Multi-standard chip for the car industry

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Infotainment automotive system

Audio & Visual

- Audio Head Unit
  - Multizone, rear-seats, headphone
- Multi-standard Radio receivers
  - AM/FM, DAB, DRM, HDRadio
- Multimedia Entertainment
  - Mobile TV

Navigation & Comm

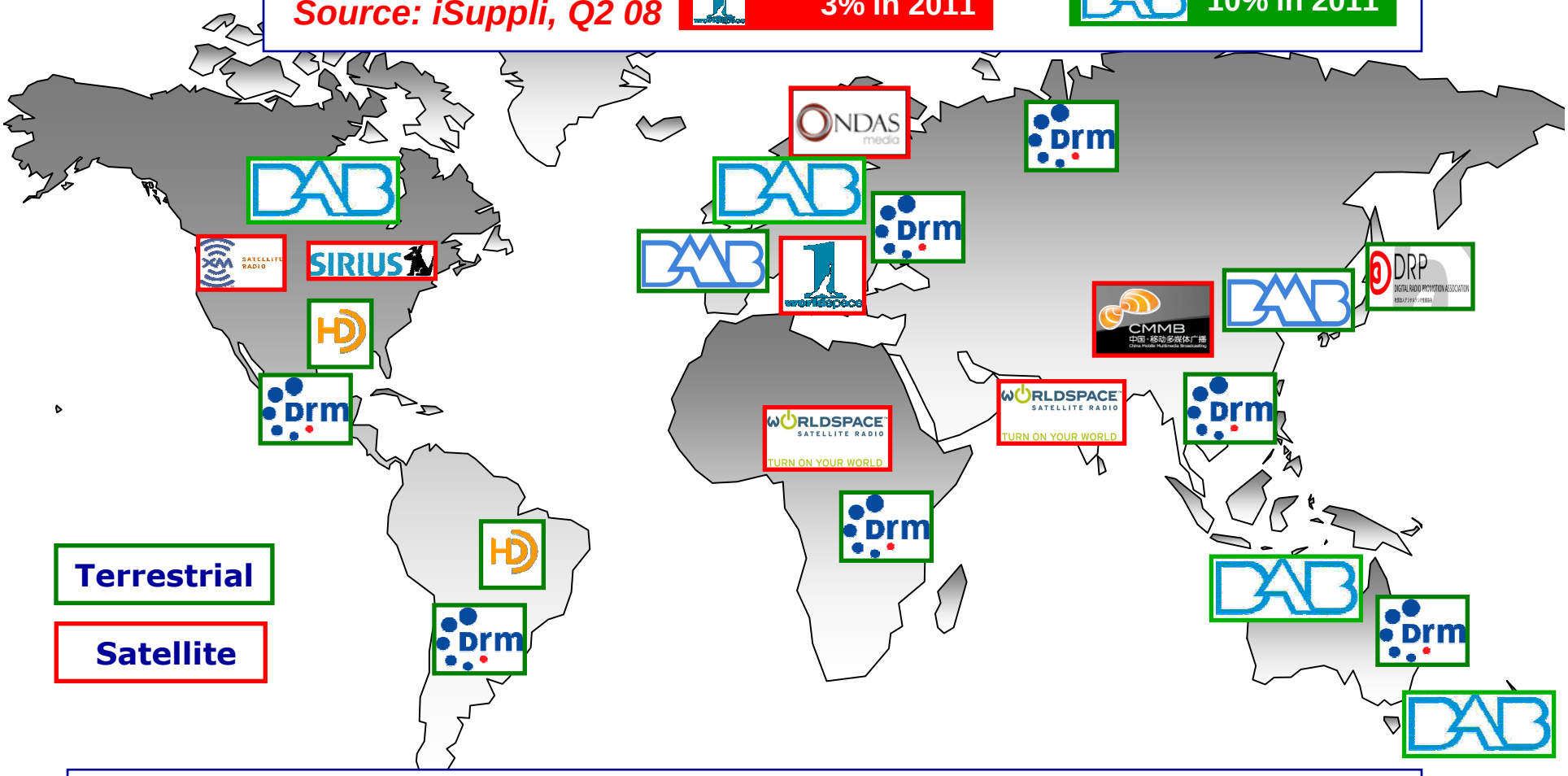
- GPS
- Navigation & Telematics
- Car Connectivity
- Car Communication

Cost and system optimized chip solutions for multi-standard radio receivers have to be defined taking into account that radio is part of the Infotainment system

