

Embedded network architectures for mobile devices

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Who we are

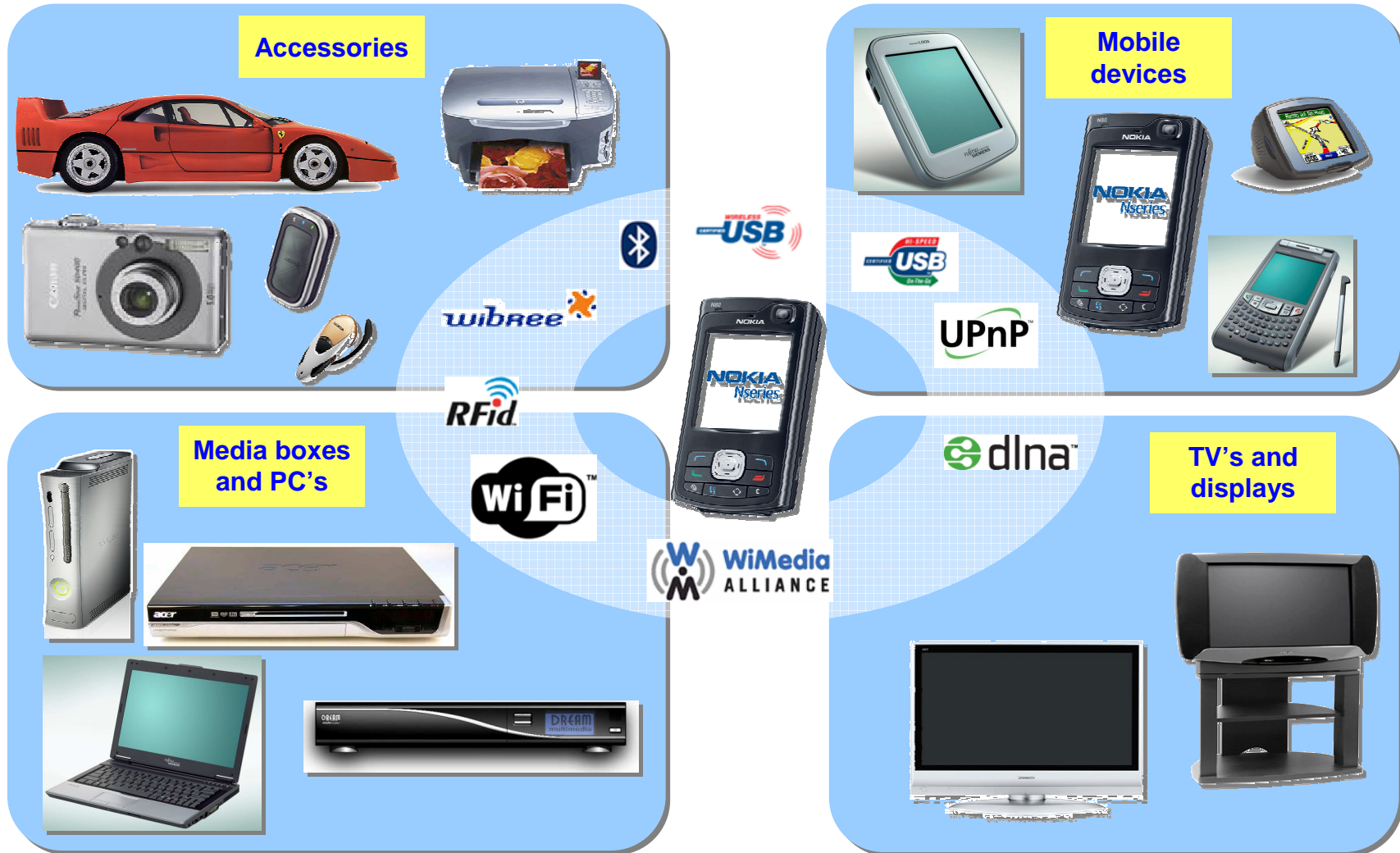
- Organizationally we belong to Computing Structures Core Technology Center of Nokia Research Center, Helsinki
- We are developing interconnect solution for embedded network within mobile device
 - Currently we are looking for wired interconnection solution physically limited to one mobile device
 - Wireless extension to embedded networks is under discussion for the future
- We are members of Nokia's team in MIPI UniPro
- Our main research interests:
 - Chip-to-chip, die-to-die and on-chip embedded networks
 - NoC, SoC

