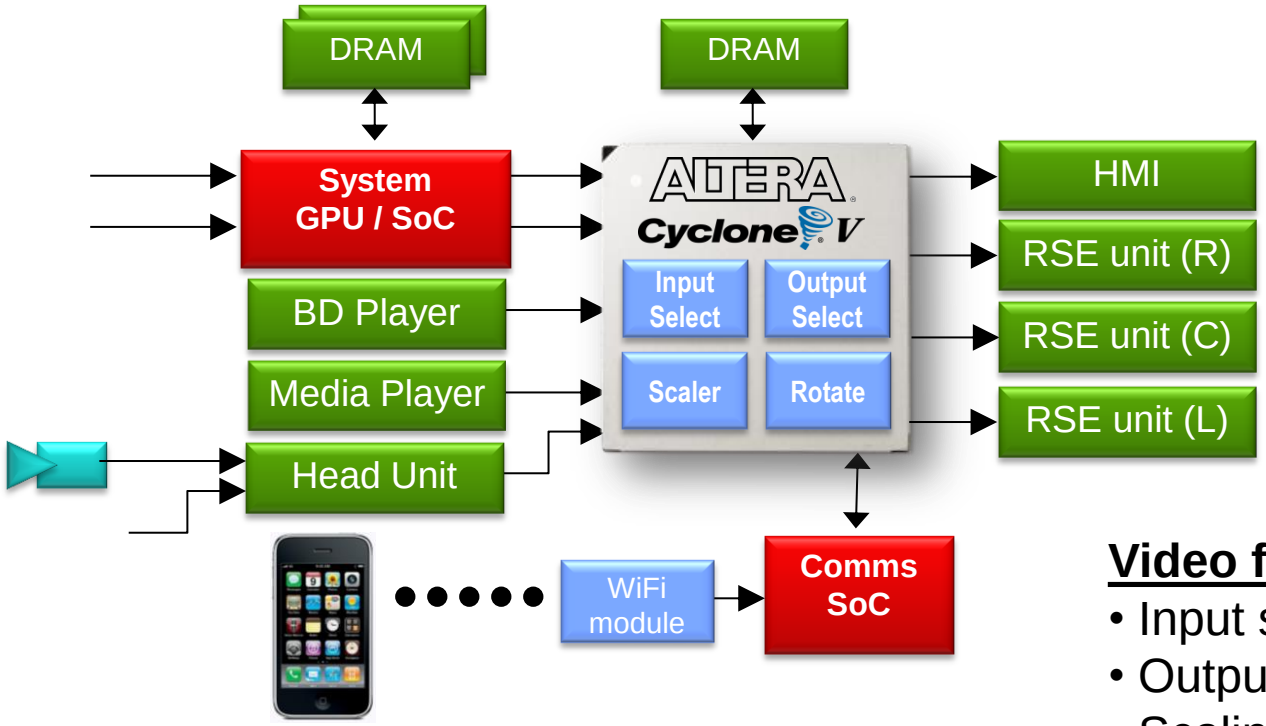
Video Selection (5:4)
Multiple inputs & formats – Multiple outputs & formats



Interface functions
- dRGB
- LVDS
- eDP
- Bridge Devices*

Video functions
- Input selector
- Output selector
- Scaling
- Rotation

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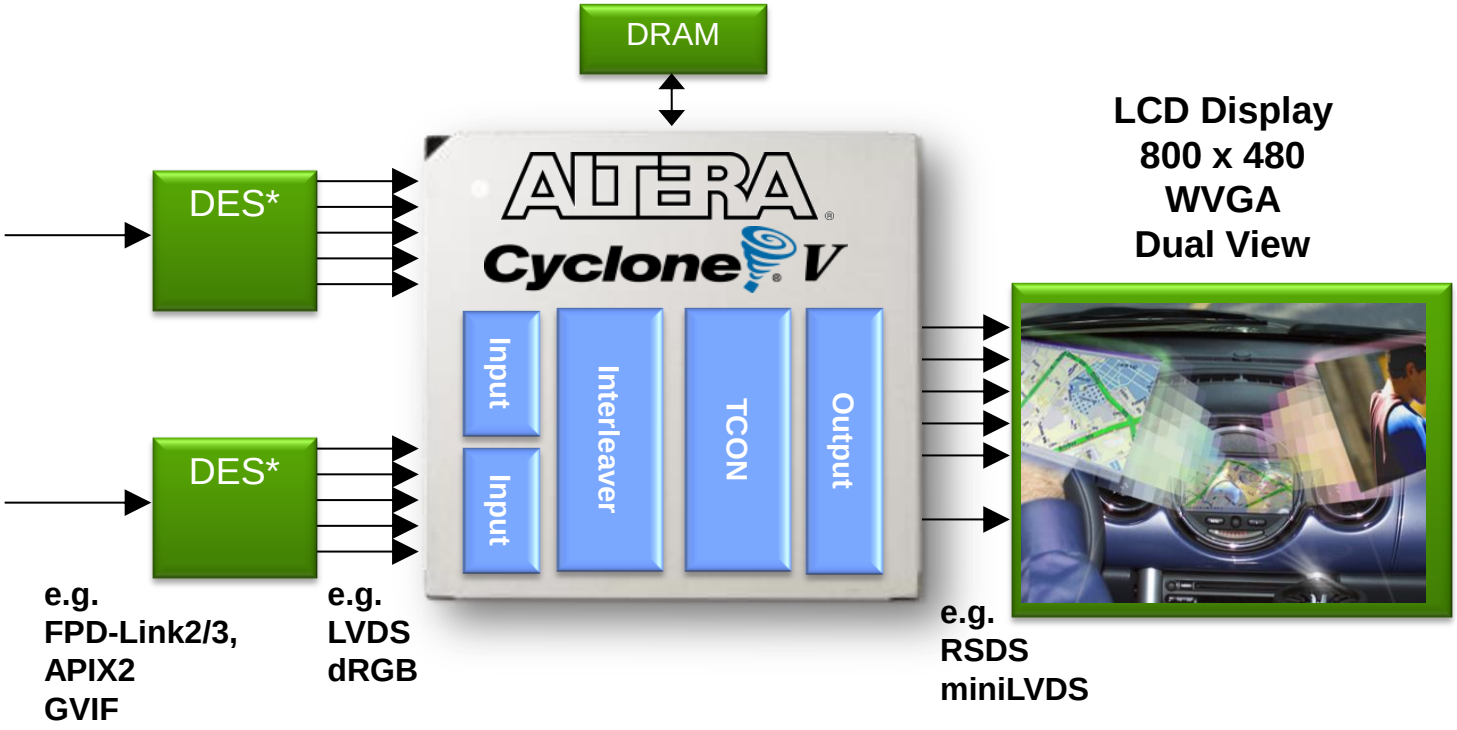
Display TCON
Multiple Inputs (Dual View), TCON, Panel Interface



Interface functions

- LVDS (OpenLDI)
- miniLVDS / RSDS
- Bridge Devices:*

  FPD-Link 3, APIX2, GMSL, etc.

Video functions

- Dual View Interleaver
- LCD Timing Control

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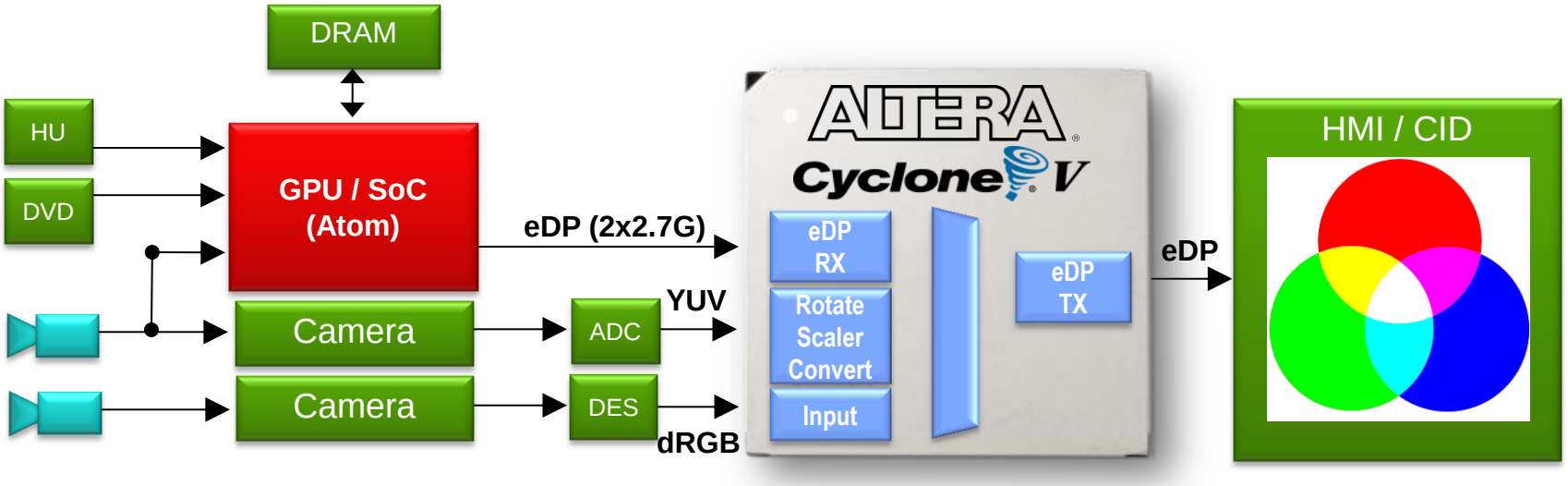
Repeater & Input Select