Competing Digital Radio Standards: Geography

Digital Radio Systems on new cars
Source: iSuppli, Q2 08

- 80% in 2011
- 3% in 2011
- 40% in 2011
- 10% in 2011



Many standards, level of maturity, different expected penetration must be taken into account to set-up a strategy for multi-standard chip for radio receivers

Radio features versus others infotainment features: different dynamics and different approaches

Different storage options

50s

60s

70s

80s

90s

00s

10s

Zenith Royal-T (1953)

Integ'd Power Amp

Integ'd Signal Proc IC

Integ'd RF FE

Digital AM/FM

Digital Broadcast

Increased connectivity, audio and video formats

Radio innovation timing: decades
Multimedia innovation timing: year/months

Silicon System partitioning: proposal

Clear separation between tuner/radio domain and connectivity/multimedia (MCU Sub-system)

Optimized tuner/radio sub-system supporting most common existing radio standards. Tuning and optimization possible thanks to Multiple core approach. Independent from MCU subsystem

Premium real-time performances, no bottlenecks, optimized hardware implementation for critical tuner blocks, low current consumption and low EMI, optimized interfaces versus RF chip (noise, timing)

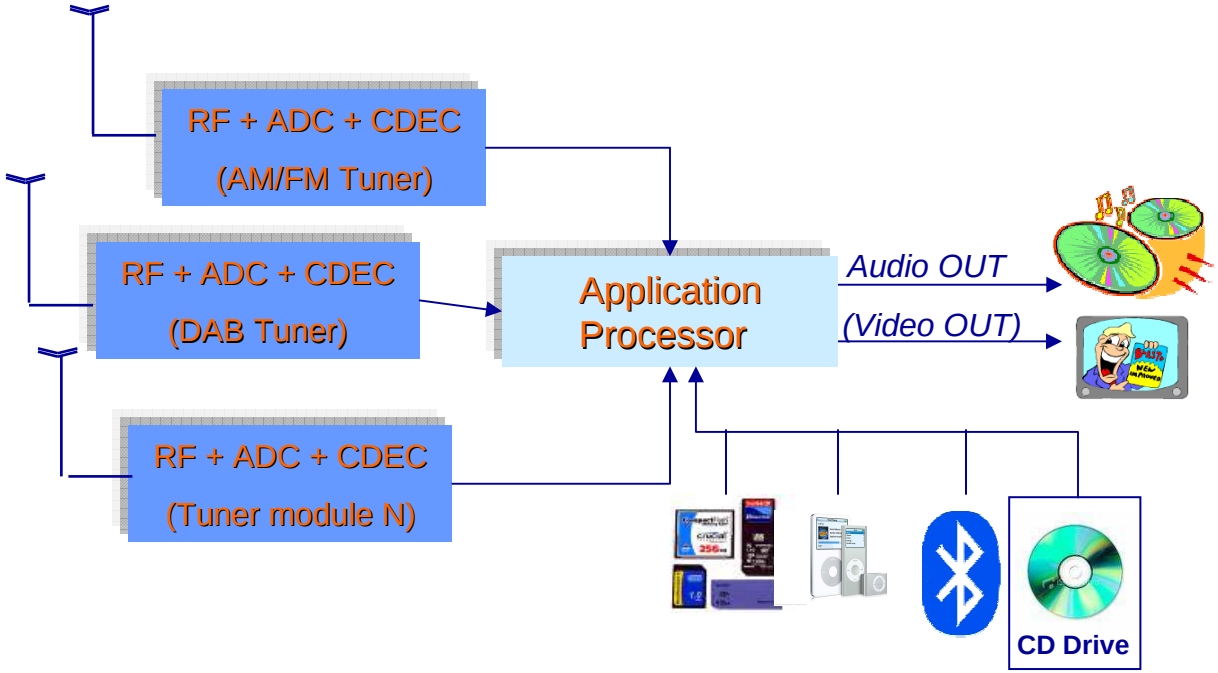
Multistd Tuner/Radio Sub-system

Fully flexible connectivity/multimedia sub-system supporting both low-end OS and standard OS (Win, Linux): easy and fast new software IPs integration.

Possibility to introduce faster changes according to advanced multimedia features dynamics.

