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Delivering Optimized Portable SBC Software

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Zeligsoft

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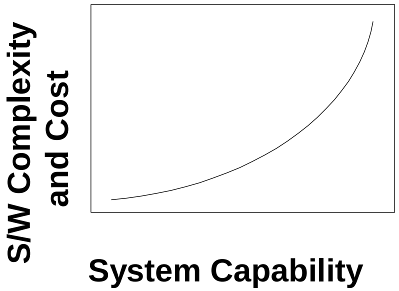
V1.0

Embedded Systems Industry Facing Software Crisis



Key Contributing Factors:

2. Ever increasing set of complex features
3. Powerful, but complex multiprocessor platforms and SoC
4. Exponential growth of software complexity
5. Ever increasing pace of new product introduction

Base Station	1996	2006	2008
Product	2G	3G	4G, WiMAX
Features	basic telephony, no data	advanced telephony, multiple standards, multiple data services	Converged standards, interactive services
Platform lifecycle	8 to 10 years	5 years	3 years
Development time	4 years	3 years	2 years

**The problem cannot be solved by adding more people…..
A new way of developing embedded software is mandatory**

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Component-Based Development Conundrum

Component-based development delivers:

Encapsulation

Reuse

Perceived benefits:

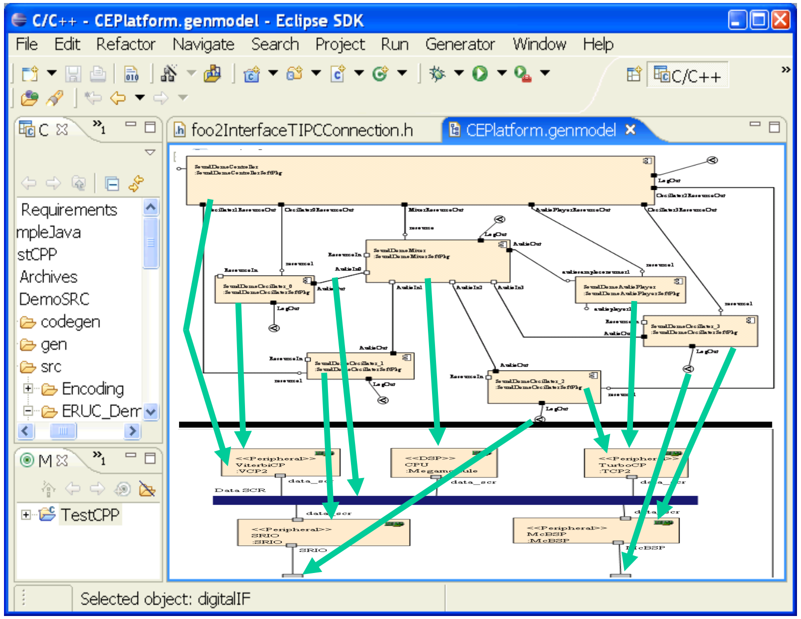
Decreased resource requirements

Increased quality

Decreased time-to-market

Perceived issue:

Performance


C/C++ - CEPlatform.genmodel - Eclipse SDK
File Edit Refactor Navigate Search Project Run Generator Window Help
C/C++
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Requirements
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<<DSP>> CPU :Megamodule
<<Peripheral>> TurboCP :TCP2
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McBSP

