Automatic generation of distributed communication in 4DIAC

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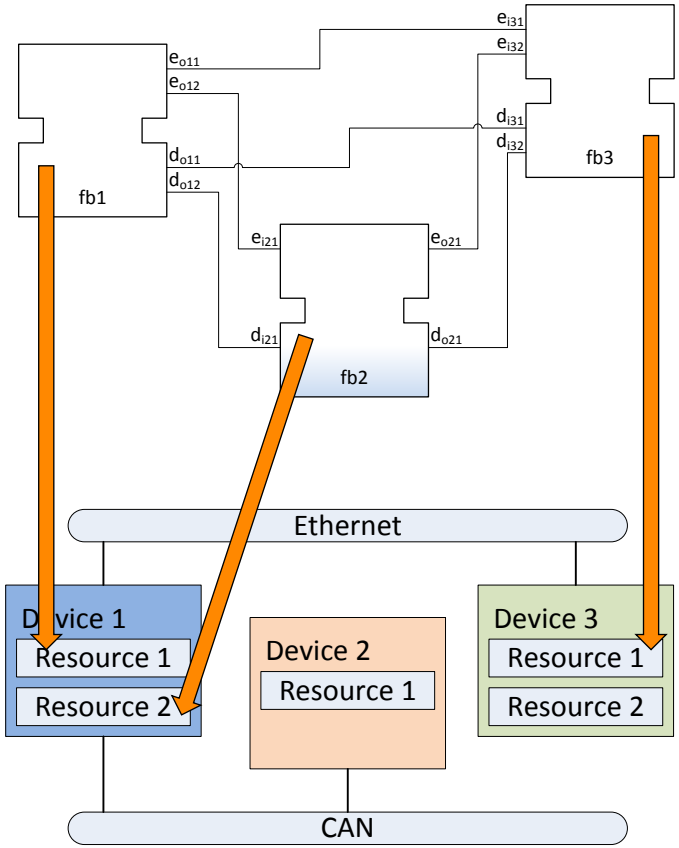
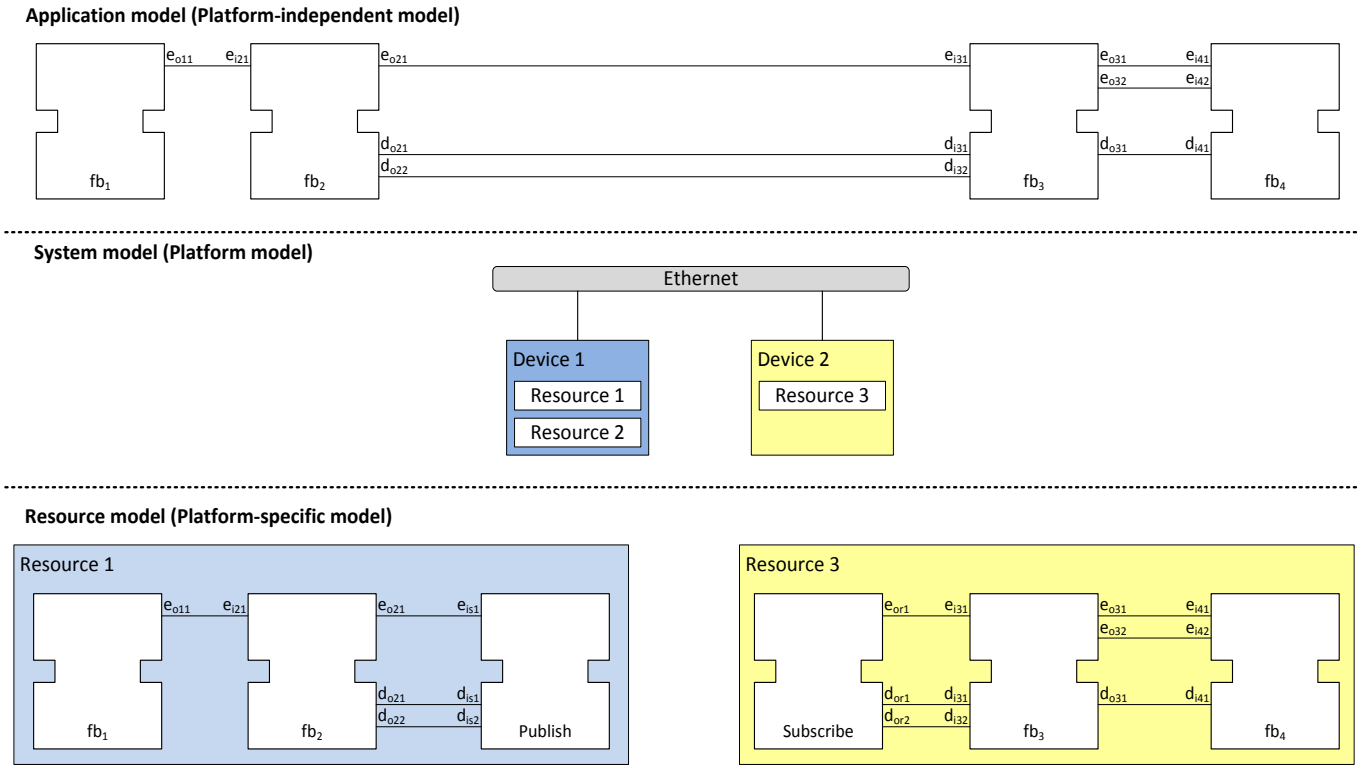
IEC 61499 - Deployment