- **3:1 Input Video Selection**
- **Fast Input of Camera Data to Display**

eDP (1.3)
- 1/2/4 lanes
- 1.6/2.7/5.4G
- Embed. CLK
- >1080p



Video functions
- eDP RX+TX
- YUV-to-RGB
- Scale & Rotate

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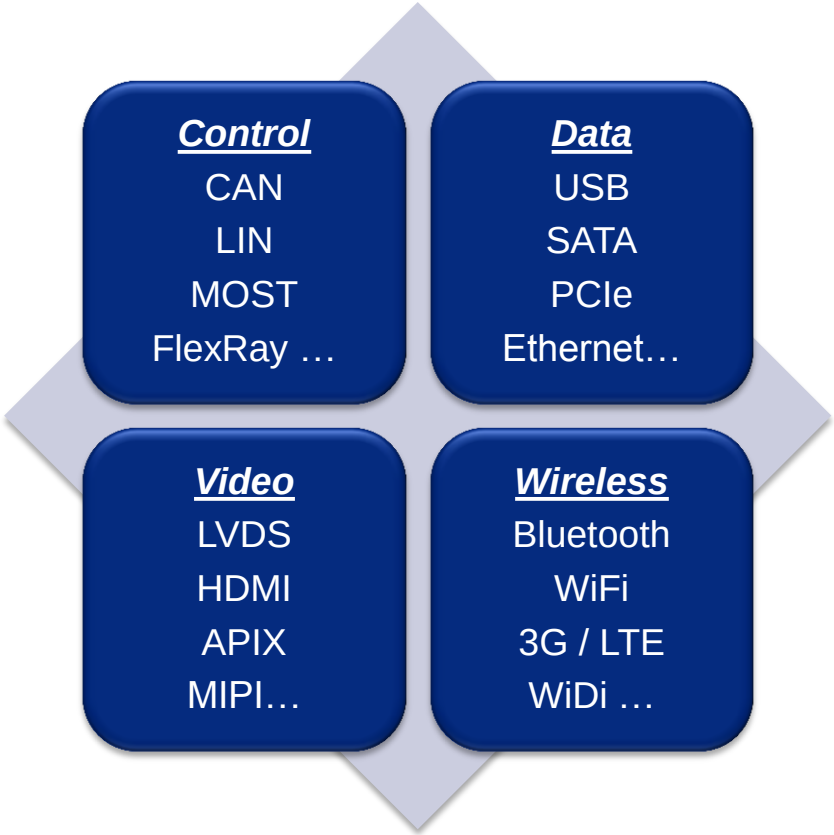
Infotainment Challenge – *Many Interfaces!*

- **Increasing connectivity & higher bandwidth**
  - Attractive user interface
  - Better image quality
  - Integrations to cockpit
- **Continuous changes on interface requirement**
  - Multiple interface standards
  - Flexibility and scalability needs
- **ASSP / uP / DSP……**
  Not a perfect fit!
  - Lack of interface ports
  - Not able to meet schedule



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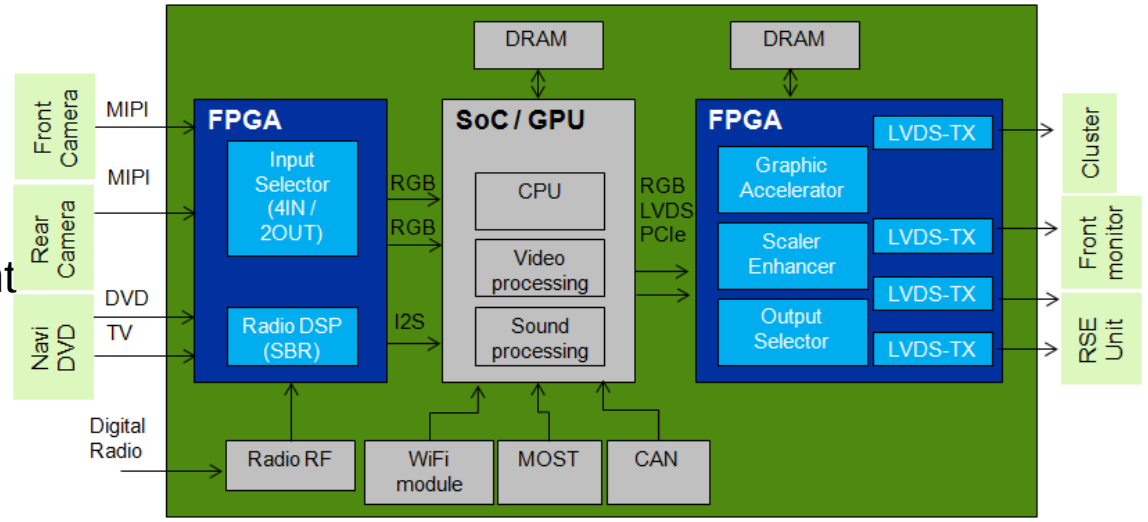
Altera FPGA Value Proposition

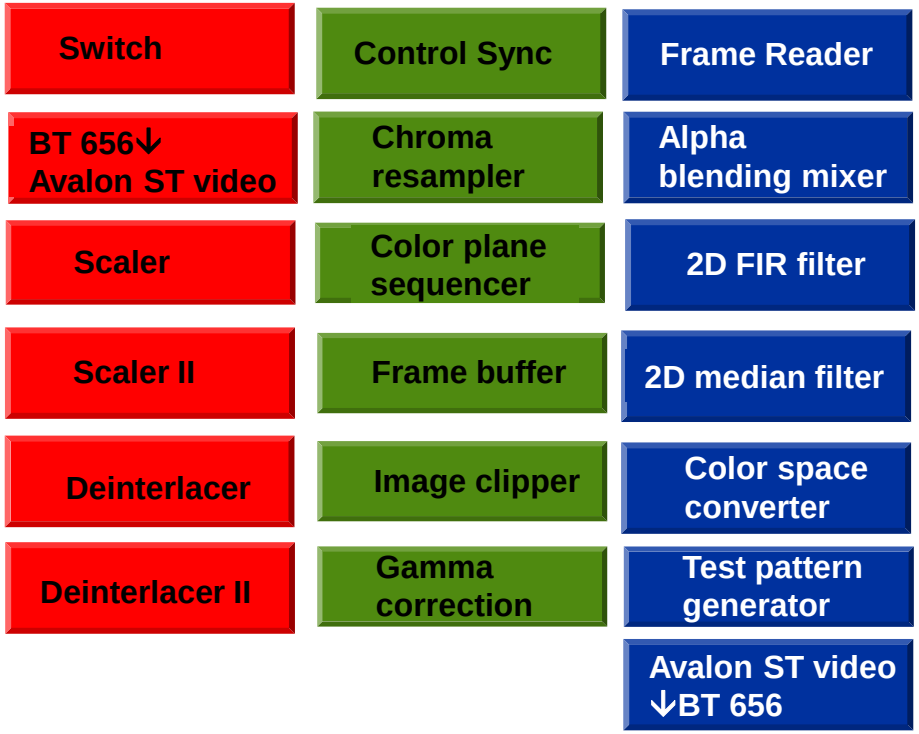
FPGA enable evolution in a dynamic Infotainment market

- **Flexible I/O companion**
  - Video interface
  - Bus interface
- **Graphic accelerator**
  - 2D/3D graphics
  - Scaling, Image enhancement
  - Alpha blending
- **System integration**
  - Embedded CPU core
  - Software Based Radio



Altera & Partner Graphics IP

- **Altera Video & Image Processing Suite (VIP)**
  - VIP Suite Home Page
  - VIP User Guide (PDF)



Graphics	IP Source	Availability
VIP Suite • Scaler •Color space conv. • 2D FIR filter • 2D median filter • Alpha blender • Gamma correct • Video switch • TP generator……	**Altera** (Suite of 20 Video & Image Processing IP MegaCore)	**Available**
Dual View	**Altera** (Ref design)	**Available** (rev in work)
MJPEG	CAST	**Available**
H.264	CAST, Eyelitics	**Available**
JPEG2000	CAST	**Available**
ATHLET IP	IMAGEM	**Available**
2D Graphic (HD/Lite/STD)	TES	**Available**
3D Graphic	TES	**Available**

Automotive Connectivity Flexibility - IP

- OEMs develop roadmap for future connectivity evolution
  - Certain OEMs promoting Ethernet AVB
- USB, PCIe, eDP emerging
- No one standard will do all
  - **Flexibility required**

Connectivity	IP Source	Availability
MOST	IFI/SMSC	**Available**
FlexRay	Bosch	**Available**
CAN ★	**Hard IP – CV SoC**	**Available**
CAN	IFI & Bosch	**Available**
LIN	IFI, CAST, Bosch	**Available**
PCIe	**Hard IP**	**Available**
USB3.0 (device)	SLS	**Available**
USB2.0	SLS, CAST	**Available**
oLDI (LVDS)	**Altera (FPD-Link)**	**Available**
DisplayPort	Bitec / **Altera**	**Available**
V-by-One HS	Altima (Japan)	**Available**
Ethernet AVB	Foresys, ...	**Available**
MIPI (D-PHY) DSI(1) / CSI2	NWLogic, Arasan	**Available**
HiSPi ★	**Altera**, Aptima	**Available**

Automotive-Grade PLD Portfolio

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AEC-Q100 PLDs

MAX® Series	Cyclone® I / II / III / IV	Cyclone® V	Cyclone® V SoC	HardCopy® Series
CPLDs	***FPGAs***	***FPGAs***	***SoC FPGAs****	***ASICs***
Lowest Cost, Lowest Power	***Lowest Cost, Lowest Power***	***Cost and Power Optimized***	***Integration Optimized***	***Lowest Risk, Lowest Total Cost***

