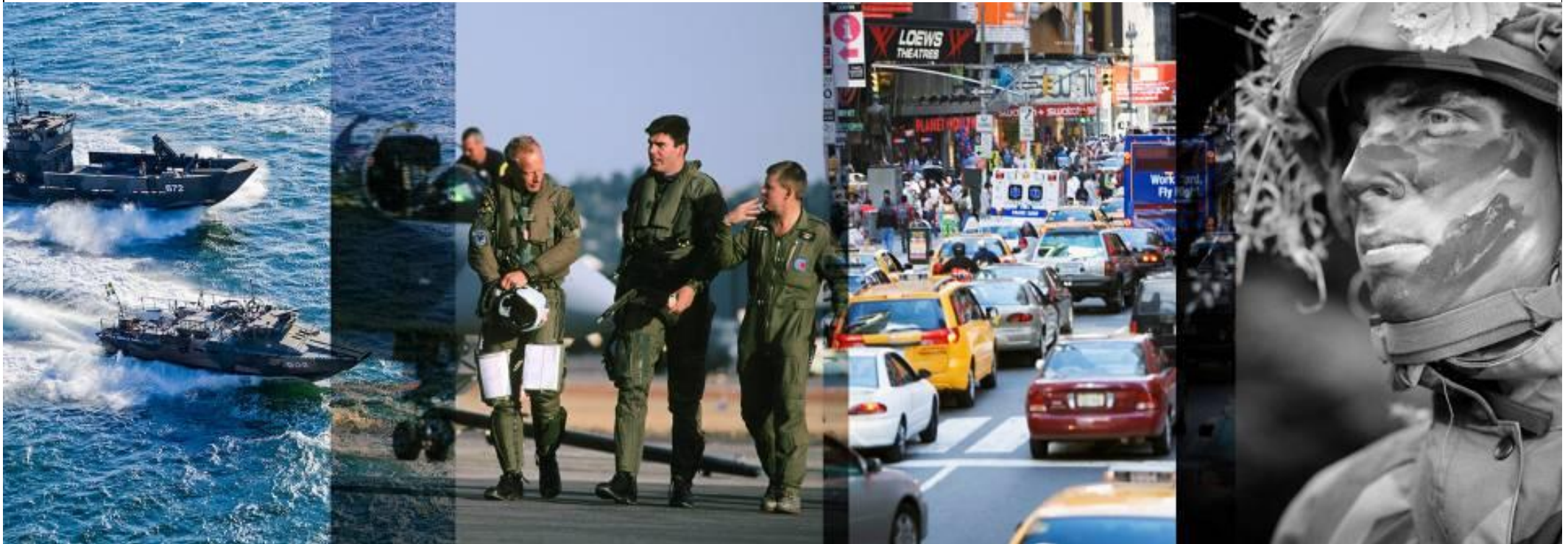


SW architecture for testing

A real world example



NAME Patrik Servin, Technical Manager Software Architecture

DATE 2011

Agenda

- Background
- Architecture description
- Architecture extended for testing
- Testing tool
- The technology behind it
- Taking it one step further...
- Conclusion

Background

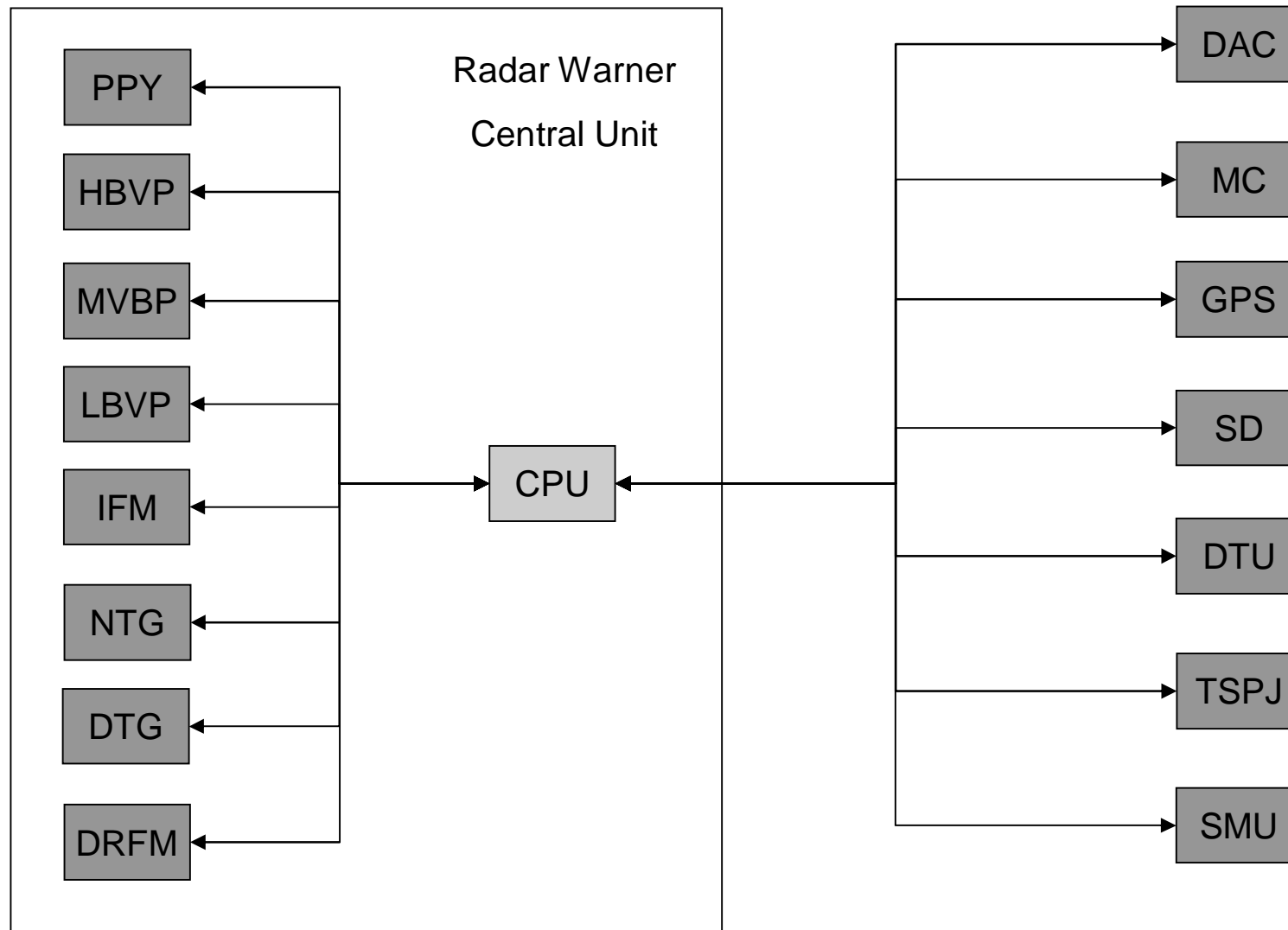
- ▶ Systems for
 - Radar warning
 - Electronic Surveillance Monitoring (ESM)