- Application can be spread over several resources and devices
- FB can be deployed to only one resource



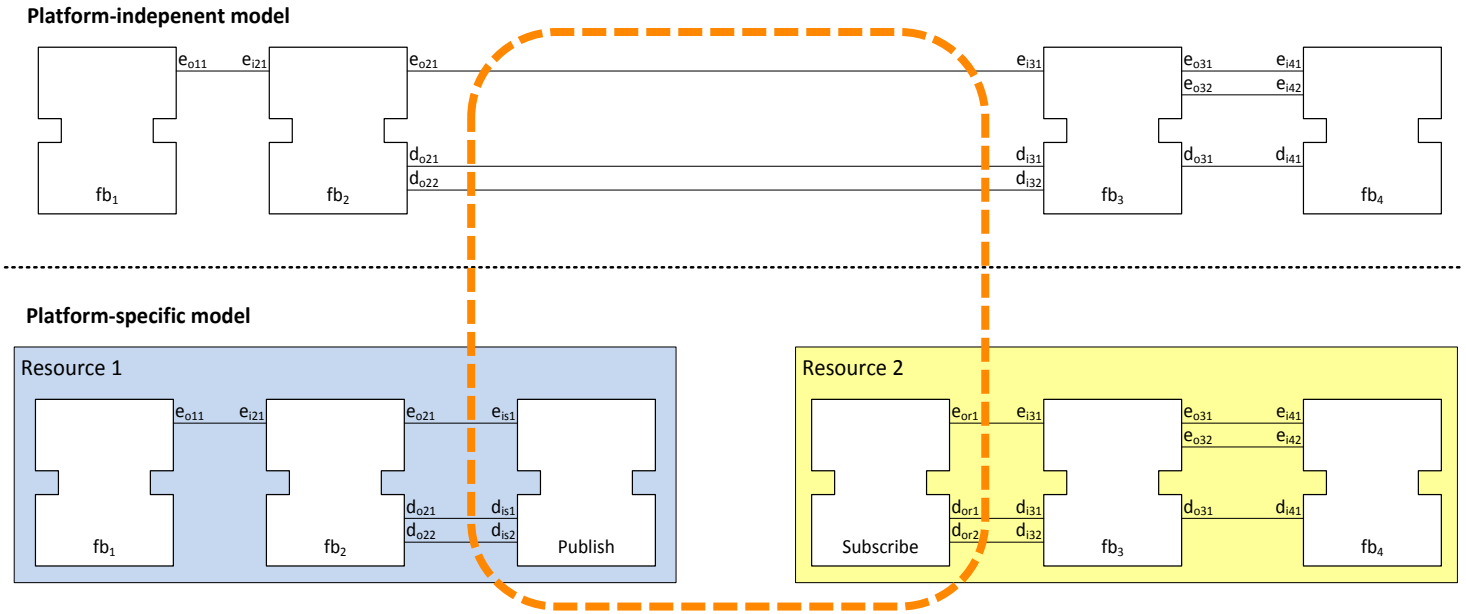
4DIAC-IDE / IEC 61499 distributed communication