Selected object: digitalIF

Key Problem

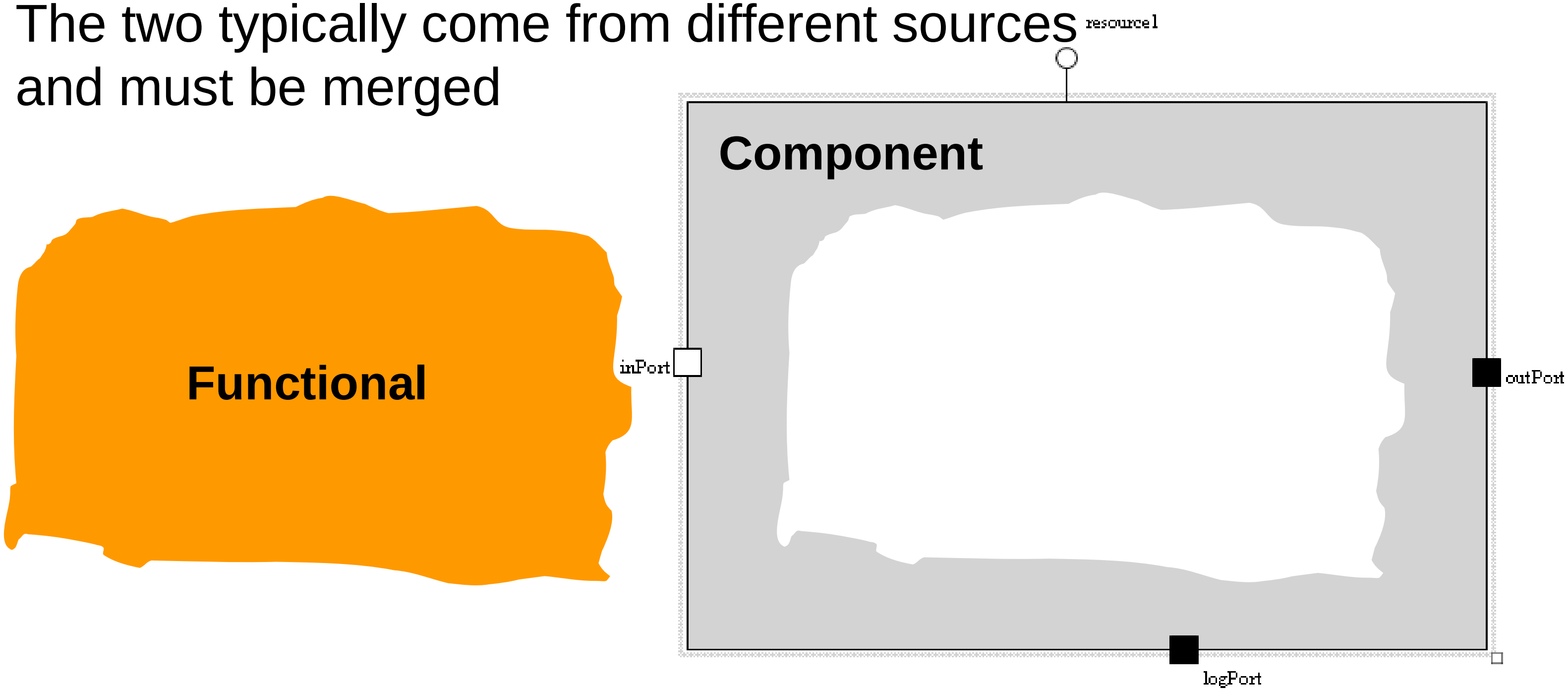
- **How can we maintain the benefits of components without paying a performance cost?**

Agenda

- Component architecture
- Traditional development lifecycle
- Deployment-Aware Generation™ (DAG™)
- Summary

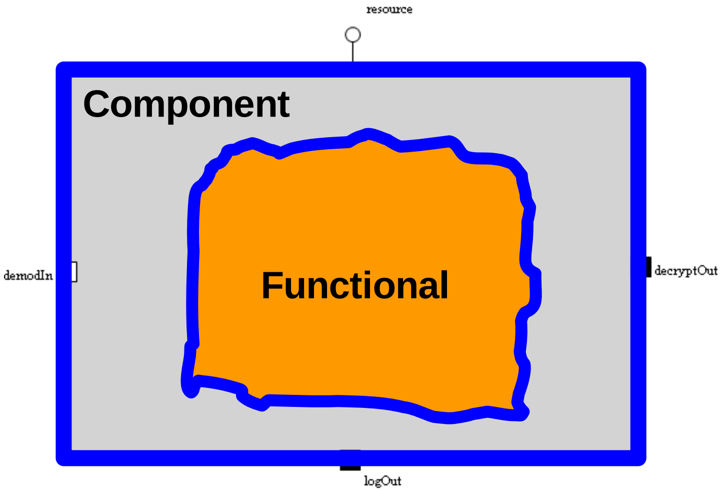
Component Architecture

- Component-based behavior: how the component interacts
- Functional behavior: what the component does
- The two typically come from different sources and must be merged



