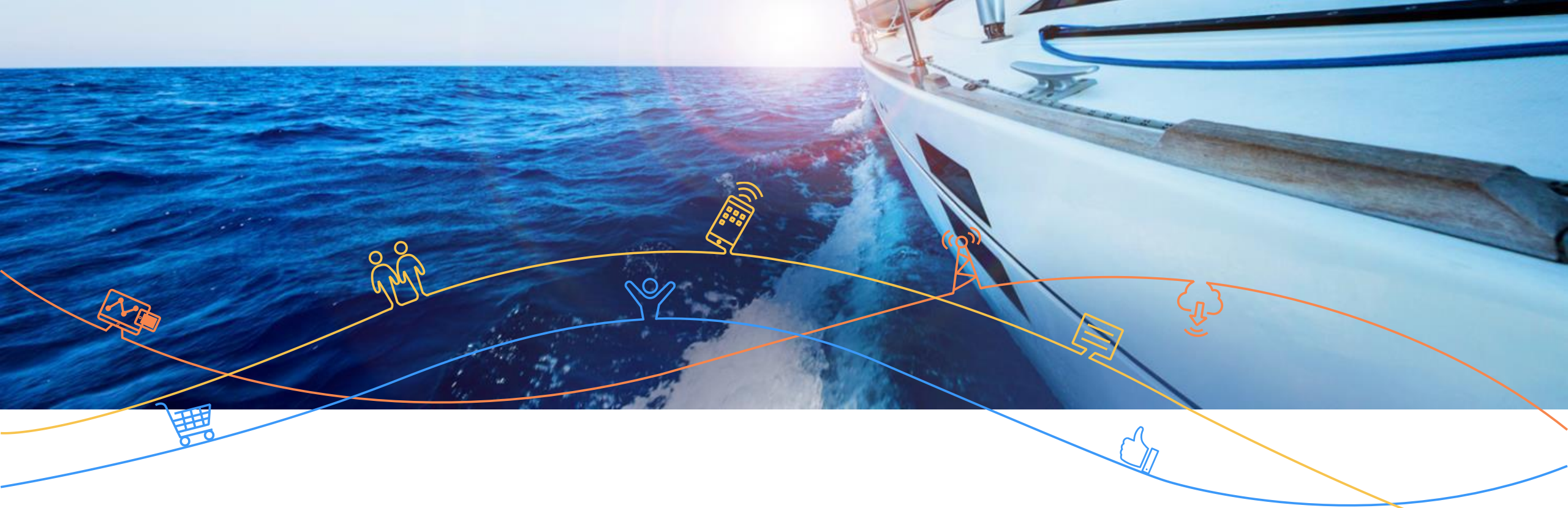


Use Case-Requirements for Camera and Backbone

Xingxin Zhang
Intelligent Automotive Solution Business Unit, Huawei
September 2019

Case one-Automotive Camera

Image Quality vs Bandwidth

30 FPS	Hres	Vres	Fps	12bit	14bit	16bit 96dB	20bit 120dB	24bit 140dB	32bit 180dB
720p	1280	720	30	0.41	0.48	0.55	0.69	0.83	1.11
1080p	1920	1080	30	0.93	1.09	1.24	1.56	1.87	2.49
2k	2560	1440	30	1.66	1.94	2.21	2.76	3.32	4.42
3k	2896	1876	30	2.44	2.85	3.26	4.07	4.89	6.52
4k	3840	2160	30	3.73	4.35	4.98	6.22	7.46	9.95
8k	7680	4320	30	14.93	17.42	19.91	24.88	29.86	39.81

60FPS	Hres	Vres	Fps	12bit	14bit	16bit 96dB	20bit 120dB	24bit 140dB	32bit 180dB
720p	1280	720	60	0.83	0.97	1.11	1.38	1.66	2.21
1080p	1920	1080	60	1.87	2.18	2.49	3.11	3.73	4.98
2k	2560	1440	60	3.32	3.87	4.42	5.53	6.64	8.85
3k	2896	1876	60	4.89	5.70	6.52	8.15	9.78	13.04
4k	3840	2160	60	7.46	8.71	9.95	12.44	14.93	19.91
8k	7680	4320	60	29.86	34.84	39.81	49.77	59.72	79.63

Note： The data rates are in the unit of Gbps, and include 20% protocol overhead

Image quality is determined by three key parameters resolution, dynamic range and frame rate