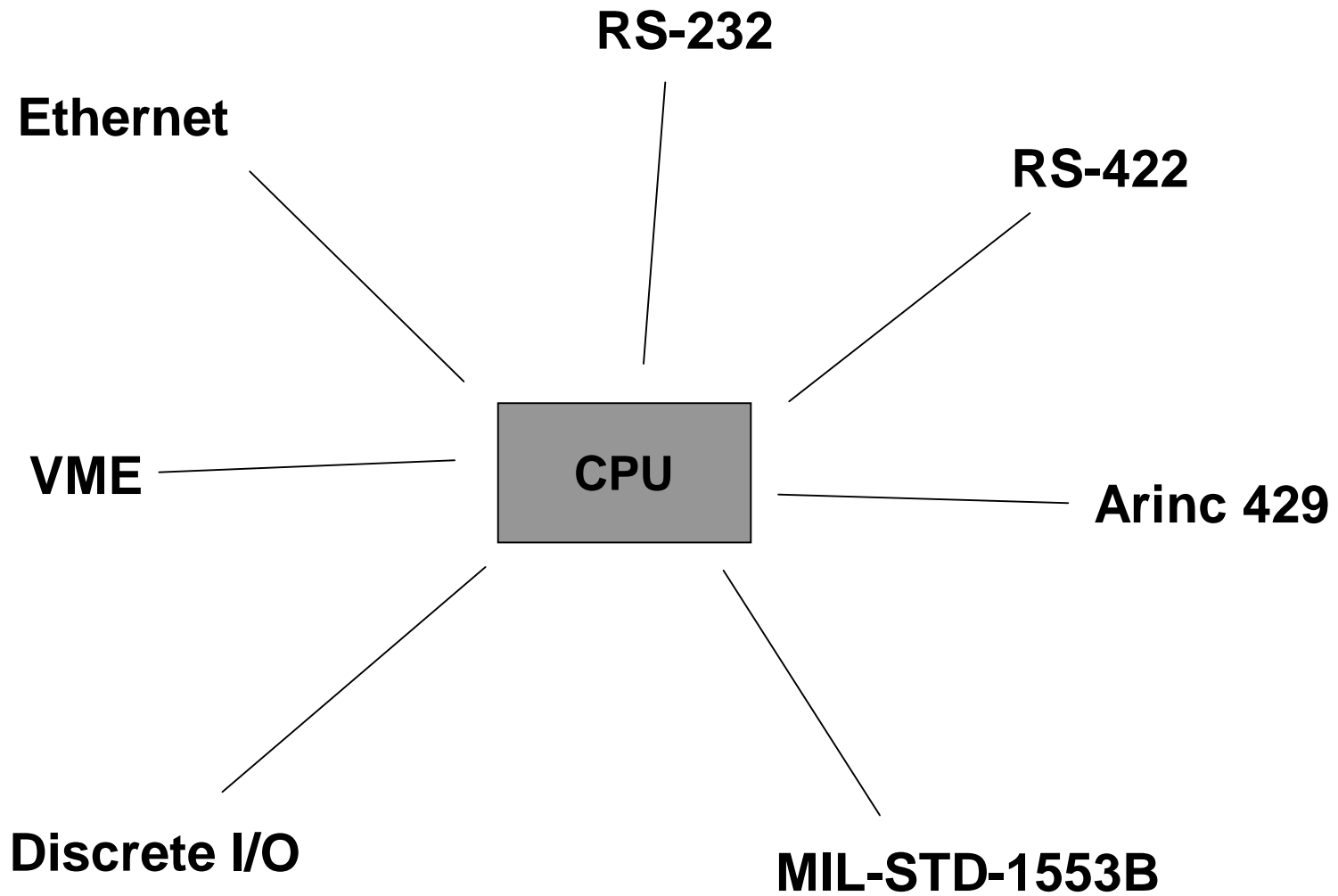
Background



Background



Background



Background

- ▶ The CPU usually integrates 10-15 internal and external systems
- ▶ Hundreds of different kinds of messages sent and received
- ▶ Thousands of parameters...

...and each and every parameter has to be correct!

Background

▶ CPU

- PowerPC
 - VxWorks
 - 400-1000 kloc
 - RTCA 178B level D
-
- Complex embedded real-time systems

Background – About testing

- ▶ Target system are expensive
- ▶ Simulators based on HW are expensive
- ▶ Hard to see what is going on inside the system
 - HW interface listeners exists but are expensive
- ▶ Unit testing and sub system testing works great but...

... we still find too many errors during integration!

Is there a way to simplify the integration testing?