RESOURCES

Embedded Soft and Hard Processors

Nios® II

ARM®

Intellectual Property (IP)

CAN MOST

lin FlexRay™

and more…

Design Software

QUARTUS® II

DSP Builder

Development Kits

*Cyclone V SoC FPGA, ES in Q1 2013

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Summary

- **Many diverse Infotainment applications – IO Companion**
- **FPGA's value**
  - Efficiency
  - Flexibility
  - Integration
  - Time-to-market
  - Performance and cost

- **Meeting and exceeding automotive application needs**
- **Altera is committed to the automotive market, expanding resources and is building on over a decade of service!**

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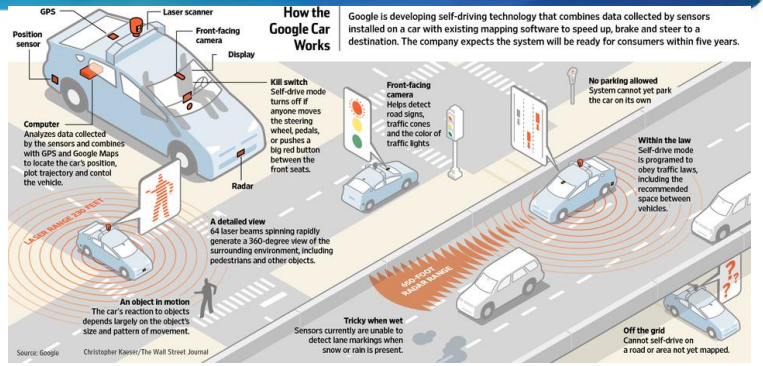
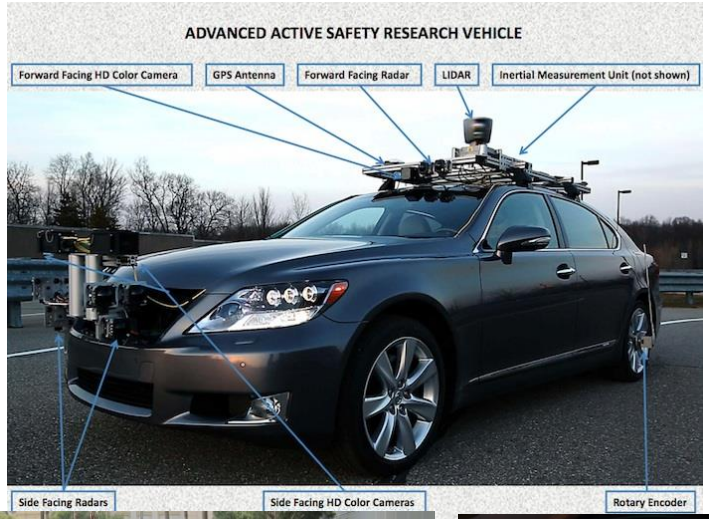
Altera Solutions for ADAS

ADAS : Advanced Driver Assistance Systems

ADAS Market Trends

- Google
  - "Self-Driving Car"
  - Reduce traffic accidents by 90%
  - Reduce wasted time/energy by 90%
- TOYOTA
  - "Active Safety Research Vehicle"
- Audi
  - "Piloted Driving"
- Growth from $4.4 in 2010 to $17.4B in 2020
- Common trends
  - Reduce accidents/save lives
  - NCAP legislation
  - Sensor fusion – laser, radar, camera
  - Differentiation, Cost reduction





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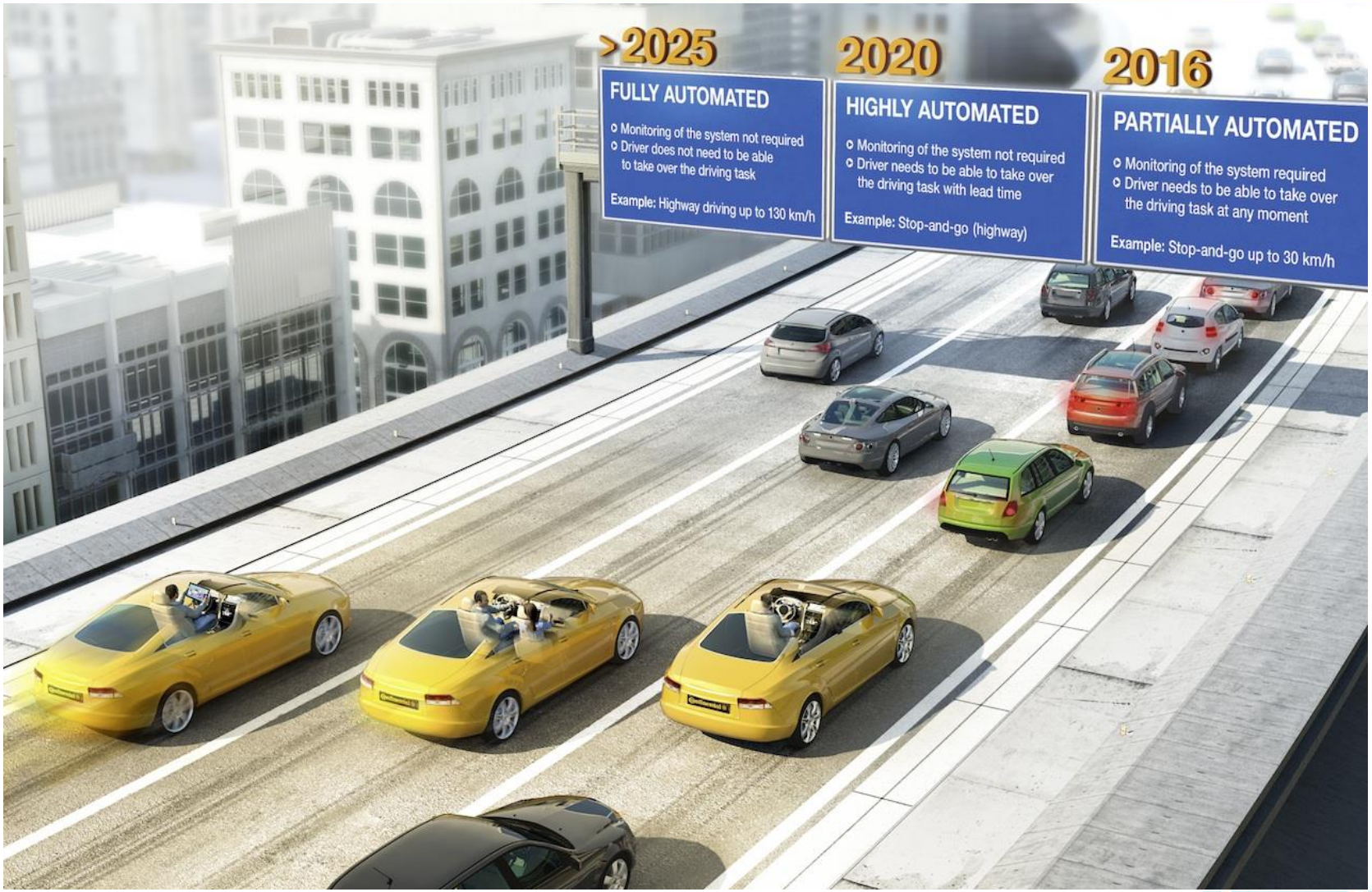
Continental ADAS Roadmap



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ADAS Legislation

- **New safety criteria for EU starting in 2014 requires active emergency braking as standard feature to achieve 5 star NCAP rating**

Rating category	Adult Occupant Protection (AOP) 	Child Occupant Protection (COP) 	Pedestrian Protection (PP) 	Safety Assist (SA) 
New criteria	AEB City	Passive safety	AEB pedestrian	Intelligent Speed assist AEB inter urban LDW/LKS
Description	Autonomous brake <20km/h		Autonomous brake by ped. detection	Autonomous break in 50-80km/h
Typical technology	LIDAR (10m)		Sensor fusion (Camera + Radar)	Long range radar (200m)
Installation requirement for 5 star	100% in '14	100% in '14	100% in '16 (push out from '14)	50% in '14-'15 70% in '16 100% in '17

NCAP = New Car Assessment Program

Upcoming Legislation by Region

- Emergency braking systems will be counted in star-rating from 2014 in Euro-NCAP
- Ratings will plan to cover Pedestrian AEB in 2016

In Effect / Confirmed
In Discussion

Region	Authority	2012	2013	2014	2015	2016	2017	2018	Comments
US	NCAP (NHTSA)	**FCW / LDW** (standard / option)							
				AEB (vehicle)					
	IIHS			**AEB** (vehicle)					
EU	Euro-NCAP		**SAS** (Speed Assistance System)						Fit Rate: 50% '13, 70% '15, 100% '16
				AEB - City					100% req'd
				AEB - Inter Urban					Fit Rate: 50% '13, 70% '16, 100% '17
				LDW / LKA					Fit Rate: 50% '13, 70% '16, 100% '17
						AEB (pedestrian)			100% req'd
JPN	J-NCAP			**AEB** - (vehicle)					
					AEB (pedestrian)				
						LDW / LKA			
							Nighttime AEB (pedestrian)		

FCW: Forward Collision Warning
LDW: Lane Departure Warning
AEB: Automatic Emergency Braking
LKA: Lane Keeping Assist

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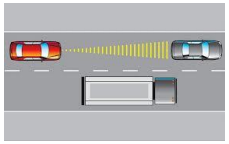
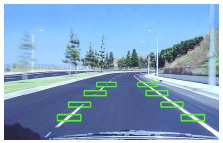
Target ADAS Applications FPGA

Forward Looking Sensor Fusion, Stereo Vision

Collision Warning & Traffic Sign Recog.