- Implemented using FBs in resource model



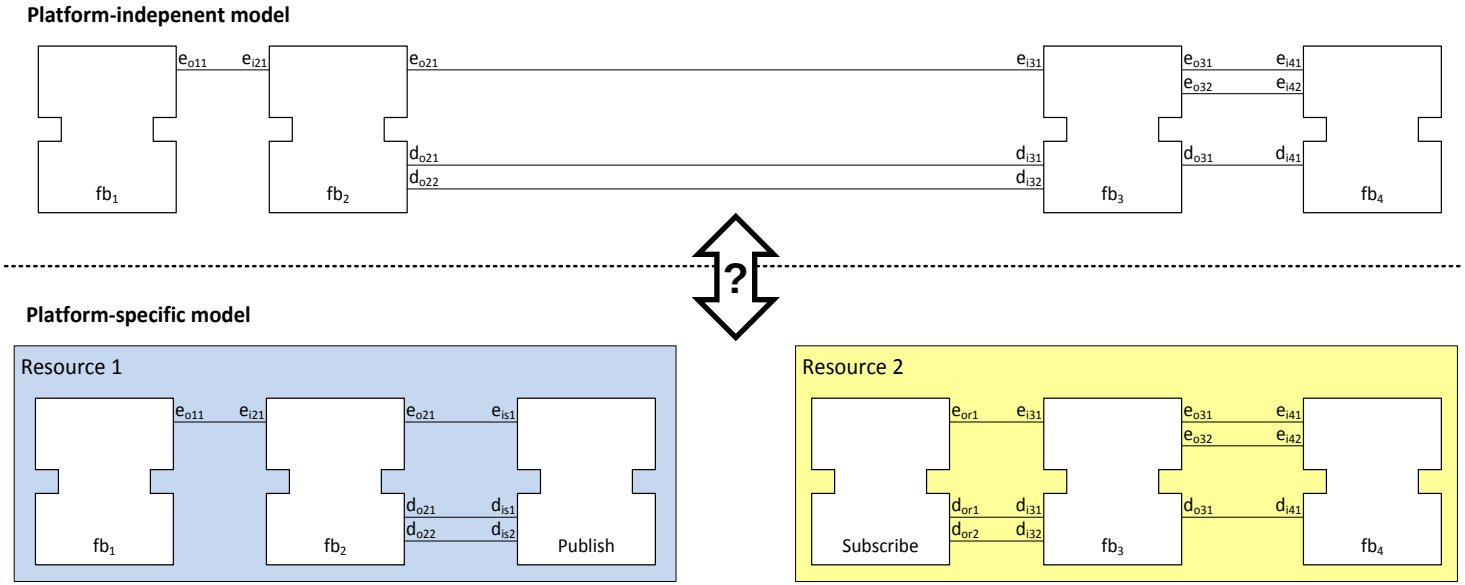
Benefit

- Represented on the model level
  - Visible to developers
  - Available to analysis tools



Problem

- Has to be created and kept up-to-date by hand
  - Time consuming
  - Error prone
  - Posponed until application model is stable?



Solution

Create communication FBs automatically

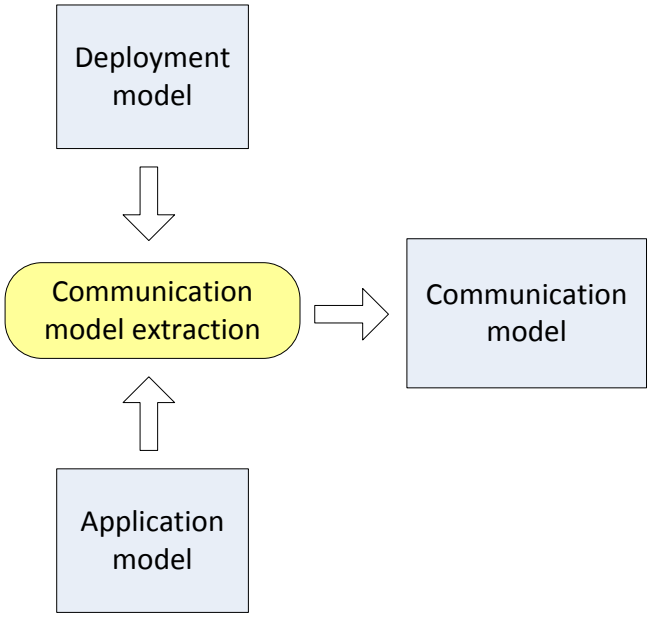
While…

- Minimal need of user interacion
  - One-click generation if possible
- Allow users to control generation
  - Users should be able to influence generation if needed
- Optimization of communication
  - Reduce resource consumption or communication time if possible
- Extendable framework
  - Adding new protocols, communication FBs and optimizations should be seamless
- Generic solution
  - Applicable to other standards/component models