Architecture description

Software architecture - layers

CPU

Application layer

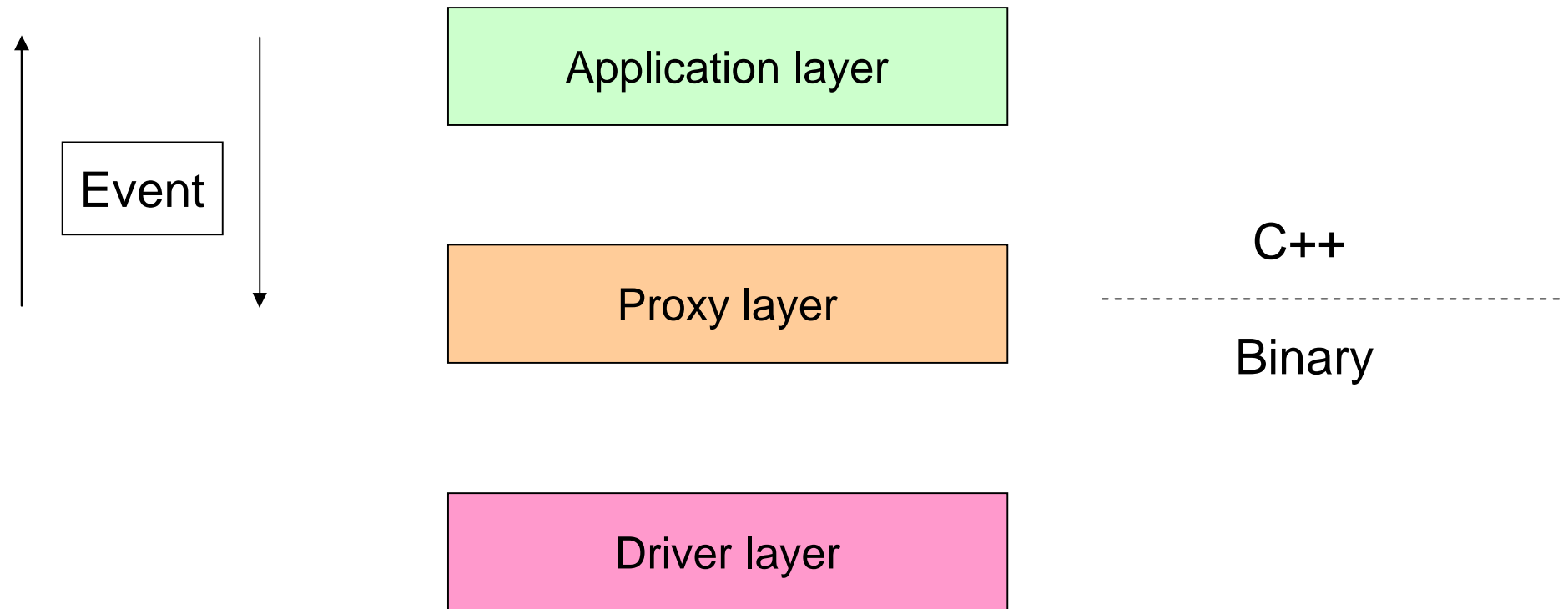
Proxy layer

Driver layer

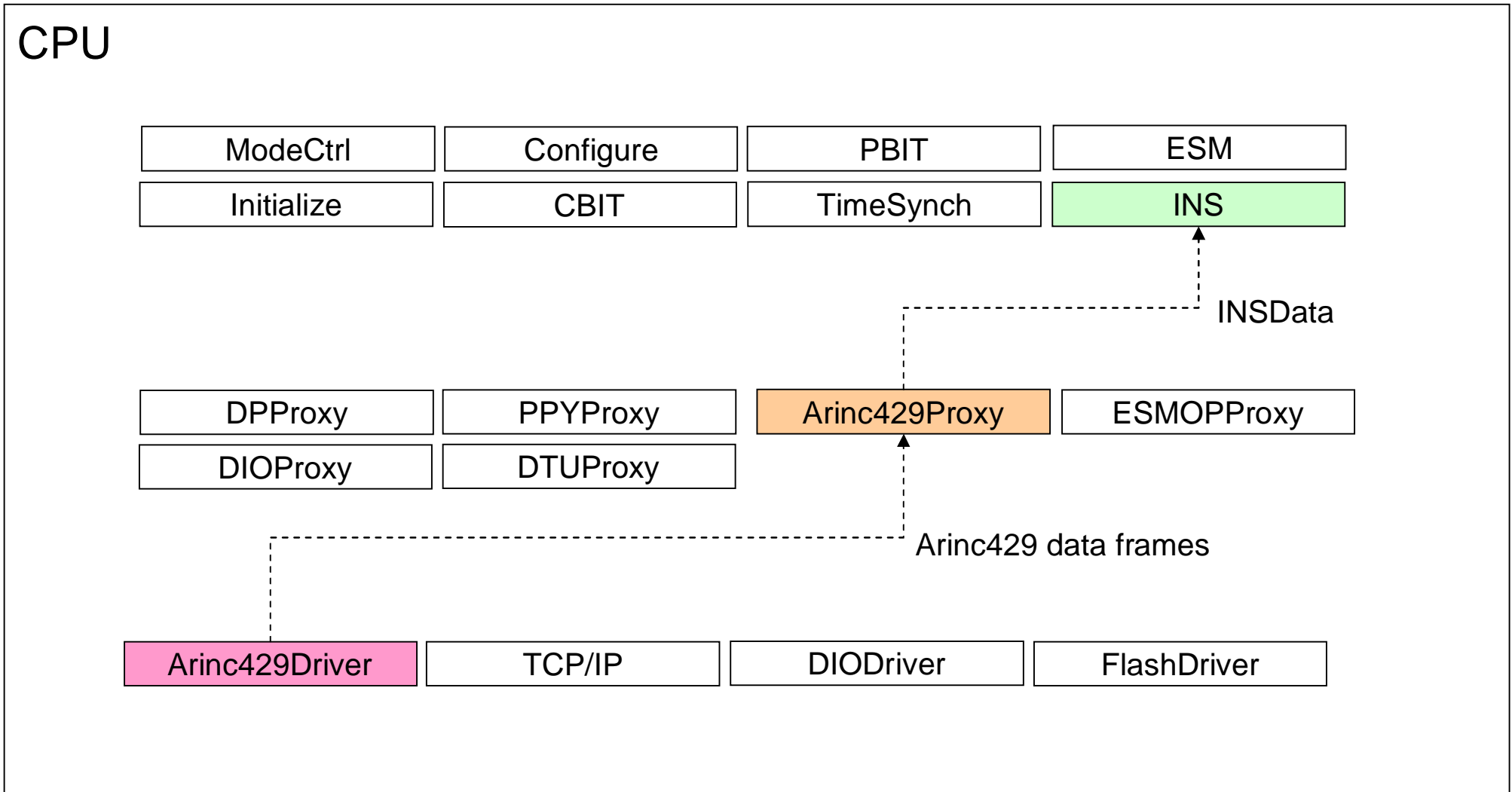
Software architecture

- ▶ Event driven system – one Event for each message
- ▶ Events are implemented as classes in C++
- ▶ Proxies transform between C++ classes and binary representation