Observations

- Forward
  - 4k is on the way, maybe not very soon, but very possible in the near 3-5 years
  - 20~32bit @60FPS might be needed for high level autonomous driving features/functions
- Backward
  - Control
  - OTA upgrade
- Power supply
  - Power on wire for space saving
  - Hybrid channel maybe a good option, fiber for forward, cooper for backward & power

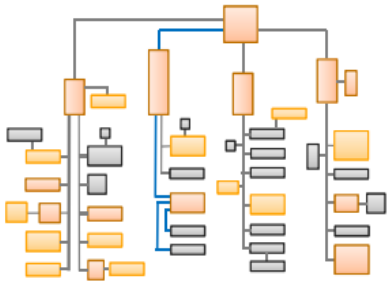
Suggestions

- Asymmetric rate, ≥10Gbps for forward, approximately 100Mbps for backward

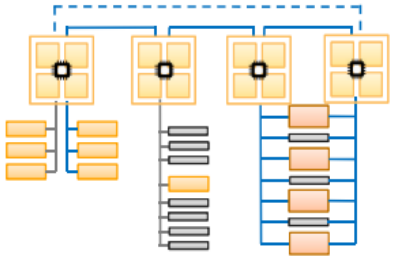
Case two-In-vehicle backbone

E/E architecture evolution

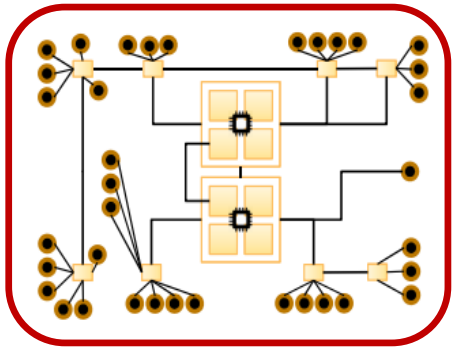
Traditional architecture



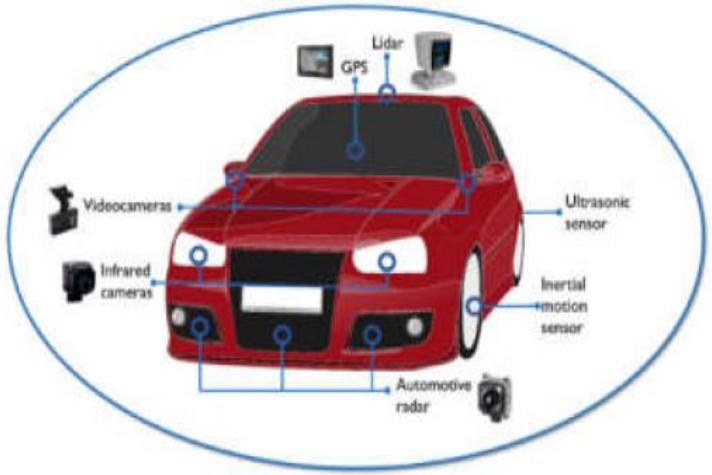
Domain architecture



Zone architecture



Source： Continental



Autonomous Driving Sensors

- 4-6 4k-Cameras
- 6-10 lower resolution Cameras
- 1-4 Lidars with 16/64-line
- 6-10 Radars
- Other sensors …

Observations

- Bandwidth: ≥ 25/50Gbps
  - Zone based architecture seems popular in the future
  - Massive sensor traffic aggregate at Zone Switches, for enabling high level AD features
- Symmetric vs Asymmetric
  - Implementation Specific
  - Symmetric is benefit for flexible AD ECU deployment and function redundancy
  - Asymmetric for lower cost
- EMC issue
  - EMI/EMS would be a big challenge, especial for electric cars

Suggestions

- ≥ 25/50Gbps
- Both Symmetric & Asymmetric are considered

Summary

Multiple Rate levels for different scenarios

- ≥ 25/50Gbps for backbone bidirectional
- ≥10Gbps for Camera forward
- <200Mbps for Camera backward

Support both Asymmetric and Symmetric mode

- Asymmetric only for Camera
- Symmetric and asymmetric for backbone

Hybrid Channel could be a choice for Automotive Camera

- Fiber for forward, cooper for backward & power
- Hybrid cable & connector

Thank you

www.huawei.com