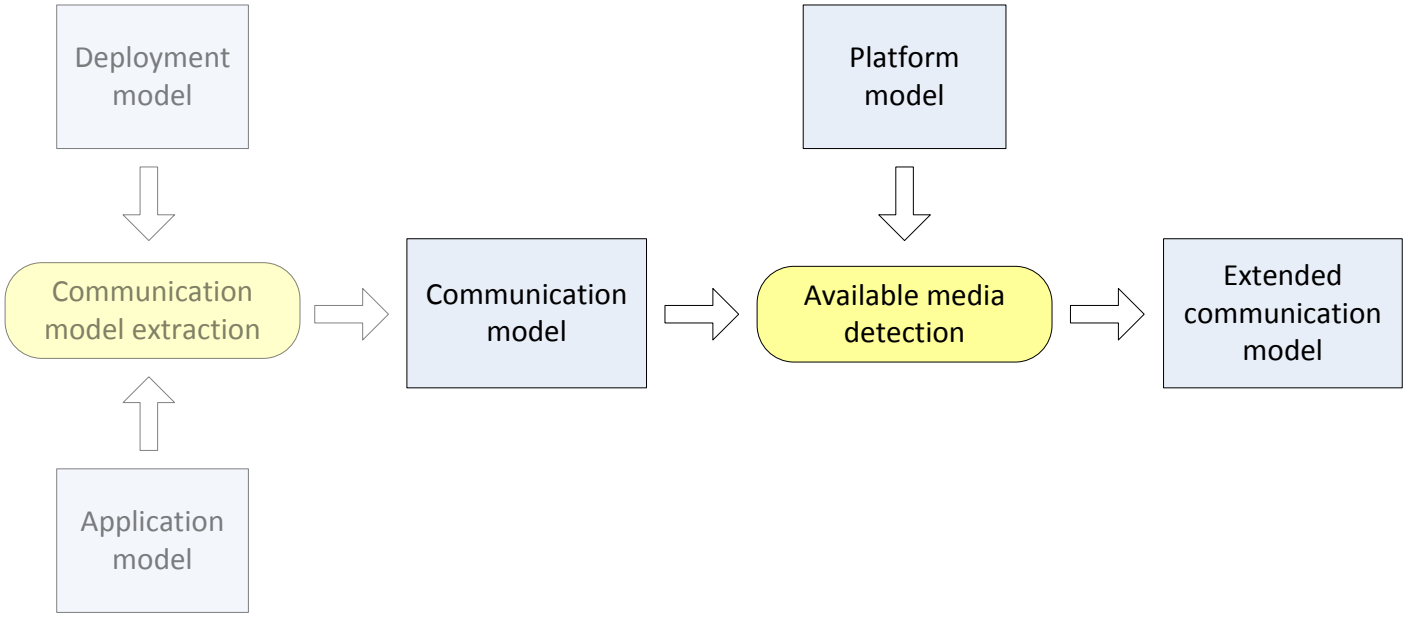
Generation overview

- Separate generation into multiple phases/modules
  - Well defined interfaces between them
  - Modules are easily updatable/changable
- Extract all needed information from existing models
  - No need for user interaction to provide a valid communication solution
- Present generation decisions to user and allow changes
  - User can satisfy communication needs that can not be described by existing models
- Annotate model elements
  - Create bidirectional references between connections and generated FBs