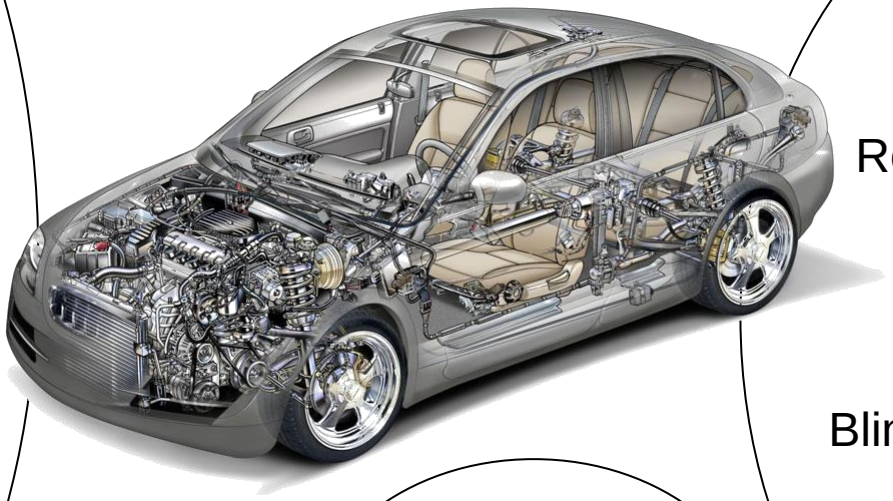
Adaptive Cruise



Lane Departure

High Beam Control

Driver Monitoring



Night Vision

Heads Up Display

Surround View, Smart Rear View

Rear Camera Park Assist

Blind Spot Detection

Surround View

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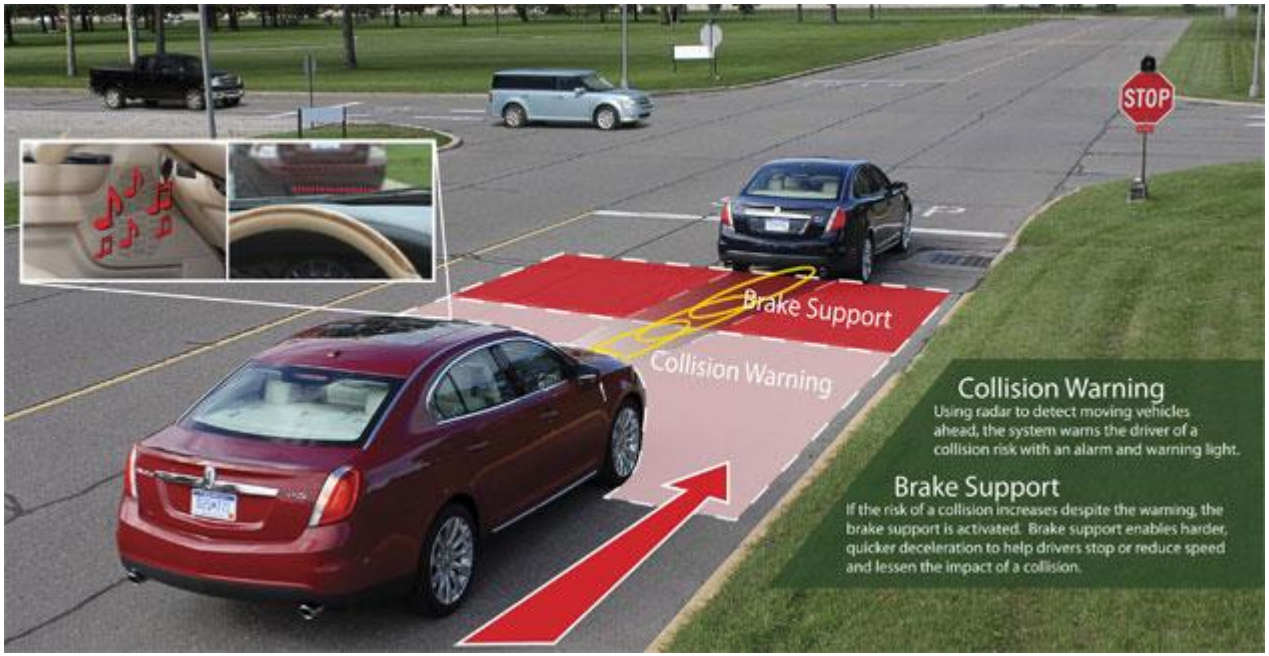
Forward Looking Applications – Collision Avoidance



App Requirements:

Radar, laser or camera sensors

Higher safety level – ASIL C or D

Can leverage sensor fusion – forward radar and video sensors or stereo vision

HD video sensor at 30+ FPS

Low latency video processing

2016 Units (K)	Fit Rate	ASP
10,520	10.7%	$166

Altera Fit: Cyclone V SoC FPGA image sensor IF/processing, fusion, analytics

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Forward Looking Applications – Pedestrian Detection

App Requirements:

Primarily camera sensor used for detection

VGA to HD image sensor

Capable of detection in wide variety of environments (day/night/city)

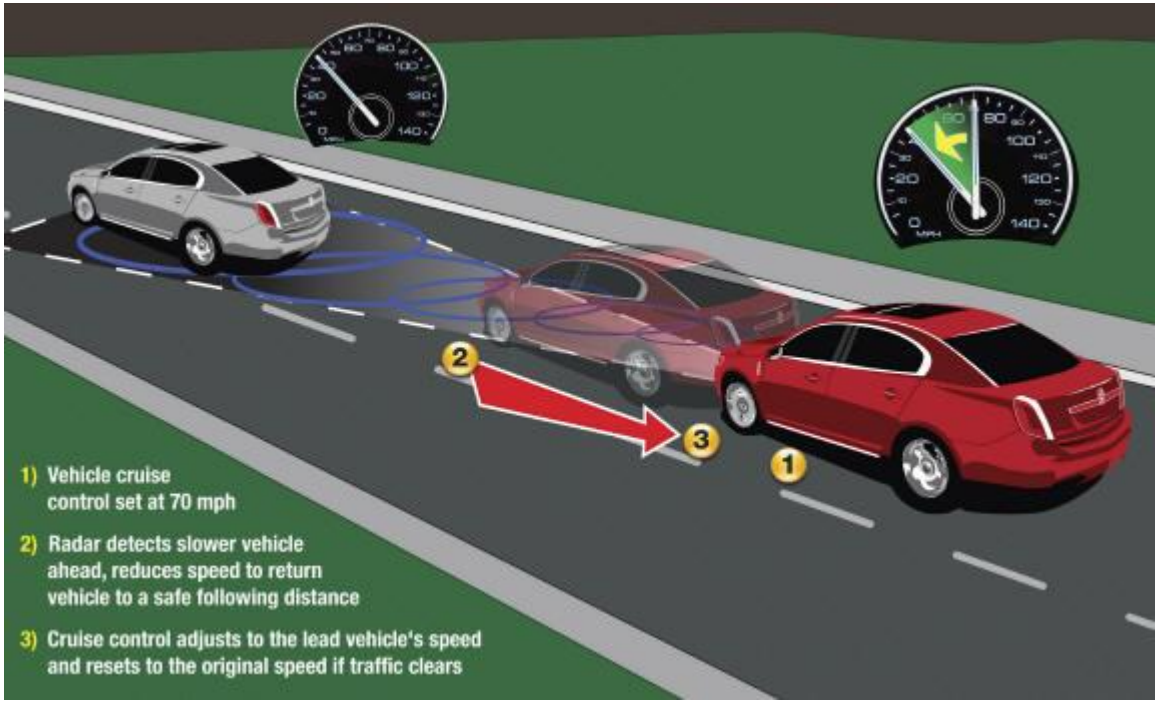
Intelligent video analytics algorithms for object classification

High probably of detection (POD) rates >95% and low false alarm rates

2016 Units (K)	Fit Rate	ASP
10,520	10.7%	$166

Altera Fit: Cyclone V SoC FPGA image sensor IF/processing, analytics

Forward Looking Applications – Adaptive Cruise Control



App Requirements:

Achieved using radar, lidar and/or stereo camera sensors

Higher safety ratings (ASIL C or D)

Low latency

Work in variety of scenarios (highway, curves, multi-lane traffic)