Background

- 5 years ago we started research project looking for a new solution to enable more flexible architectures for mobile devices
- The key problems:
 - Too many different interfaces
 - Increases architectural complexity and maintenance cost
 - Too many pins in ASICs and low bandwidth per pin
 - Serious EMC and mechanical design problems
 - High integration cost
 - Difficult to formalize the integration process and it takes too much time
 - Monolithic architecture is slowing down integration of new technologies
- With the basic facts, we started to investigate networked architectures and interconnect solutions based on high-speed serial links

Local Connectivity landscape, Nokia view as per today

Multitude of standards to be made simple-to-use and to provide interoperability



Requirements

Architecture

Modular generic bus
“globally asynchronous,
locally synchronous”
Minimise CPU intervention

Low complexity
Scalability
QoS

Reuse

Hot swap

Software compatibility
Low latency

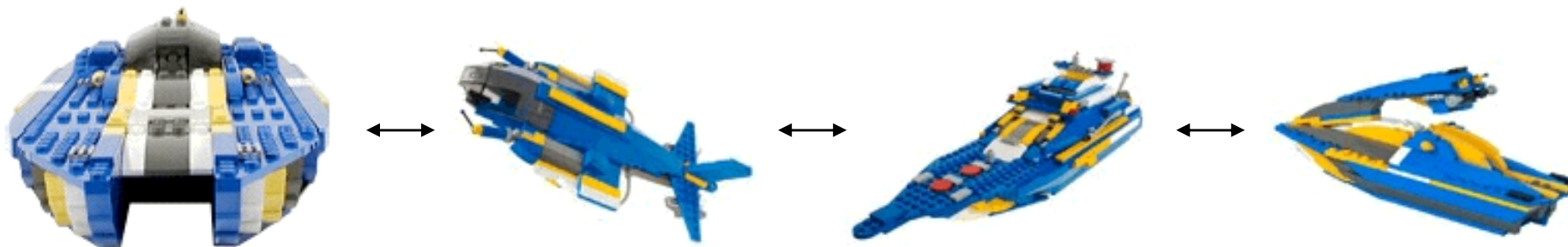
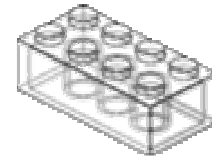
Electrical

1 Gbit/s
4 pins
EMC
Low-power

Protocols

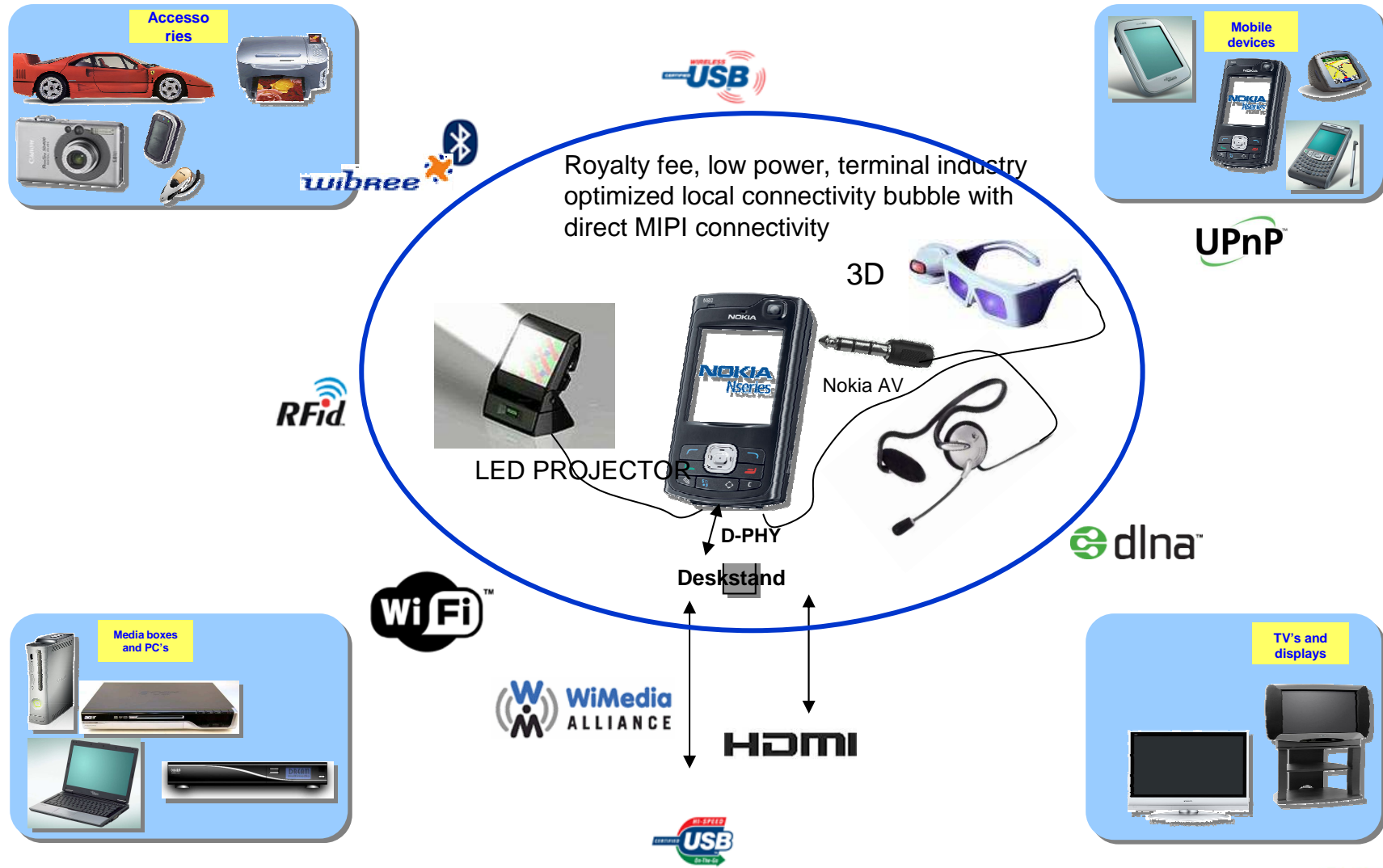
Our approach: Let's play LEGO or Transformers