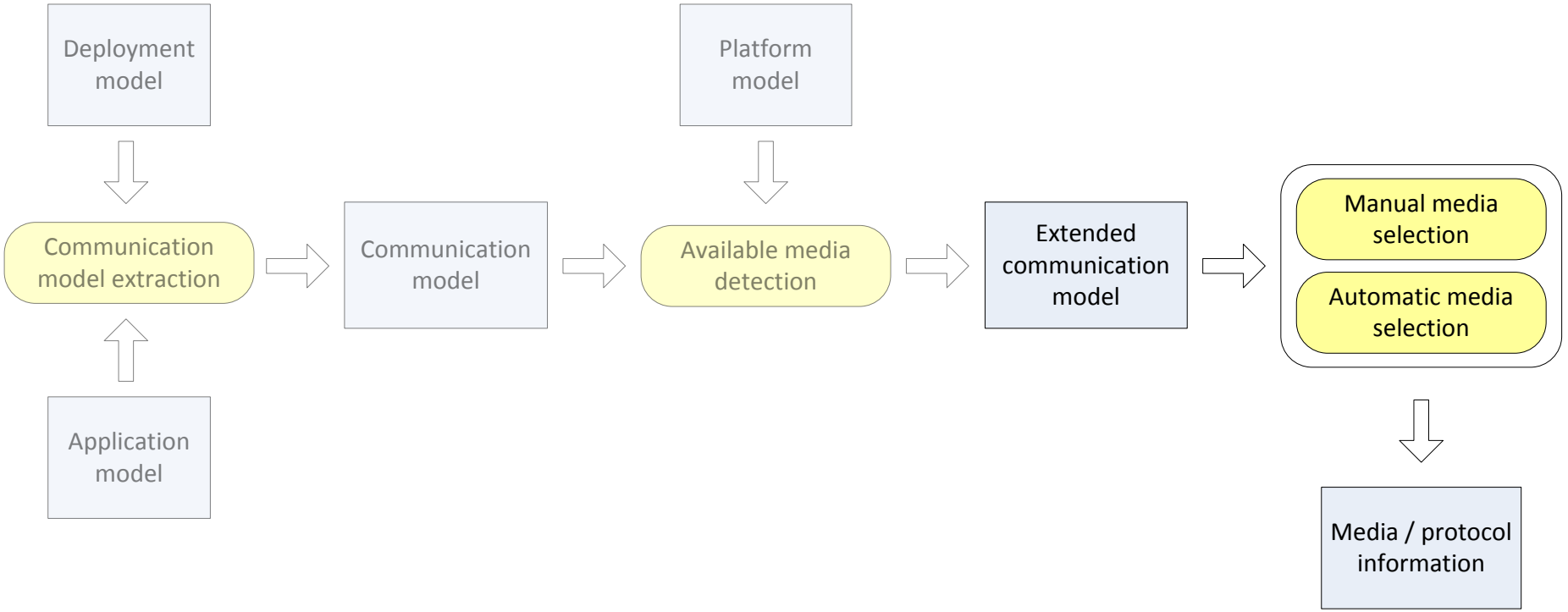
Generation process (i)