MCU Sub-system

System partitioning and IC specification

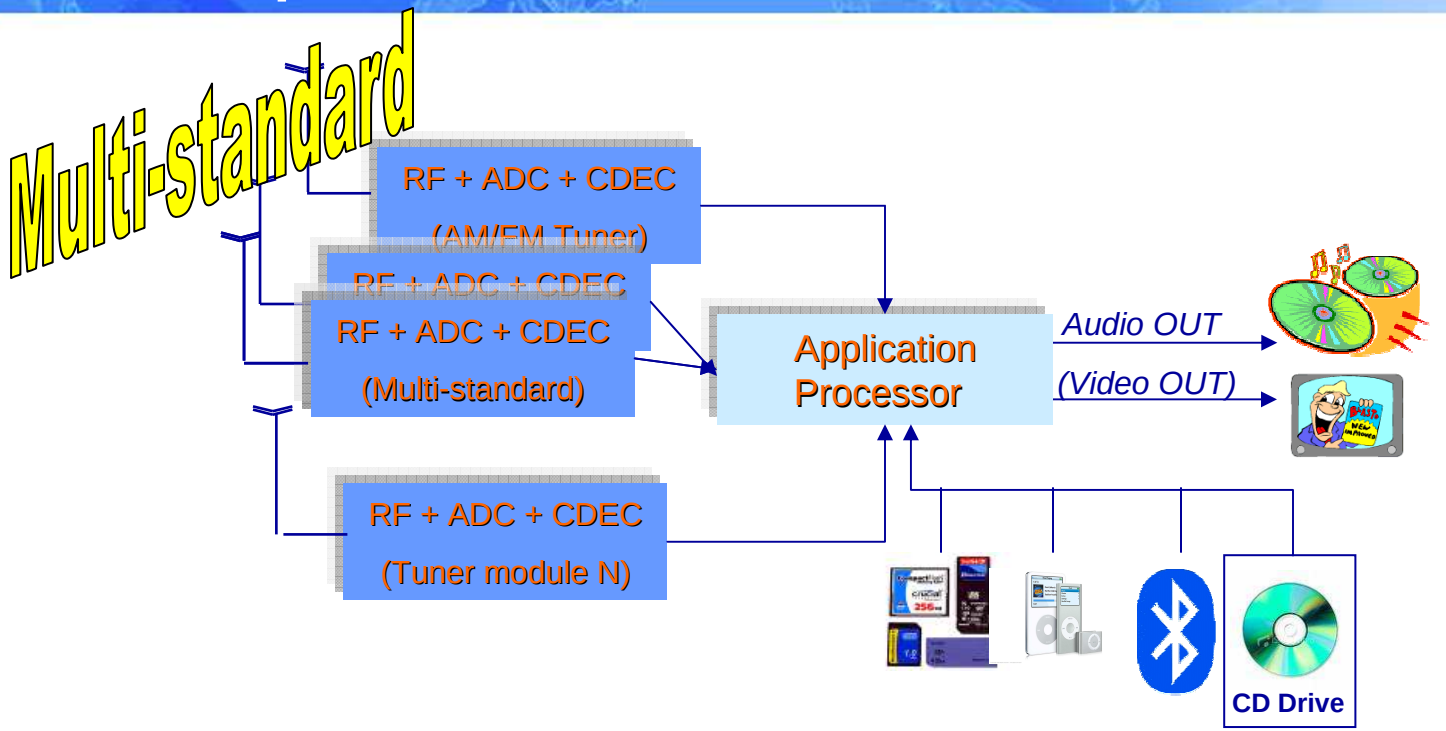


Tuner module(s) including RF and channel decoder ASSP + Application Processor for source decoding and connectivity

- **Simple**
- **Flexible**
- **Modular : easy to add/integrate a new tuner module**
- **No features duplication: all source decoders on the application proc**

A further step of integration allows cost optimization for multi-standard radio systems (i.e. AM/FM + DAB/DAB + DMB-A)