Leverage same sensors as other applications and can be added as software upgrade

2016 Units (K)	Fit Rate	ASP
3,061	3.1%	$169

Altera Fit: Cyclone V SoC FPGA image sensor IF/processing, fusion

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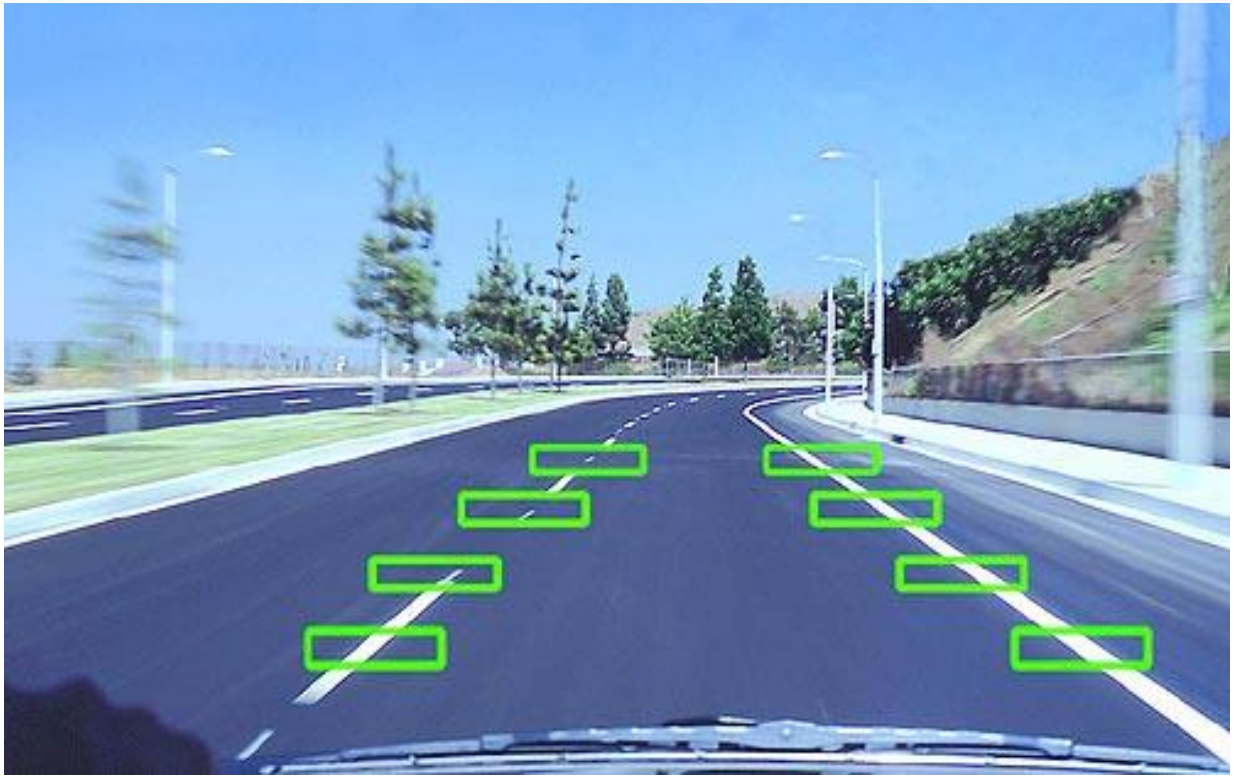
Forward Looking Applications– Lane Departure Warning



App Requirements:

VGA to HD image sensor, 25+fps, >45º horizontal FOV

Uses forward or rear facing cameras

Operates at highway speeds

2016 Units (K)	Fit Rate	ASP
5,685	5.8%	$84

Altera Fit: Cyclone V/SoC FPGA image sensor IF/processing, analytics

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Forward Looking Applications – Traffic Sign Recognition

App Requirements:

Requires HD 720p cameras at 30+ fps

High probability of detection >95%

Yet to be introduced system will monitor speed of vehicle and compare to road sign

Significant challenge to adapt to all types road signs worldwide

Can leverage existing forward sensors (no added HW costs)

2016 Units (K)	Fit Rate	ASP
2,450	<1%	N/A

Altera Fit: Cyclone V SoC FPGA image sensor IF/processing, analytics

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Forward Looking Applications – Surround View

App Requirements:

2-6 VGA to HD Image Sensors

Image stitching, fisheye correction

Integrated with video analytics for multi camera object detection

Operates at speeds less than 5 mph

2016 Units (K)	Fit Rate	ASP
1,473	1.5%	$294

Altera Fit: Cyclone V FPGA image sensor IF/processing

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Forward Looking Applications – Blind Spot Detection

App Requirements:

Utilize 24GHz short range radar, camera or ultrasonic sensors

External CAN MCU for communications

Radar range 45m range on side, 20m behind

<100MHz CPU,DSP
<3.7W total power

2016 Units (K)	Fit Rate	ASP
4,977	5.1%	$168

Altera Fit: Cyclone V FPGA digital radar processing

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Forward Looking Applications – Camera Park Assist

App Requirements:

VGA to MegaPixel Camera

Direct connection to Display
Via LVDS (FPD Link or simlar)

Graphics overlay, fisheye correction

Smart camera – object detection algorithms

Small form factor (12x12)

Low power (<1W)

2016 Units (K)	Fit Rate	ASP
21,867	61.1%	$39

Altera Fit: Cyclone V FPGA/SoC ECU processing

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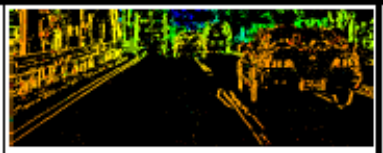
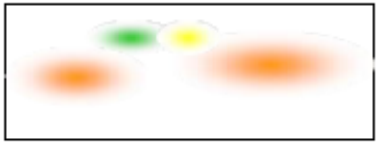
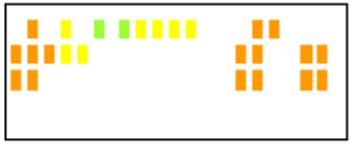
ADAS Sensor Types

FPGA / SoC fit? ✓ ✓ ✓ ✓

Type	Camera		Radar	Laser Scanner
	Mono Camera	Stereo Camera	Mm-wave radar	LIDAR
Signal Image				
Detectable Object	Predefined object (i.e. vehicles)	Able to detect object regardless of its shape and material	Able to detect object which reflects Radio wave	Able to detect object which reflects Light wave

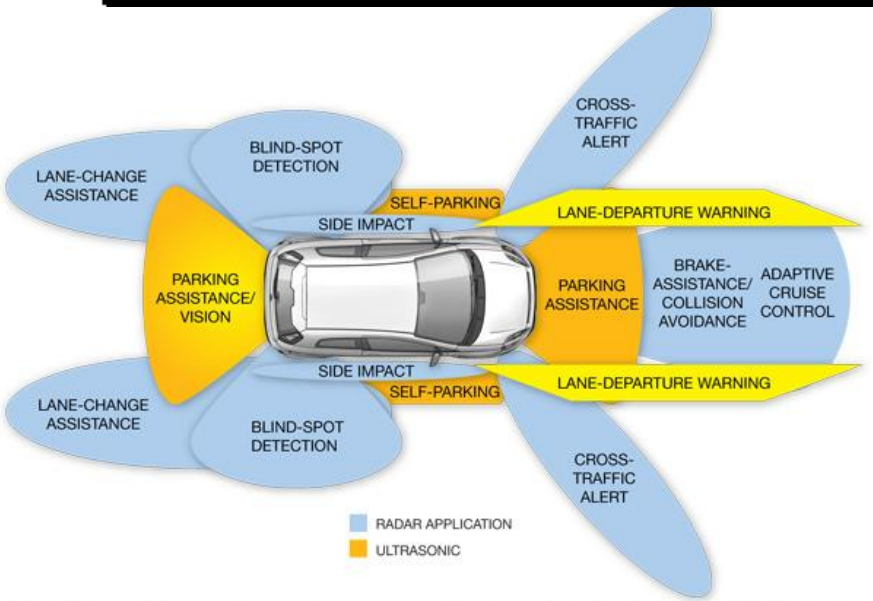
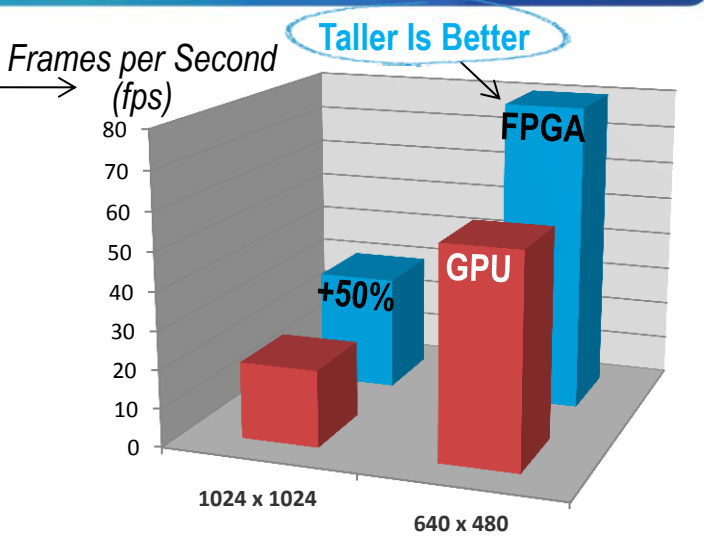


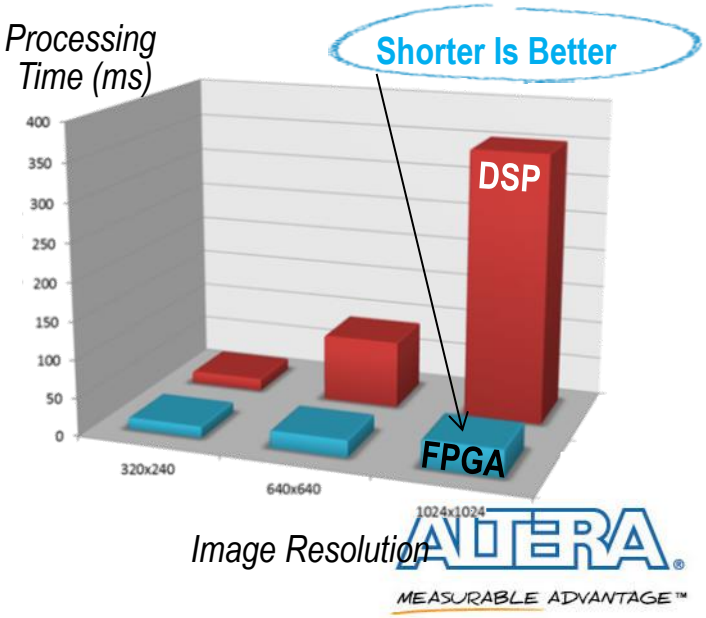
Figure 2 Several driver-assistance systems are currently using radar technology to provide blind-spot detection, parking assistance, collision avoidance, and other driver aids (courtesy Analog Devices).