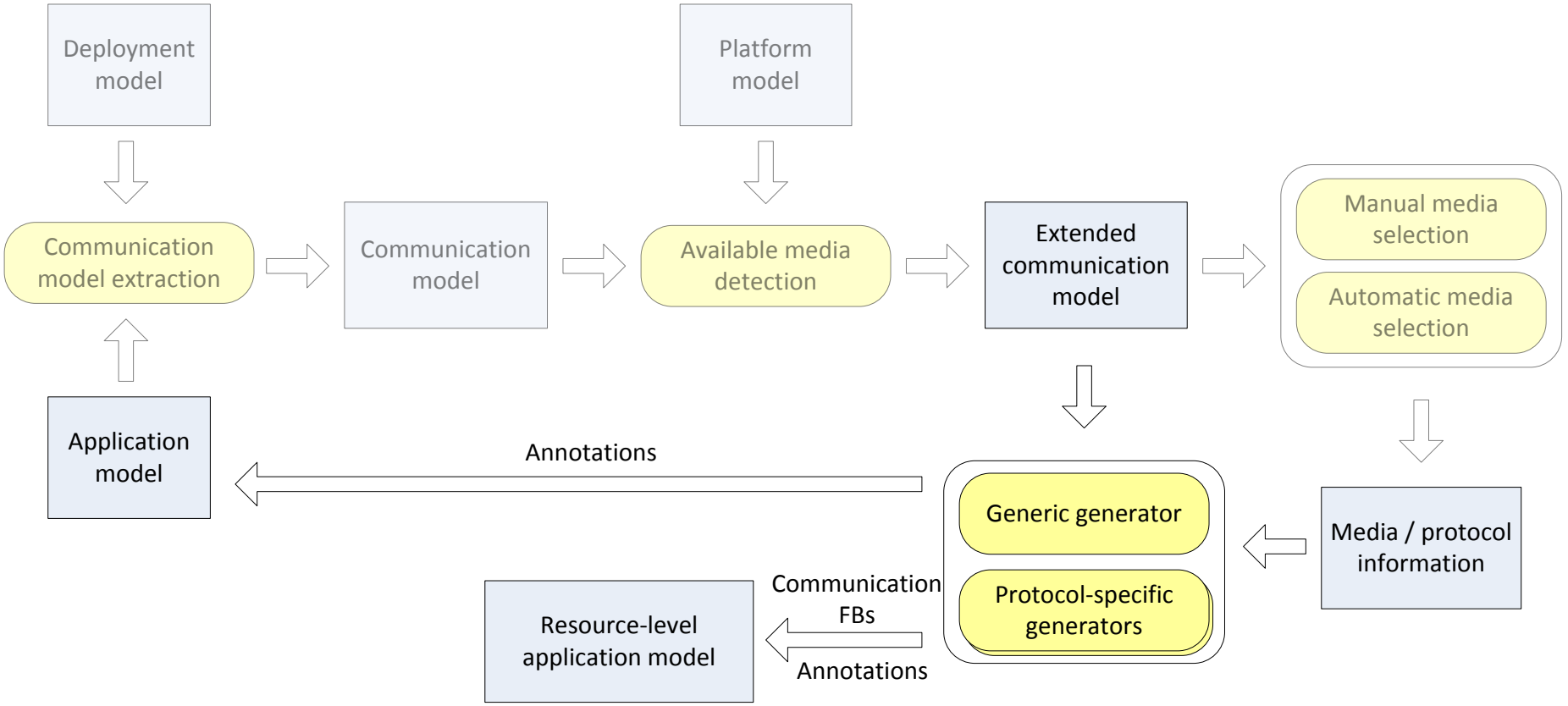
Generation process (ii)



Generation process (iii)

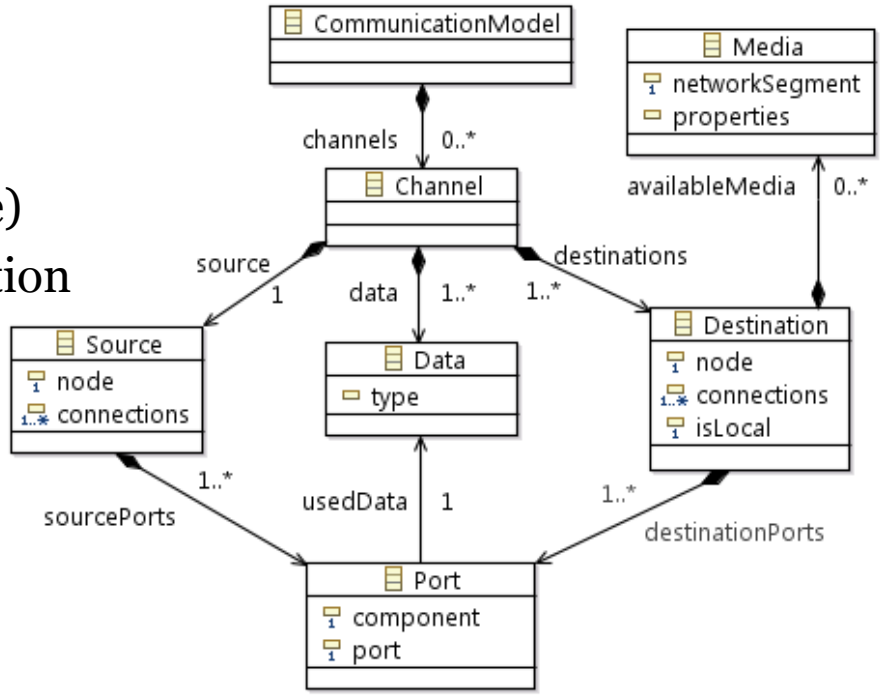


Generation process (iv)