Software architecture - layers

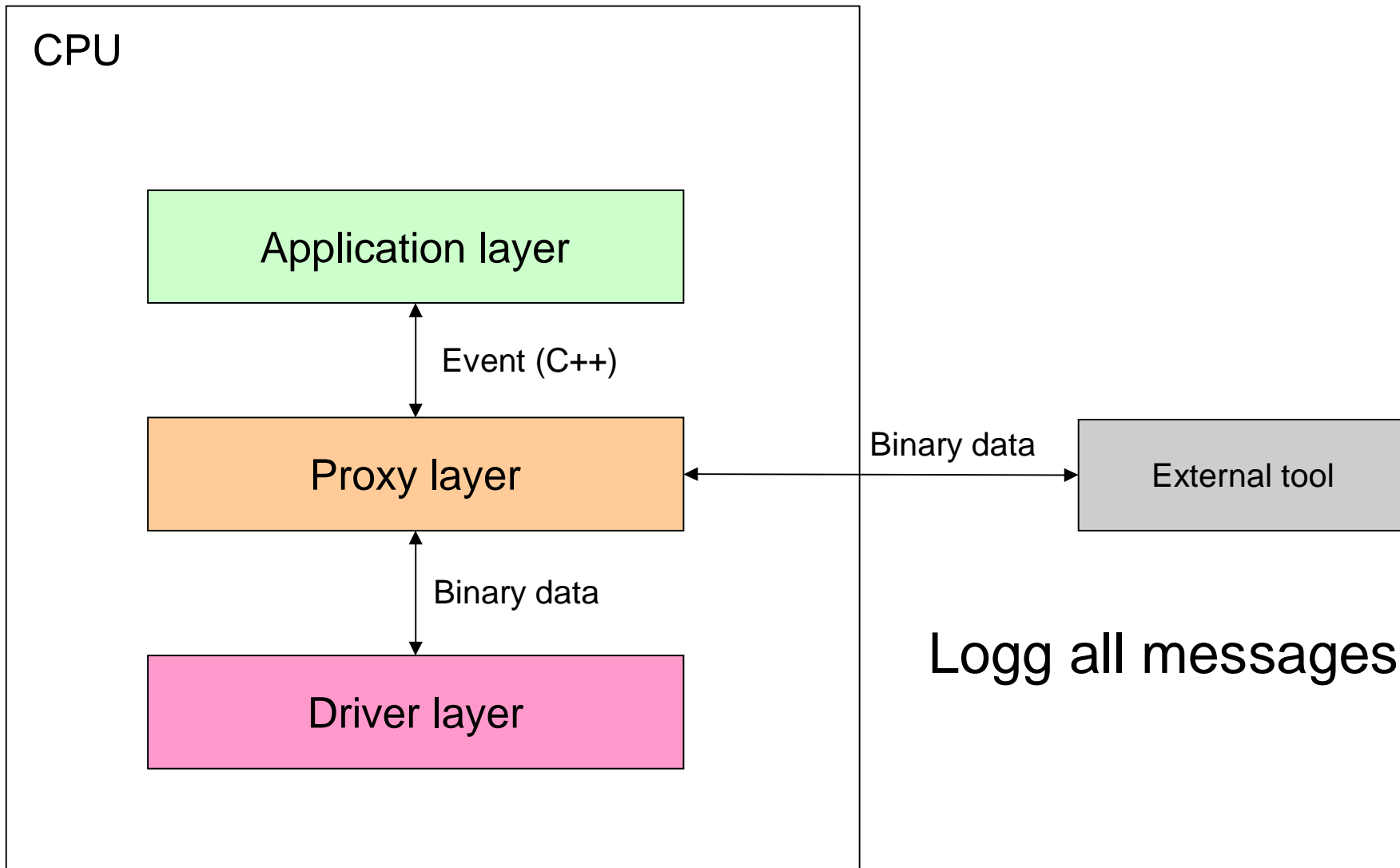


Software architecture - layers

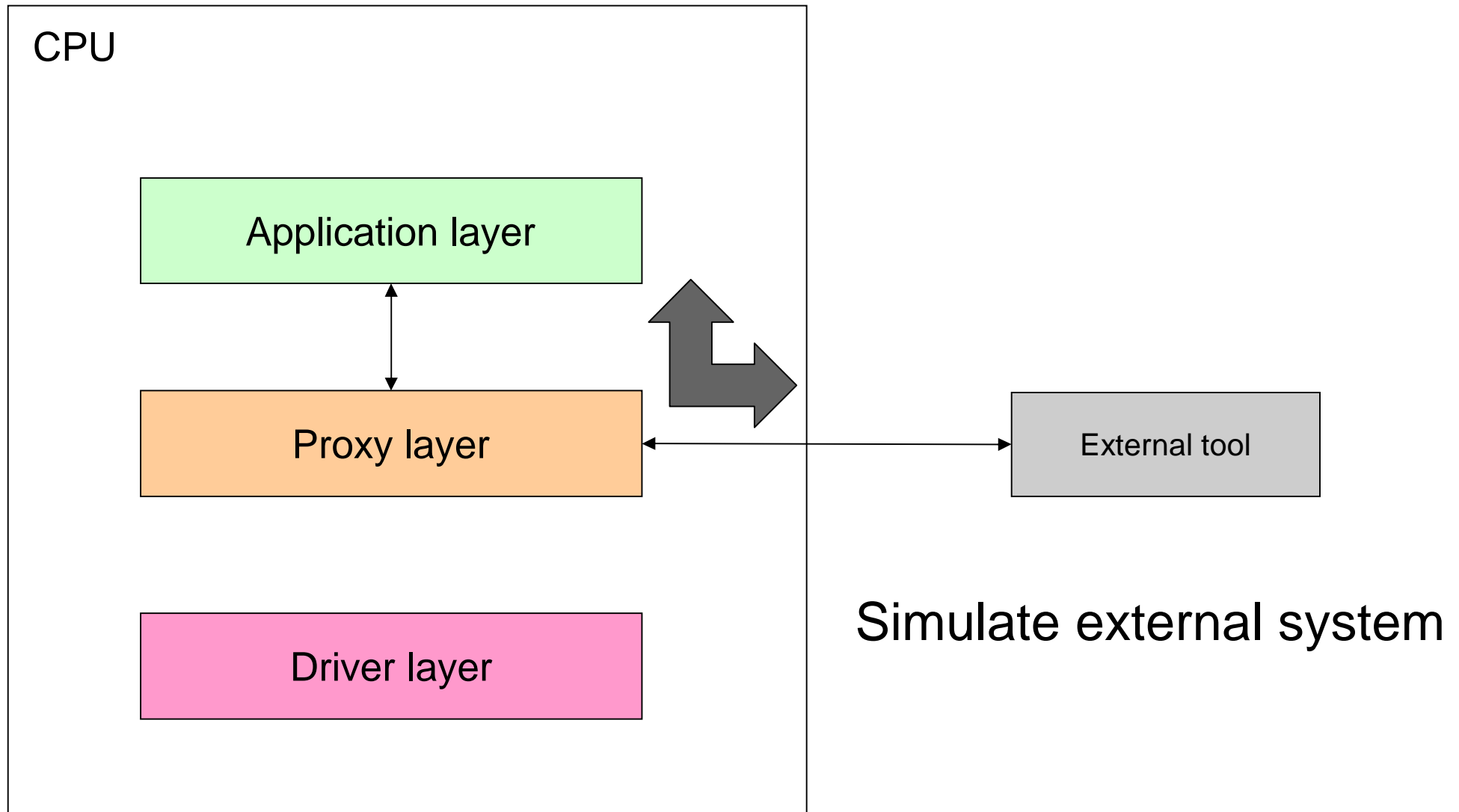