System partitioning and IC specification: multi-standard chip



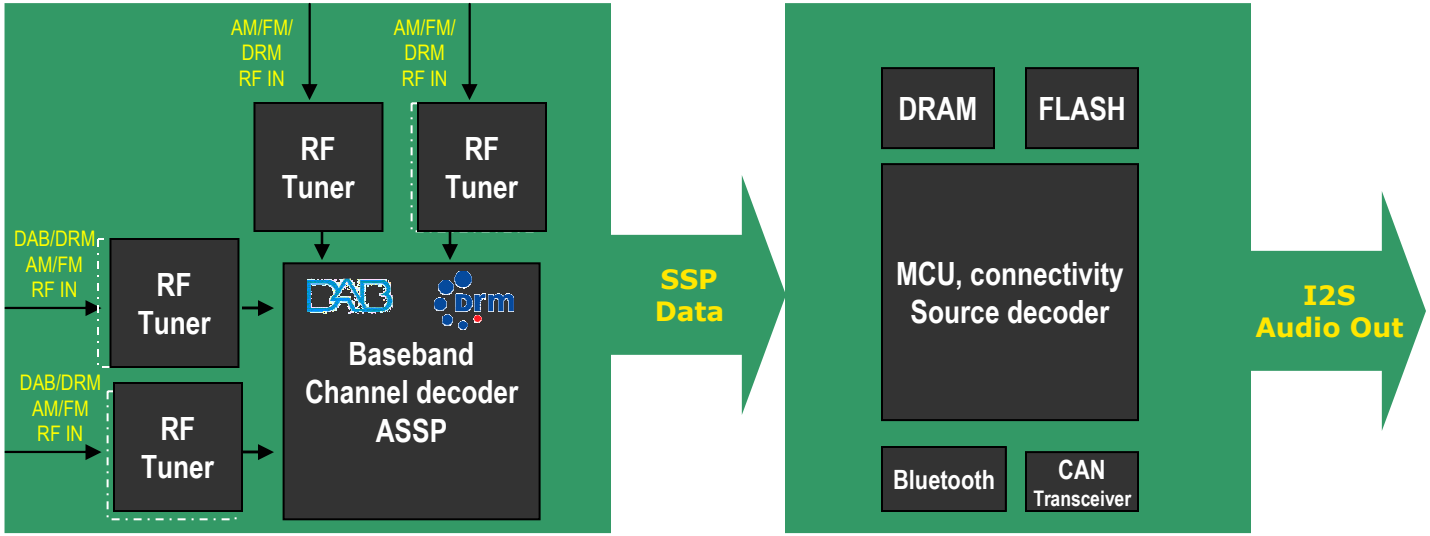
This partitioning allows a simple and efficient evolution versus multi-standard chip for the digital radio receivers

Combination of more tuners systems into multi-standard chip are cost efficient as the penetration of the different systems are relevant and comparable in %.