ADAS Application	Camera/IR Camera	Radar	Ultra-sonic	Laser / Lidar
Lane Departure Warning	X			
Traffic Sign Recognition	X			
Night Vision	X			
Intelligent Headlight Control	X			
Adaptive Cruise Control	X	X		X
Collision Avoidance	X	X	X	X
Surround Vision	X			
Blind Spot Warning	X	X	X	X
Park Aid	X	X	X	X
Backup Aid	X		X	

FPGA Features & Benefits for ADAS

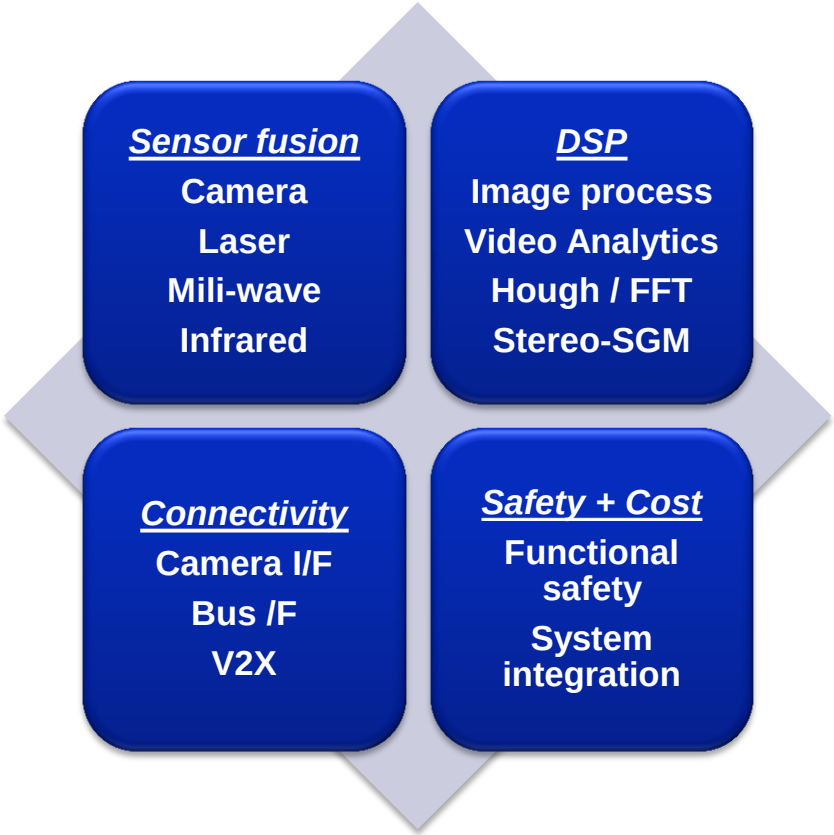
- Higher frame rates
  - Improves image recognition and machine vision, especially for fast motion
- Customizable
  - Allows OEMs and Tier 1s to differentiate their offerings (vs. fixed function ASICs & ASSPs)
- Scalable – vertical migration
  - Designers can use increased density FPGAs according to their application needs without spinning PCB
- Faster processing times
  - Improved performance for split-second machine decisions, i.e., assisted braking / collision avoidance
- Integration
  - Reduce system cost, minimize BOM, improve reliability (fewer points of failure)





ADAS challenges

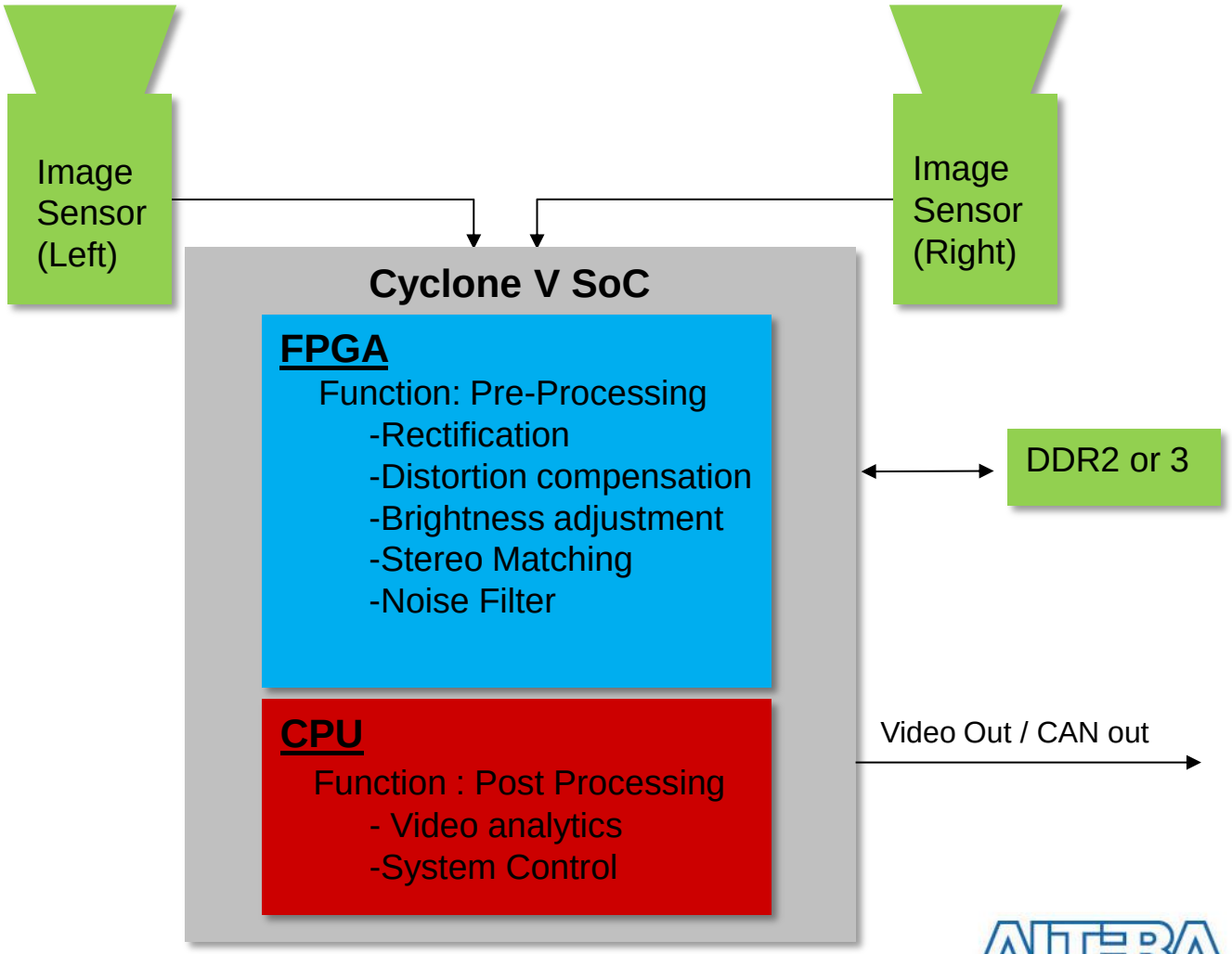
- **Evolving technology with new methodology**
  - Rapid innovation within 4+ years development cycle
- **Performance bottleneck of processors**
  - Increase performance while reducing power consumption and cost
  - Massive parallel processing
- **System cost reduction while ensuring safety**
  - System integration with automotive quality and safety standards
  - Lower total cost of ownership (TCO)