- What are the LEGO blocks?
 - Engine, modem, camera, display, etc.
- Each block has a standard attachment mechanism
 - Engine has few *sockets* where *anything* can be connected
- With the same basic blocks, many configurations or topologies can be made easily
- Needs a skeleton block to attach all others
 - Network of blocks



Local Connectivity landscape, Proposal using native MIPI I/F:s

Multitude of standards to be made simple-to-use and to provide interoperability



First step: analyze the existing interconnect solutions

- It requires crystallization of criteria that can be used for evaluating candidates
- Our study discovered that **SpaceWire** is one of the most interesting solutions
- As a first evaluation of the network interconnect solution, we created SystemC model of SpaceWire
 - The model follows the SpaceWire specification (ECSS-E-50-12A) and implements all features
- From this work, we have concluded that available version of SpaceWire is not completely fulfilling our needs
 - No QoS support
 - No L4 protocol
 - DS coding is not scalable to xGbit/s
 - Get impression that there is no plans for further development of SpaceWire

Our following steps were:

- Development of the new point-to-point link solution for embedded networks in mobile device
- Development of the SystemC simulating platform for evaluating new model proposals, e.g. a proposal of a new PHY layer
- Development of the new proprietary network interconnect solution
- Ultimately, it lead to creation of MIPI UniPro Working Group and definition of a new protocol (*in progress*)

Mobile Industry Processor Interface alliance (MIPI)

- MIPI has been established by Nokia, ARM and TI in 2004, www.mipi.org
- Alliance is targeted in creating new standards for the mobile industry with lifetime expectancy of 10+ years
- The original focus was solely on processor to peripheral interfaces internal to the mobile device, but later it has been extended to networking architecture and external interfaces
- At the moment MIPI consists of 114 member companies
- The access to produced knowledge is restricted, so based on their financial input the member companies are divided into the following groups:
 - 7 Board Members – driving development of MIPI standards
 - 45 Contributors – participating in the specifications development
 - 62 Adopters – get access to the specifications only after board approval
- MIPI consists of the following Working Groups:
 - UniPro WG, Camera WG, Display WG, Test&Debug WG, Software WG, etc.
- Due to its focus area, UniPro is the key and most critical WG in MIPI

Conclusions

- When looking to existing interconnect solutions few years ago, SpaceWire was our best candidate
- Because features were missing and also because we couldn't see if a new version of SpaceWire would be created and would fulfill better our needs, we started working on a new solution for mobile industry
- The work is moved to a standardization body – MIPI
 - Specification work of new interconnect standard for mobile industry is well on track