Architecture extended for testing

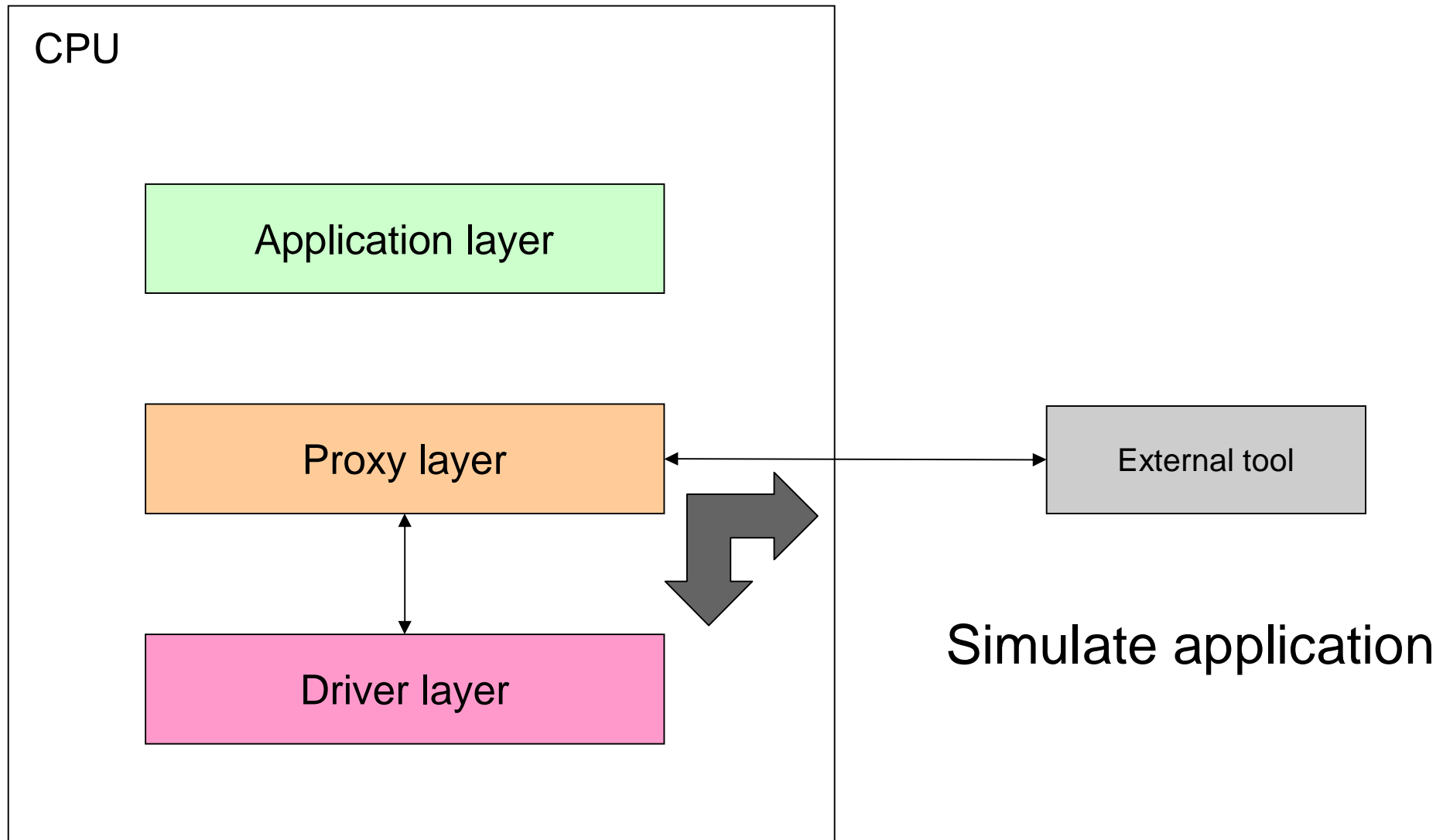
Architecture extended for testing



Architecture extended for testing