ADAS System Block Diagrams & Demos

FPGAs in ADAS - Stereo Vision Block Diagram

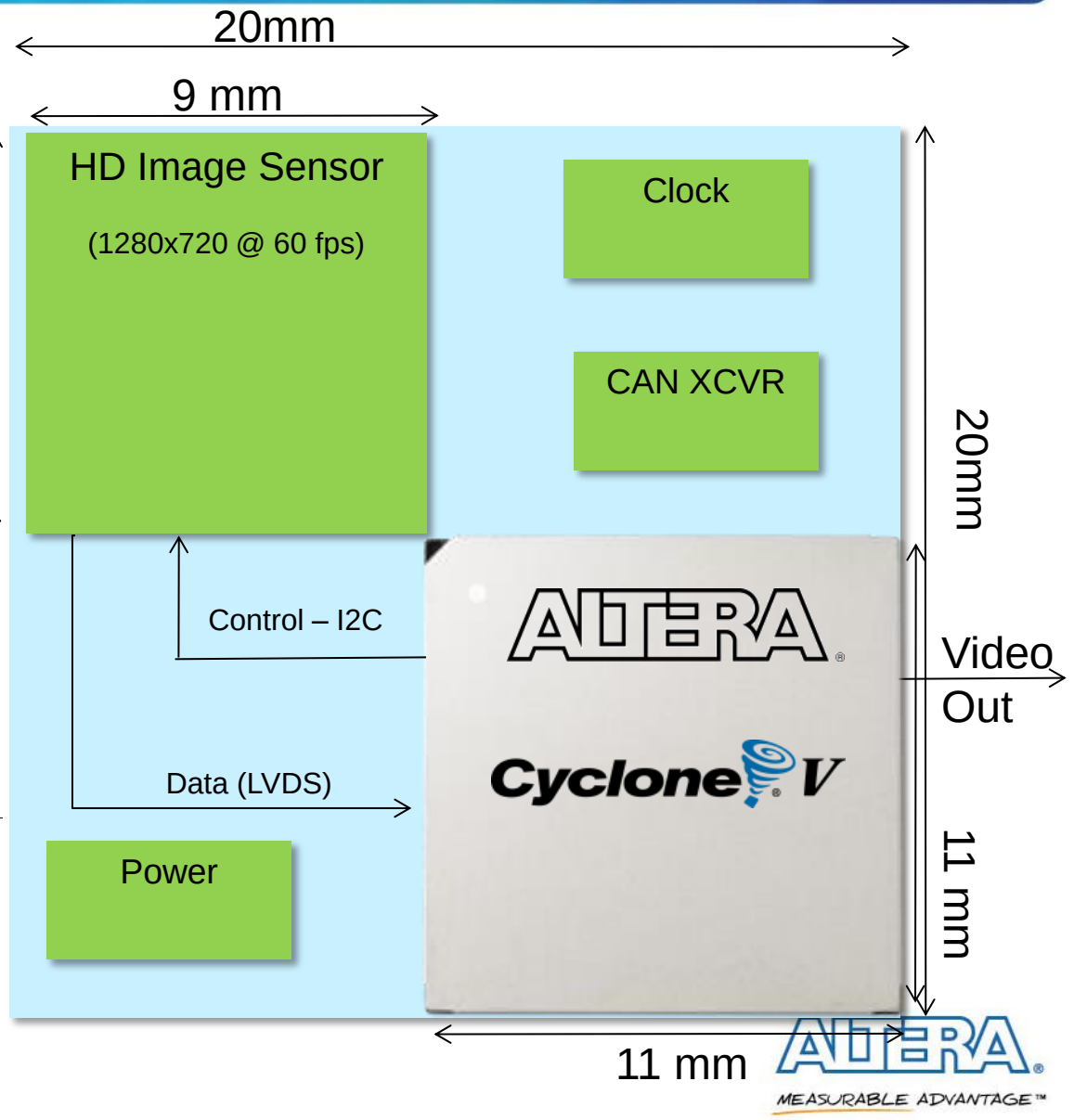
- **FPGA Functions**
  - Stereo camera Front end image processing
- **FPGA Requirements**
  - Logic size (>110KLE)
  - performance of CPU
  - Power (<2~3W)
  - Cost
- **Recommended solution**
  - Cyclone V SoC



SAD = Sum of Absolute Differences (algorithm)

FPGA "Fit" in Rear View Camera Apps

- **FPGA Functions**
  - Sensor control
  - Image processing
  - I/O translation
- **FPGA challenge**
  - Size (20mm^2 PCB)
  - Need.5mm ball pitch packages to fit
  - Power (1.5W)
  - Cost <$10
- **Recommended solution**
  - Cyclone V GX in M301 small package
  - 50-77 KLE
  - Caution: may still not hit power requirement



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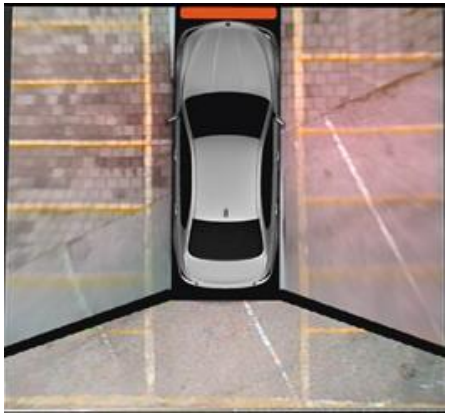
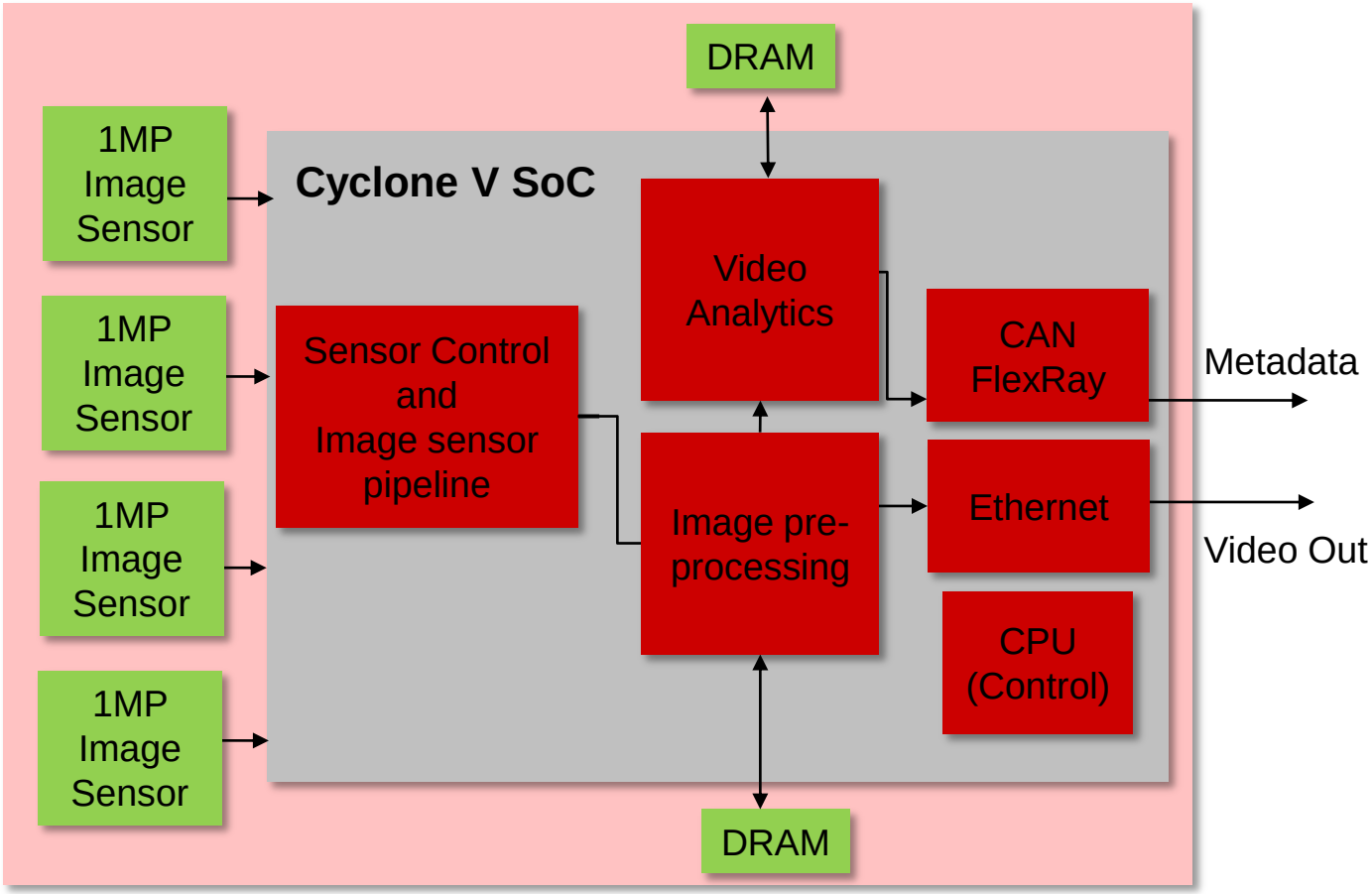
Surround View System Diagram





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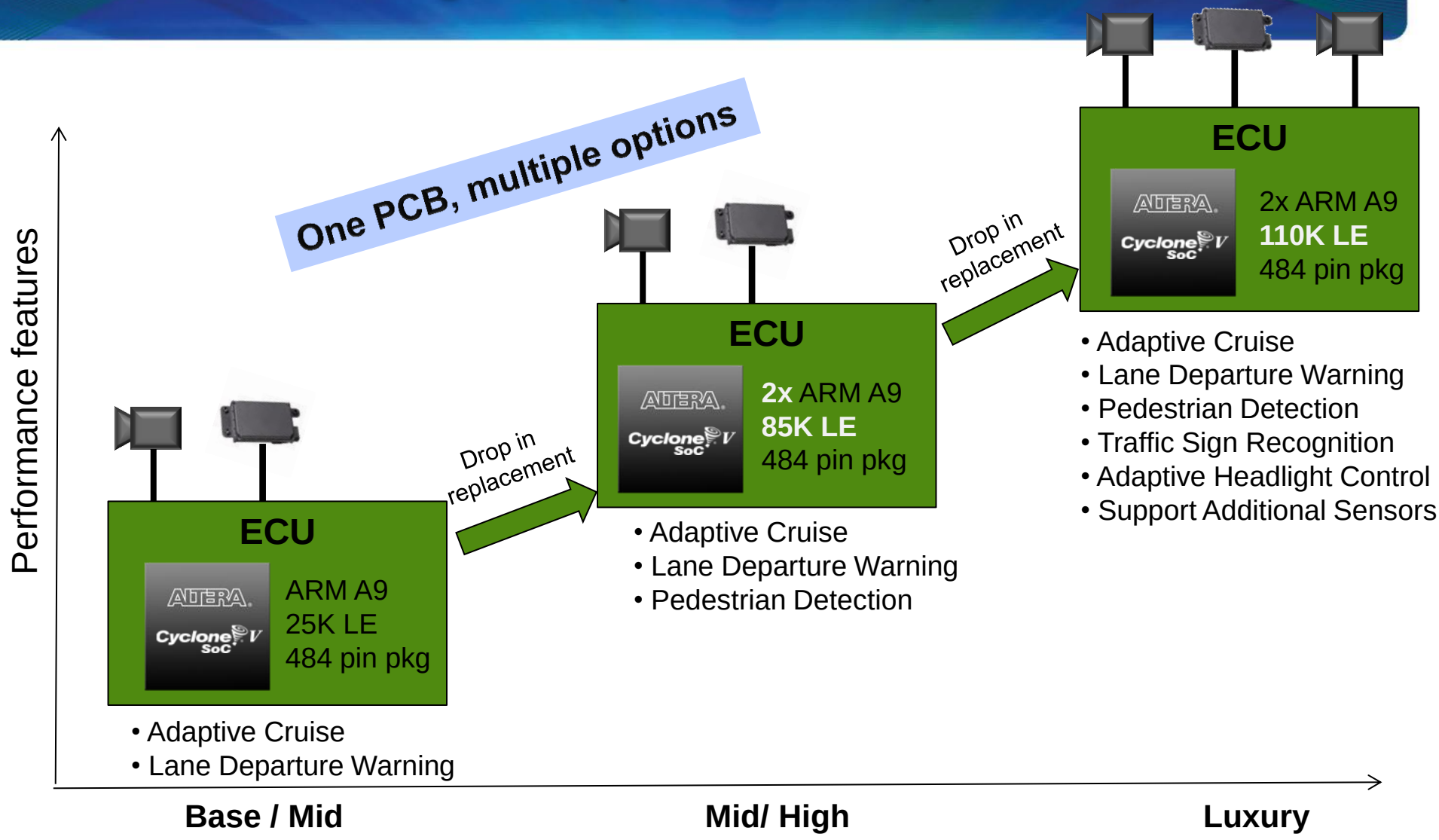
FPGA Vertical Migration (Radar fusion)