Communication model

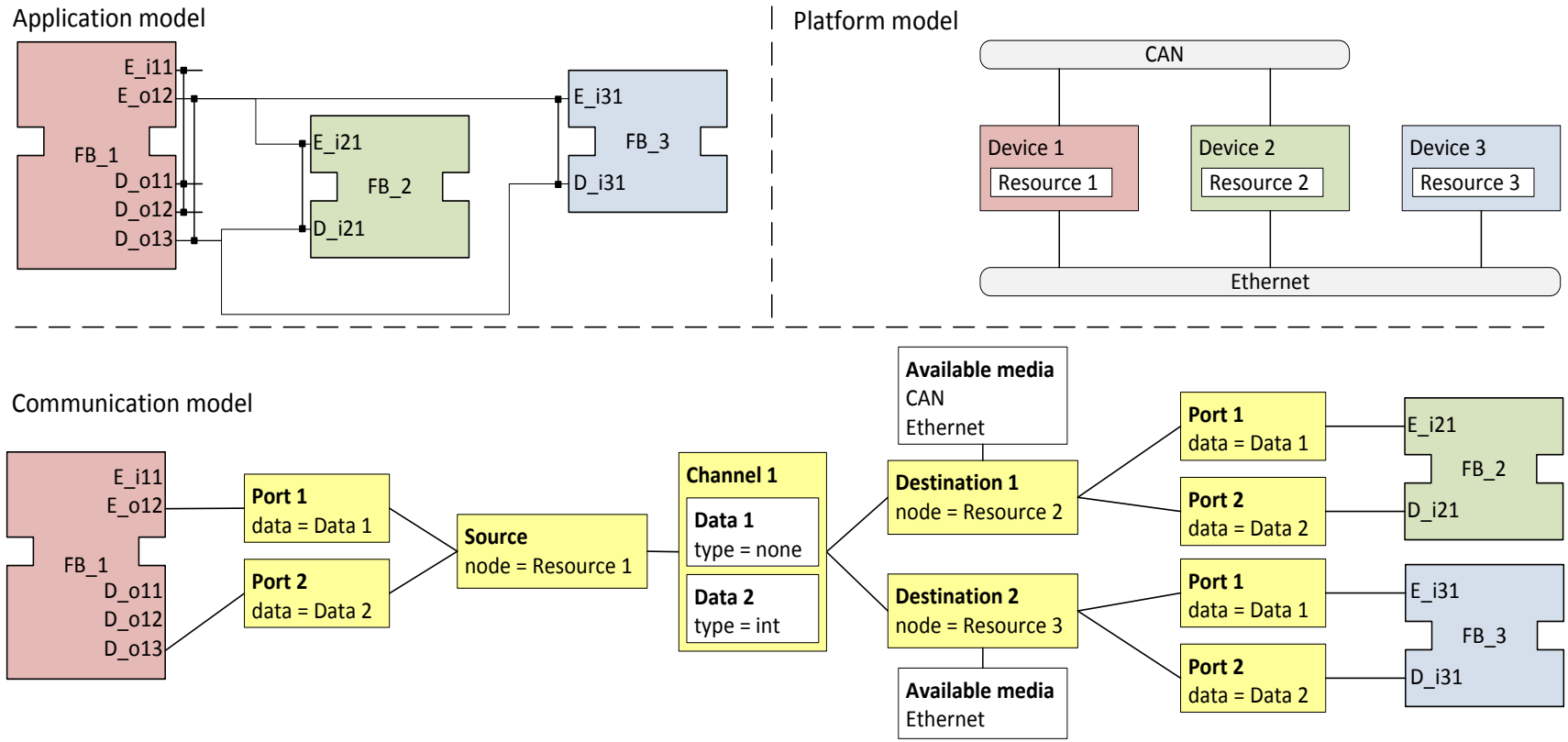
- Describes the communication requirements of an app
- Implementation-independent
- Main element – Channel
  - Describes transfered data
  - One source
  - One or more destinations
- Destinations
  - Can be local (on same device)
  - Contain a set of communication media that connects source and destination resources



Communication model – extraction

- If a connection is between FBs on different resources, generate a channel for the WITH that the source port belongs to
- Create a new destination for each resource that connections from that WITH set lead to
- For each destination, find communication media (network segments) in the platform model that connect the source and the destination nodes

Communication model - example



Media/protocol selection

- Automatic
  - Select which available media to use based on the communication model
  - Current optimisations – if a common media is available for all destinations, use that one
- Manual
  - User can see results of automatic selection, and make changes
  - Currently not implemented in the prototype tool