Component APIs

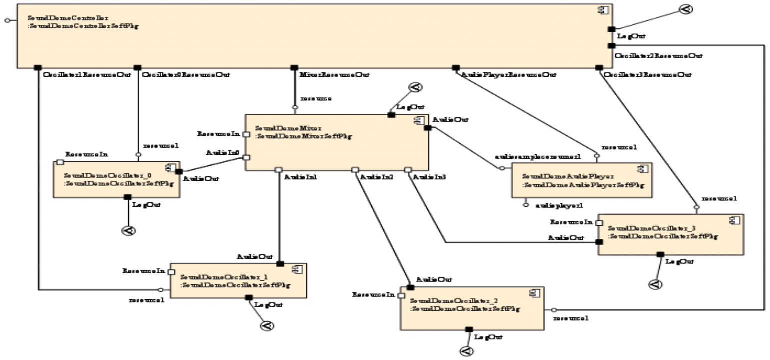
- Component outer API: interface of component-based to external system
    - Requires knowledge of communication system



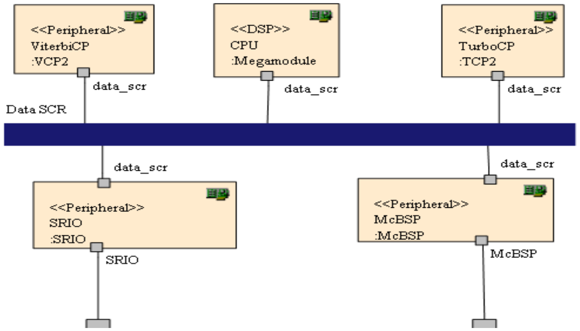
- Component internal API: interface of functional code to packaging
    - Requires knowledge of messages
- *Both APIs provide opportunities for integrating generated code*

Component Architectures

- “Who speaks to whom”
- Relationships between elements
  - Components in application

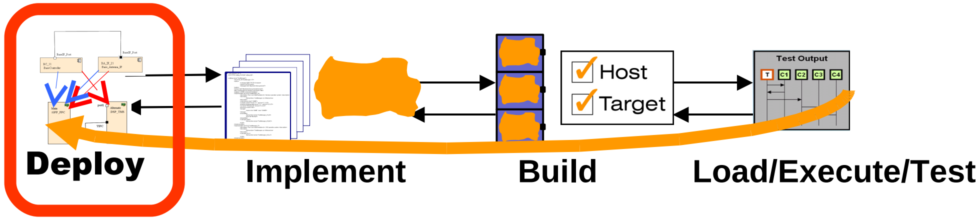


  - Devices in platform



Hand-Optimized Non-Component Lifecycle

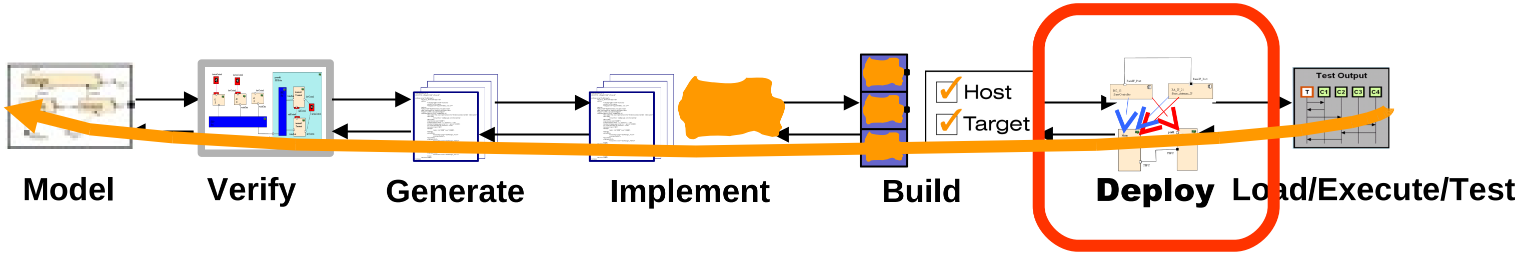
- Hand-optimized lifecycle without components:



- Deploy *before* generation, implementation and building
- Enables system optimization
- Severely limits component portability

Traditional Component-Based Lifecycle

- Traditional development lifecycle with components:



Model Verify Generate Implement Build **Deploy** Load/Execute/Test

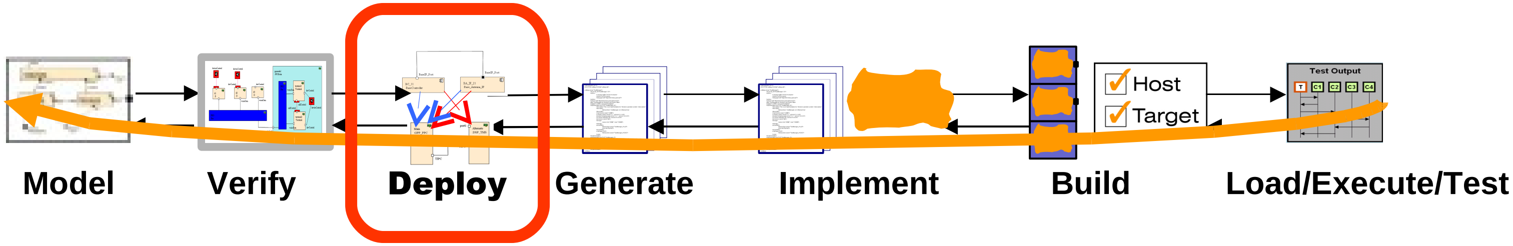
- Deploy *after* generation, implementation and building
- Enables component portability
- *Limits component optimization*

Optimizing in the Traditional Lifecycle

- The contract of the generated code is the contract of the model
  - Implicitly code-centric approach
  - (Equivalently, binary-centric approach)
- Optimization strategies are based on middleware
  - Generate generic invocation code for communication (or other aspects)
  - Optimize in the implementation of the middleware
- Can’t optimize to same level as hand-coding

Reorganizing the Lifecycle

- Optimized lifecycle:



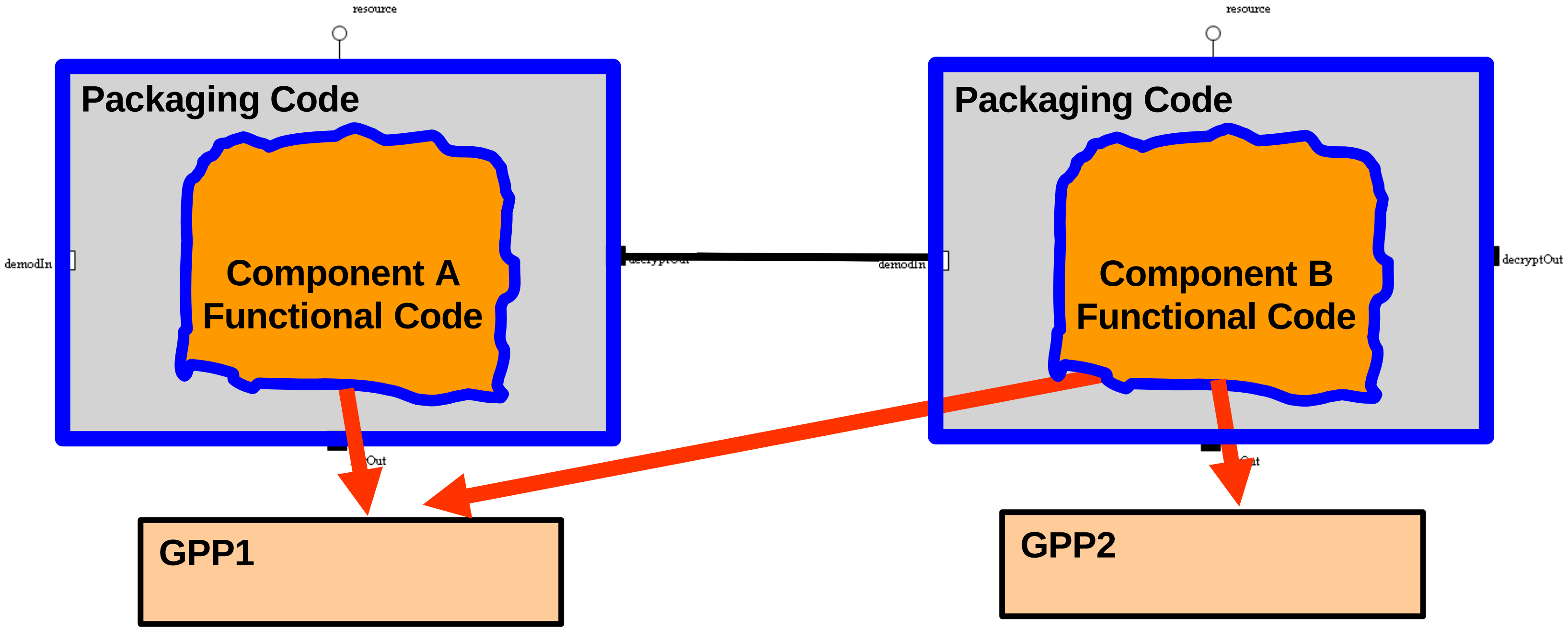
- Deploy *before* generation, implementation and building
- Enables component portability
- Enables component optimization
- ***Deployment-Aware Generation™ (DAG)***