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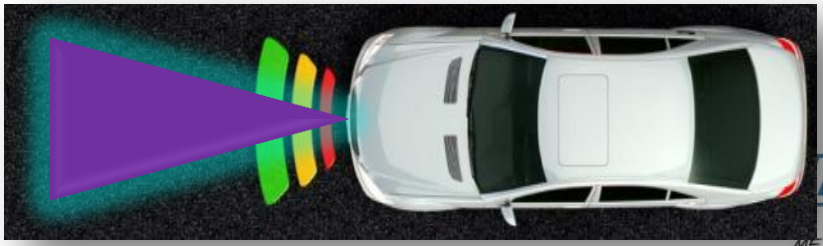
Sensor Fusion Demo I

Digital Design Corporation

Partner

- **Applications / IP**
  - Forward looking automotive camera / radar system
  - Nios II, DVI I/O, CAN Radar I/F, I2C, DDR memory controller, custom IP
  - Aptina HD camera, Delphi ESR Radar
- **Device**
  - Cyclone IV,
    - ~25KLE, 2.5Mbits RAM
    - 1W typical power consumption
  - Design ported to Cyclone V SoC
    - Extensive use of new hard IP
      - ARM Cortex A9, CAN, DDR controller, UART
    - ~18KLE – 26% LE savings
    - .3Mbits RAM – 87% memory savings

NEW



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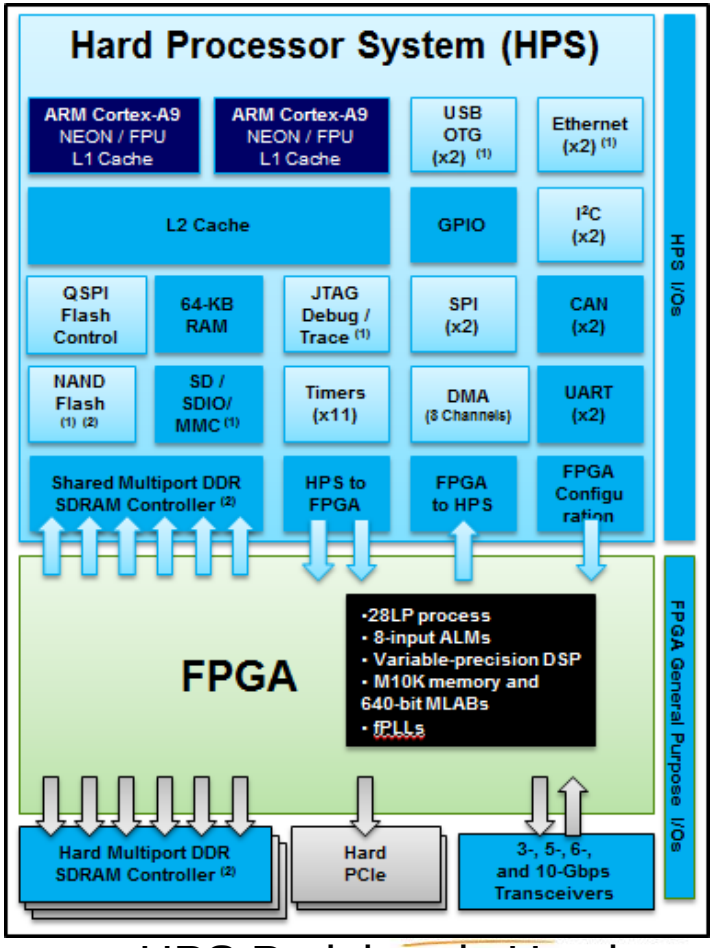
Sensor Fusion Demo II

- **Applications/Hardware**
  - Forward looking automotive camera / radar system
  - Aptina 1MP (720p) image sensor, Delphi 77Gz ESR Radar
  - ARM A9, running Linux 3.7

Resource	Cyclone V SoC	Cyclone IV	Change
LE	17,985	24,341	-26%
Memory bits	329,039	2,524,384	-87%
Pins	202	213	-5%
Registers	9,837	17,111	-43%
Power (static/dynamic)	343mW	915mW	-63%
Power (I/O)	830mW (SDI xcvr used)	156 mW (no xcvr used)	N/A



HPS Peripherals Used

Stereo Vision IP Demo

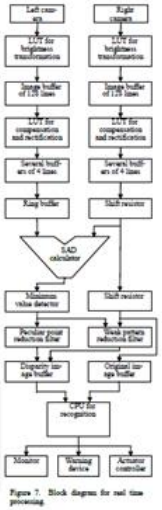
Radiation Research and Management Center
Tokyo Institute of Technology
SANEYOSHI LABORATORY

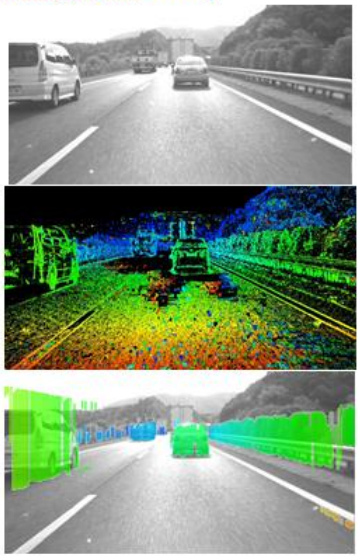
- **Prof. Saneyoshi developed world's fastest frame rate, highest resolution stereo vision system using Stratix II (<70KLE)**
- **Now developing low cost version using Cyclone IV**

Stereo camera ADAS demo using Altera FPGA (Tokyo Institute of Technology Saneyoshi Lab)

Specification	
Method	Block matching
Algorithm	SAD
System clock	80MHz
Block size	4x4
Line buffer	128 lines
Resolution	1312x688
Frame rate	160fps
Collision avoidance Performance	~200m @100km/h
Logic size	~70KLE

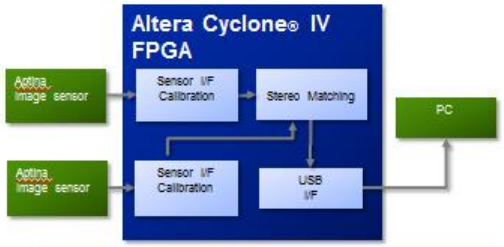
Contact Altera to inquire collaborative research with Tokyo Institute of Technology.
Attn : Takayuki Ikushima
Email: tikushim@altera.com





Stereo Vision Demo System

FPGA based Stereo camera system
(Dr. Saneyoshi / Tokyo Institute of Technology)



Demo system
- ✓ Velocity, Range : 100km/h, >100m
- ✓ Image sensor: 752x430, 60fps, FOV 40°
- ✓ Latency : 4msec
- ✓ Power : 5W (FPGA: 2W)

Stratix II demo (available)
160fps, 902Kpixel, 70KLE

Cyclone IV demo (development)
60fps, 323Kpixel, <25KLE

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Intelligent Rear View Camera Demo

Partner

- **Applications / IP**
  - Intelligent automotive back-up camera, video surveillance
  - Same as fisheye demo plus: Eutecus video analytics IP, CAN or Ethernet metadata streaming, PC GUI for core parameterization
- **Device / resource utilization**
  - Cyclone IV FPGA
  - Entire design = 108KLE, 46KLE for analytics
  - 2.1W total FPGA power consumption

Summary

- **ADAS market growing to over $17B by 2020**
  - Every OEM, Tier 1 is developing ADAS technology with goal of autonomous driving experience
- **FPGAs ideal fit for ADAS applications with constantly changing algorithms, sensors and need for differentiation**
  - Scalability, flexibility, low power and performance
- **Altera is dedicated to automotive providing products, solutions and demos for key ADAS applications**
  - Forward facing, surround view vision and fusion applications

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Thank You!