FB generation

- Generic generator
  - Parses communication model, finds adequate protocol-specific generators and initiates FB creation
  - Creates connections to created FBs
- Protocol-specific generators
  - Do actual FB creation
  - Configure FBs for communictaion
  - Specify medias/protocols for which they can be used
  - Keep information about types of FBs to create for communication

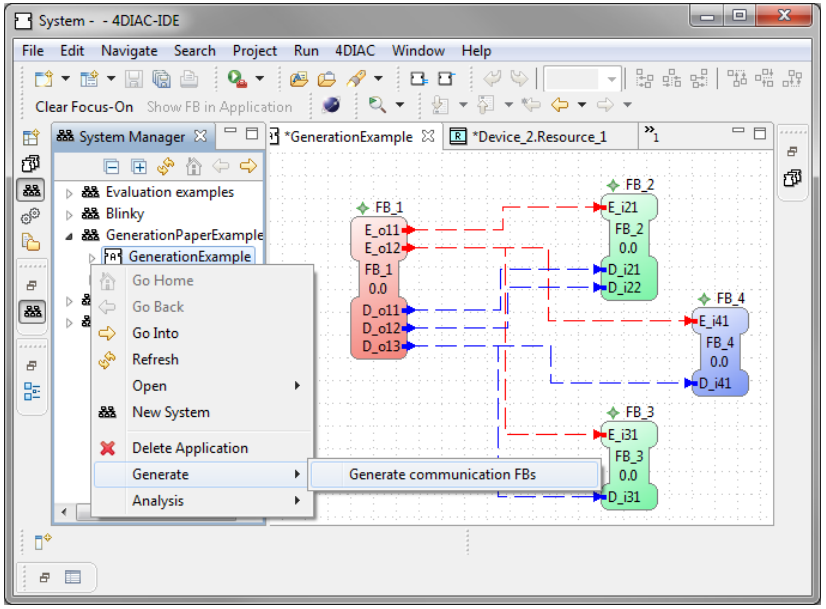
FB generation - implementation

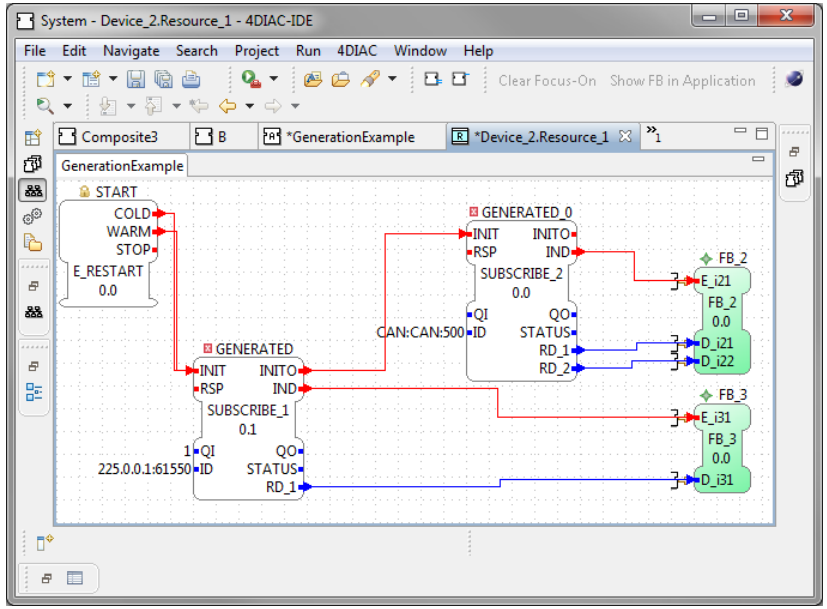
- Implemented publish-subscribe generator for Ethernet
  - One PUBLISH FB for each source*
  - One SUBSCRIBE FB for each destination
  - For local communication, use PUBL and SUBL
  - FB verson (number of ports) selected based on number of data in the channel
  - Configured for communication using port number

* In some cases, more than one publisher is created (e.g. when using multiple media/protocols, or when not all data at some destination is used).

Implementation

- Plug-in for 4DIAC-IDE
- Prototype stage – not all aspects are fully implemented
- One-click generation from application context menu
- http://www.idt.mdh.se/~jcn01/research/4DIAC-plugins/





Questions?

Thank you for your attention