Deployment-Aware Optimization

- DAG-generated code depends not just on the target (platform-aware generation) but on the targets of related components
- The contract of the generated code is *separated from* the contract of the model
  - Model elements are reusable in other contexts
- Generated code is context-specific
  - Based on clear division between component-based and functional code
- Optimization strategies are based on using right middleware
  - Same approach used to optimize hand-coded applications

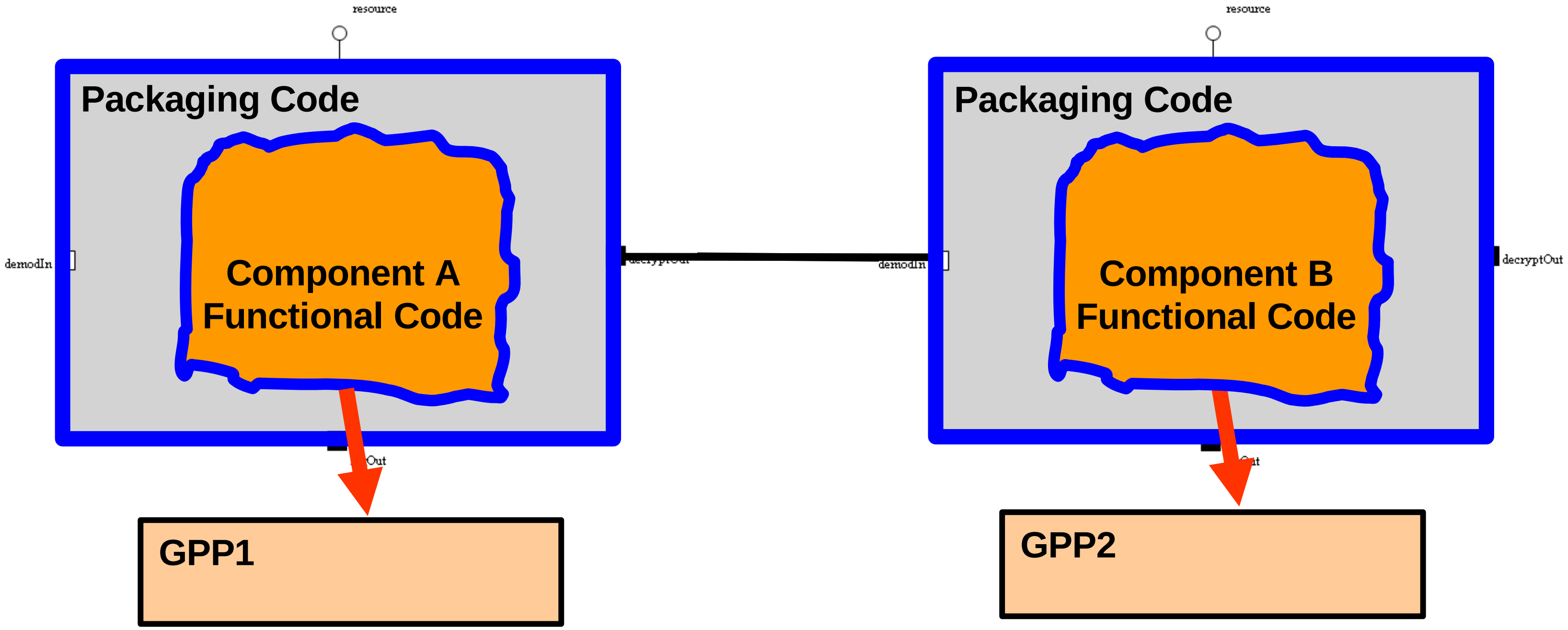
Traditional Generation

- Consider component’s deployment only
  - Packaging code matches constant external and internal API
  - Generated code is independent of other components’ deployments