Examples of multi-standard chip solution: AM/FM phase diversity, dual DAB, DRM

Tuner/Radio Sub-system

MCU Sub-system



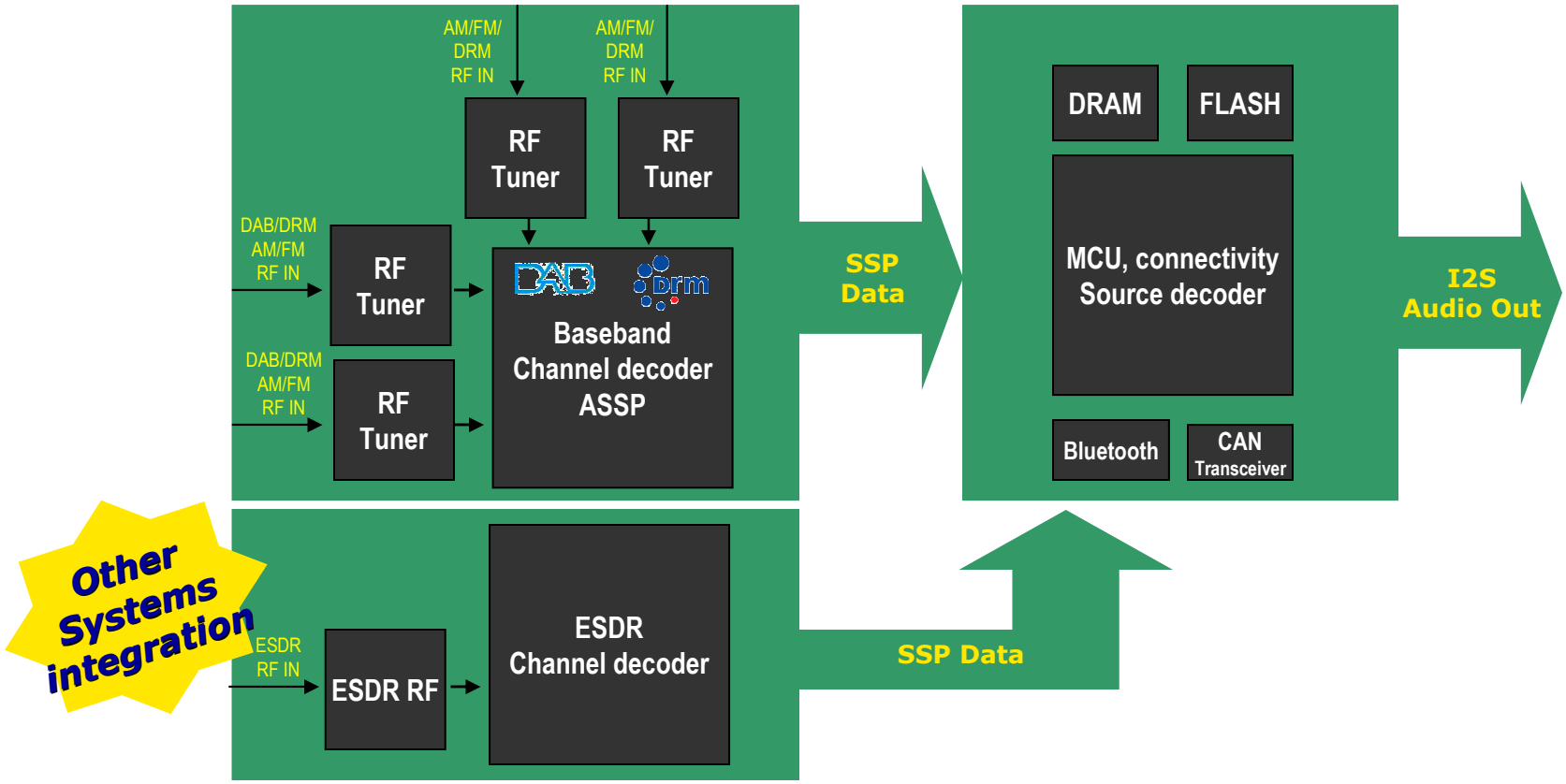
Radio features:
- AM/FM phase diversity + RDS
- DAB+/DMB-A single/dual channel decoder
- DRM channel decoder

Multiple RF chains for parallel demodulation
- AM/FM+DAB or dual DAB or AM/FM+DRM
- Scalable RF: support 1 to 4 RF chip

Standard ARM platforms and OS
- Audio decoder, video (optional)
- Connectivity :Bluetooth, USB
- System Controller, HMI

Wide choice of application processor to address:
- Different level of connectivity
- Different HMI, display

Multi-standard chip solution: integration of other systems (i.e. ESDR)



High complexity (i.e. ESDR) or proprietary systems may not be easily and efficiently integrated into multi-standard chip solution.

ASSP comparison versus SDR

Channel decoder ASSP + Application processor for source decoder

- Flexibility: world radio, common application processor
- Modularity: easy to adopt new standards/tuner module
- Optimized hardware implementation for critical CDEC blocks
- All CDEC DRAM can be embedded.
- Small pin count CDEC processor
- Lower current consumption
- Wide choice of Application processors: including connectivity or A/V features for video DMB. Various OS supporter: CE, Linux
- Efficient combination with other systems (i.e. ESDR). Application processor/SDEC shared
- Optimized interfaces: noise, timing