Architecture extended for testing

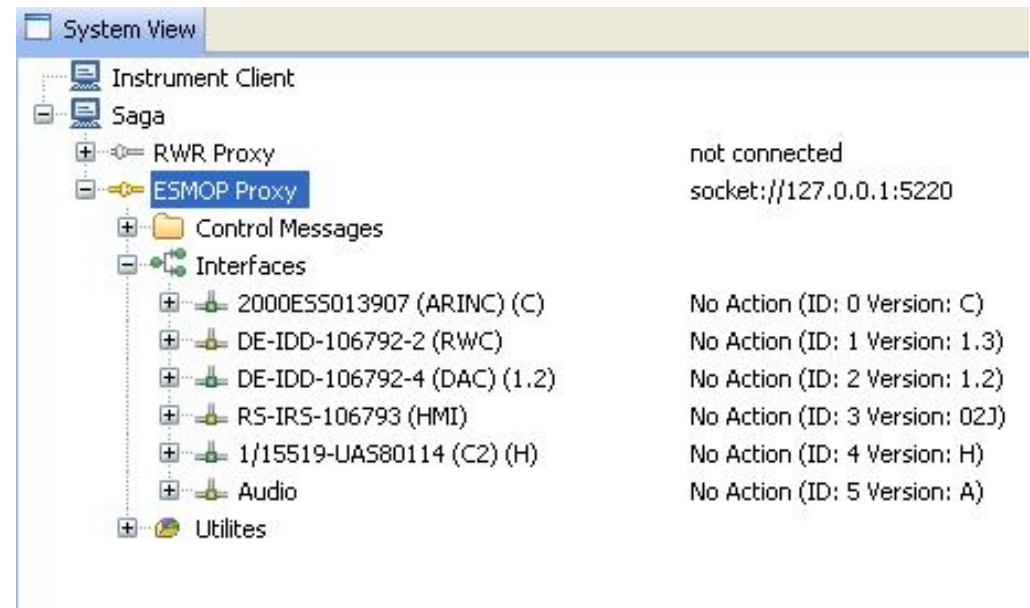
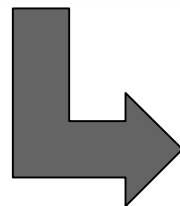
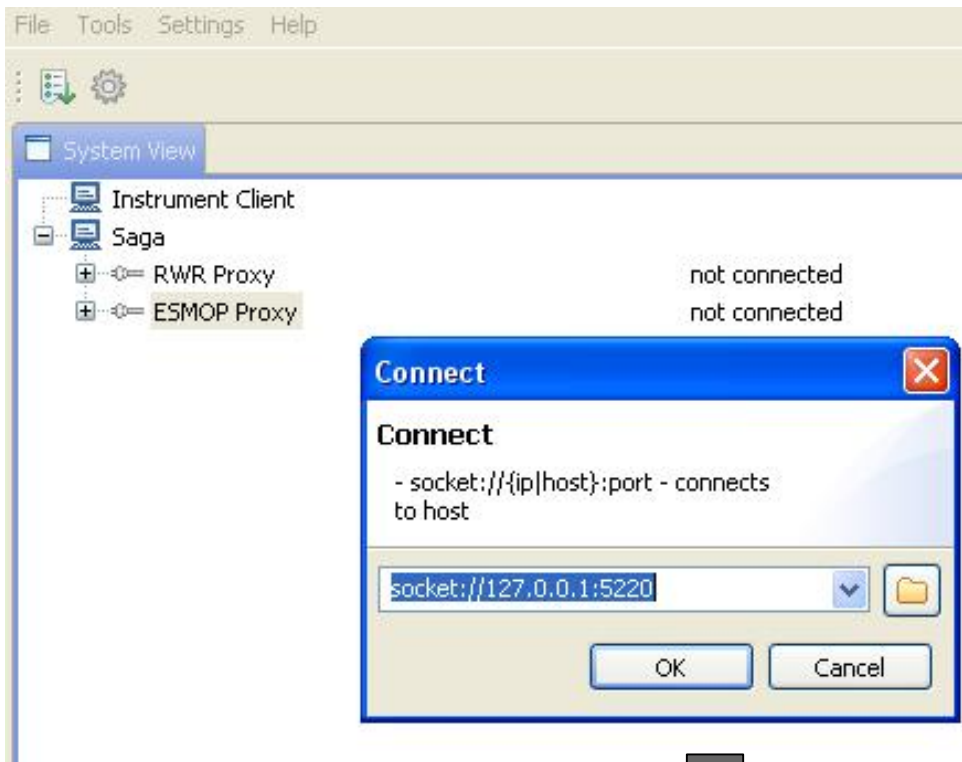