DAG Generation

- Consider other components’ deployments
  - Packaging code matches constant internal and context-dependent external API
  - Generated code depends on other components’ deployments



DAG Generation

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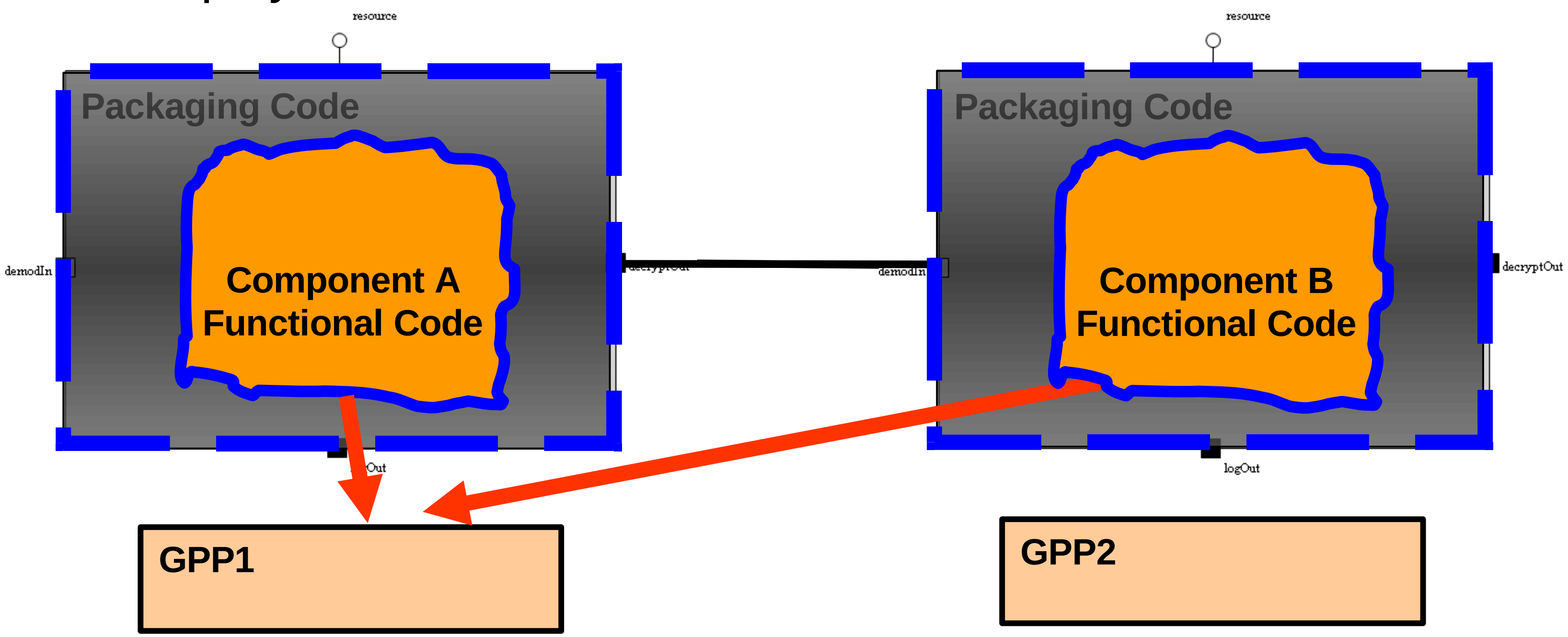
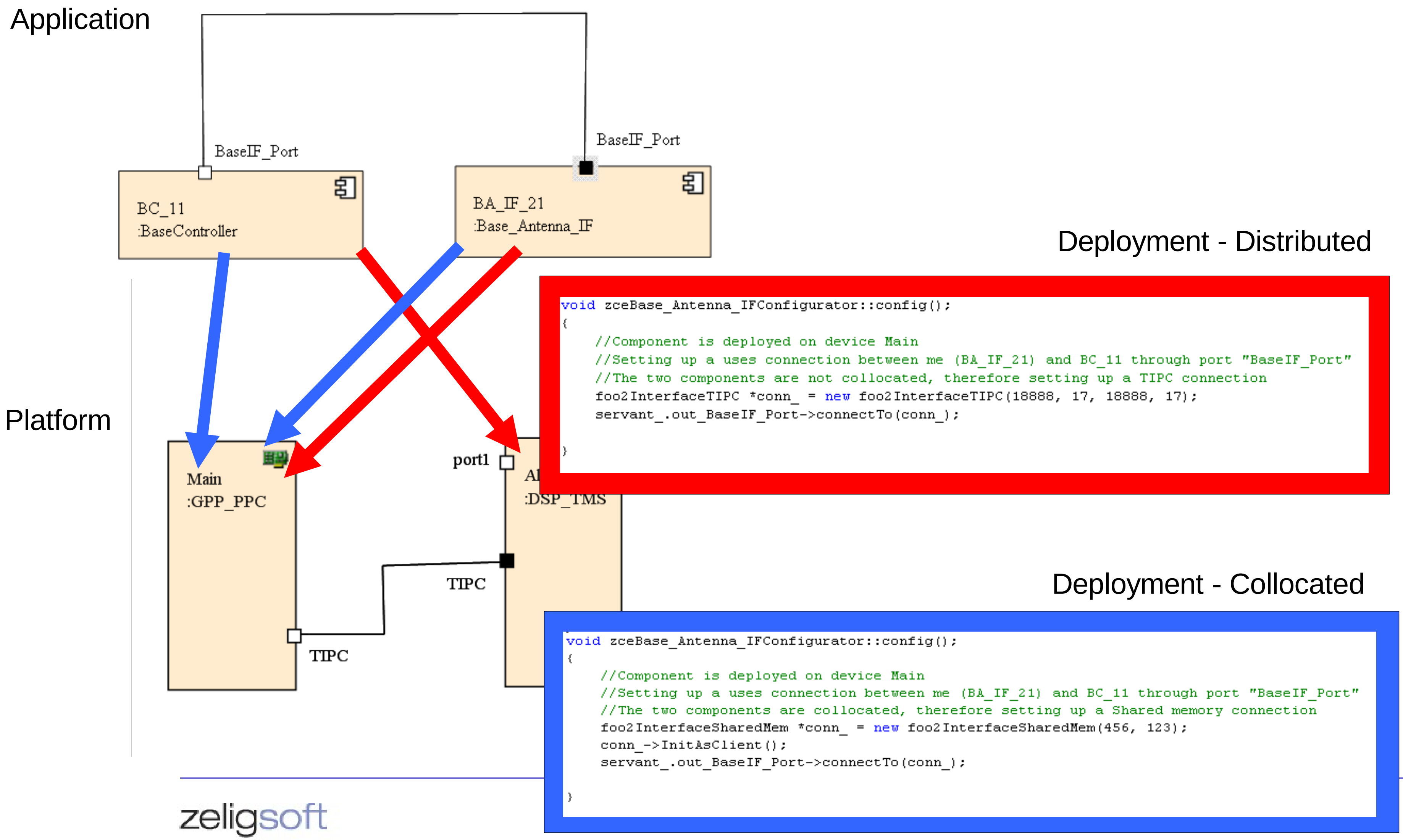