Software Digital Radio: general purpose processor

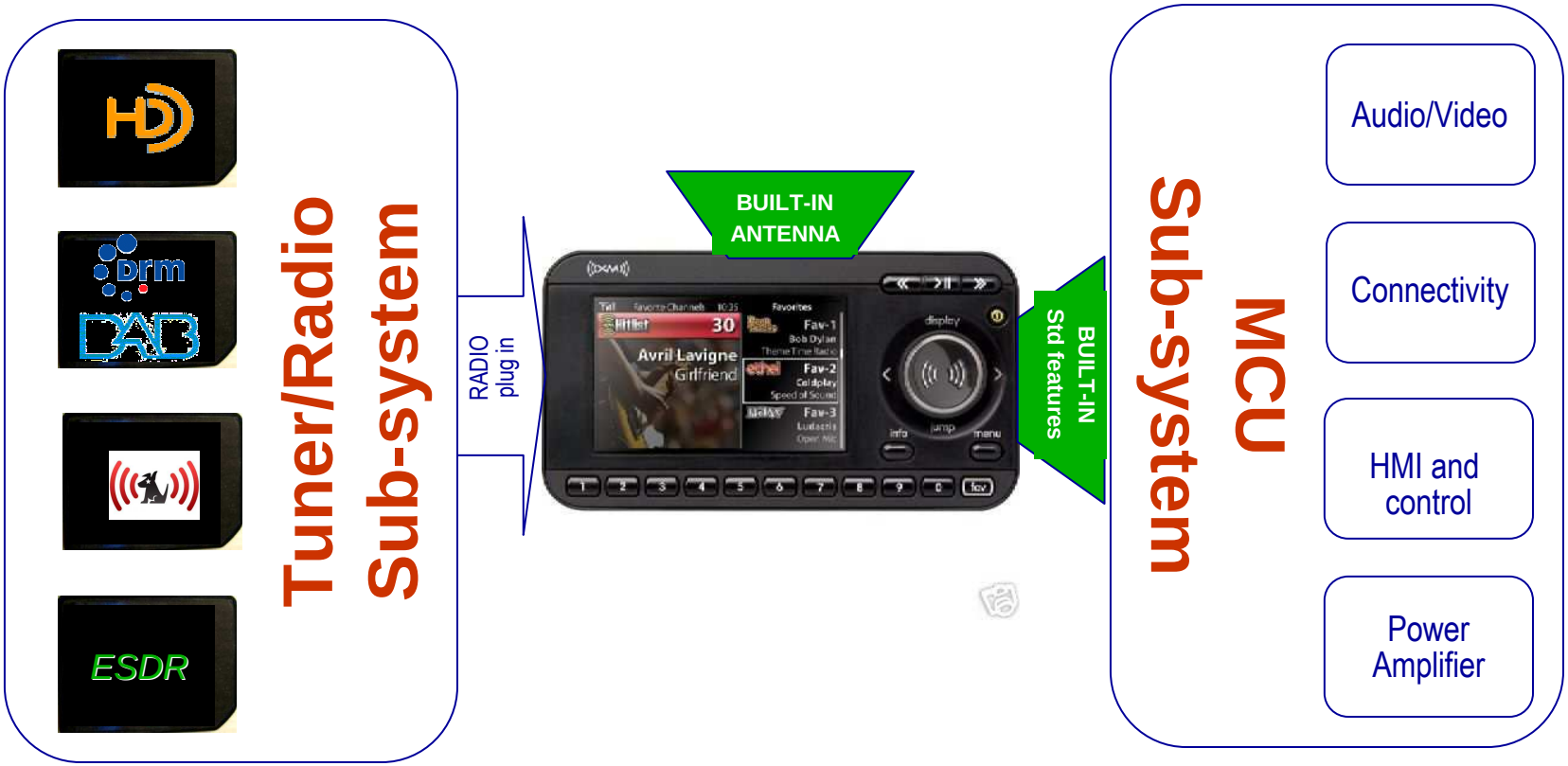
- Software/firmware complexity: difficult to debug and control (unexpected software behavior)
- Real time constraints does not fit general purpose architecture: difficult MIPS budgeting.
- Inefficient implementation of intensive signal processing algorithms (i.e. RS, Viterbi, OFDM demodulators)
- Performance issues with critical parallel tasks execution
- High current consumption due to high speed DSP, RISC engine (600MHz and more!)
- Higher cost overhead to guarantee flexibility for future extensions: potentially difficult combination with other systems
- Tuner requires specific low noise interface: general purpose processor does not have it

Software Defined Radio (SDR) approach may bring some benefits in the early phase of new system introduction and for low volumes. To address more sophisticated systems with high level of parallelism and high volumes, high cost sensitive application, ASSP is in our opinion a better solution. This may change in future with multi-core IC (>>1 GHz)

A few final remarks…

- Several criteria drive multi-standard chip definition
  - System penetration and maturity
  - Comparable complexity
  - Geography
- Multi-standard chip must be easily and efficiently integrated with the other elements of the Infotainment system
  - Connectivity
  - Navigation
  - Media processor
- Multi-standard chip must be suitable to address different application profiles
  - Allowing a modular/scalable approach with multiple RF configurations
  - To save/preserve development investments
  - To be cost effective
- Software Defined Radio still have some technical and cost drawbacks in respect to ASSP
  - Suitable for new, emerging, less consolidated standard
  - Not cost effective for mature receiver technologies
  - Very high speed requested for high-end application profile (parallel decoding)
  - Possibly the right approach in the future

And to conclude:
a look at our vision for the future



Thank you for your attention!

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