Deployment Aware Generated Code



Deployment - Distributed

```
void zceBase_Antenna_IFConfigurator::config();
{
    //Component is deployed on device Main
    //Setting up a uses connection between me (BA_IF_21) and BC_11 through port "BaseIF_Port"
    //The two components are not collocated, therefore setting up a TIPC connection
    foo2InterfaceTIPC *conn_ = new foo2InterfaceTIPC(18888, 17, 18888, 17);
    servant_.out_BaseIF_Port->connectTo(conn_);

}
```

Deployment - Collocated

```
void zceBase_Antenna_IFConfigurator::config();
{
    //Component is deployed on device Main
    //Setting up a uses connection between me (BA_IF_21) and BC_11 through port "BaseIF_Port"
    //The two components are collocated, therefore setting up a Shared memory connection
    foo2InterfaceSharedMem *conn_ = new foo2InterfaceSharedMem(456, 123);
    conn_->InitAsClient();
    servant_.out_BaseIF_Port->connectTo(conn_);

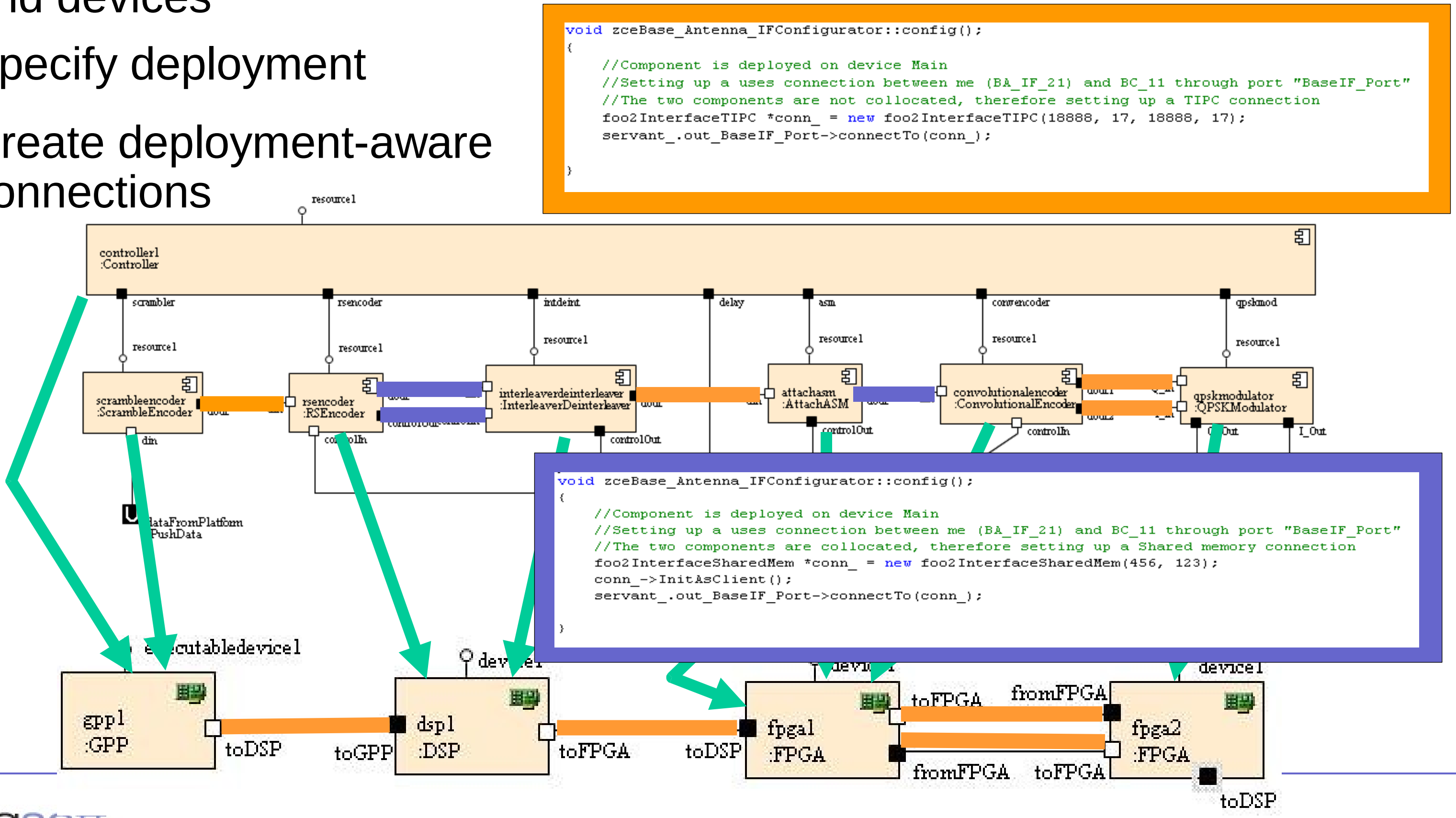
}
```

Applying DAG to Other Aspects

- Communication and middleware are natural applications of DAG
- Other aspects can also be optimized:
  - Services
    - Timing
    - Log
    - Accelerators
    - …
  - Encryption
  - …

Heterogeneous Environment Support

- Embedded platforms are typically heterogeneous
  - Functionality on GPPs, DSPs, FPGAs, ASICs
- Represent software in a uniform way as communicating components and devices
- Specify deployment
- Create deployment-aware connections



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}
```

Summary

- Hand-coding maximizes optimization, but limits portability
- Traditional component-based SBC development maximizes portability, but limits optimization
- Deployment-Aware Generation maximizes portability ***and*** optimization
  - A precise platform model is the cornerstone of DAG
- **DAG generates optimized components**

Thank You

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