Testing tool

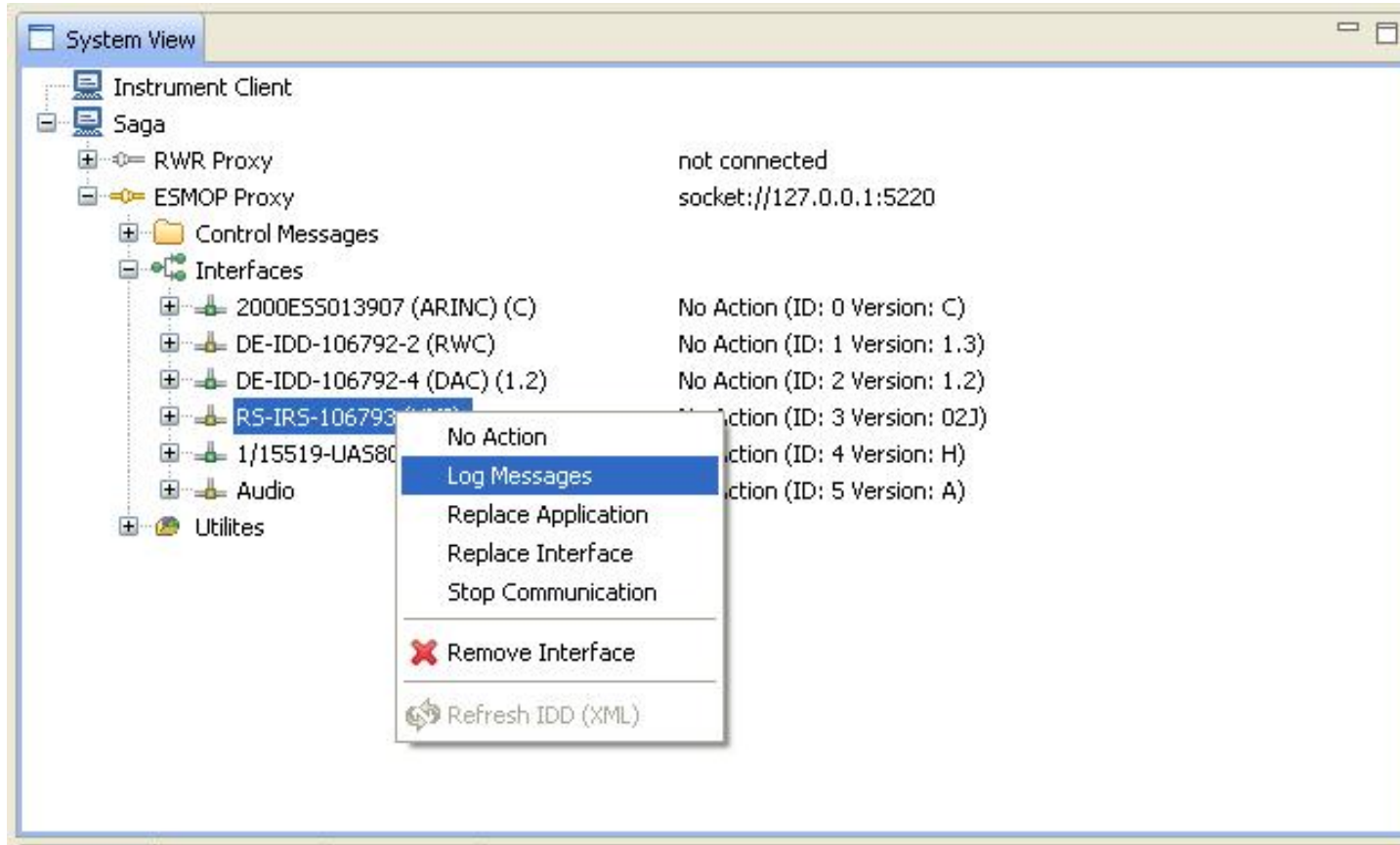
Testing tool

- ▶ Eclipse based
 - ▶ Automatic discovery of interfaces/proxies
 - ▶ Display all messages in HEX format
 - ▶ XML definitions of interfaces to interpret messages
 - ▶ Record all messages
 - ▶ Replay messages
 - ▶ Filter messages
 - ▶ Set up triggers for specific parameter values
-
- ▶ JUnit test cases

Testing tool



Testing tool



Testing tool

The screenshot shows the ESMOP Proxy Message Log interface. The main window displays a list of messages with columns for TOA, Interface, ID, Dir, and Message. The selected message at TOA 21:05:41,703 is expanded to show its raw data in hexadecimal format. The raw data is displayed in a table with columns for offset (#), Data (hex), and String (ASCII).

TOA	Interface	ID	Dir	Message
21:05:40,687	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:40,890	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:41,093	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:41,296	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:41,500	RS-IRS-106793 (HMI)	38	Int	SYSTEM_STATUS
21:05:41,500	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:41,703	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:41,890	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:42,093	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:42,296	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:42,500	RS-IRS-106793 (HMI)	38	Int	SYSTEM_STATUS
21:05:42,500	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:42,703	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:42,890	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:43,093	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:43,296	RS-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:43,500	RS-IRS-106793 (HMI)	38	Int	SYSTEM STATUS

#	Data	String
0	00 00 00 00
4	01 cf 00 00	..
8	00 00 00 00
12	00 00 00 00
16	27 0f 27 0f	' '
20	ff ff 27 0f	' '
24	27 0f 00 00	' ..

Testing tool

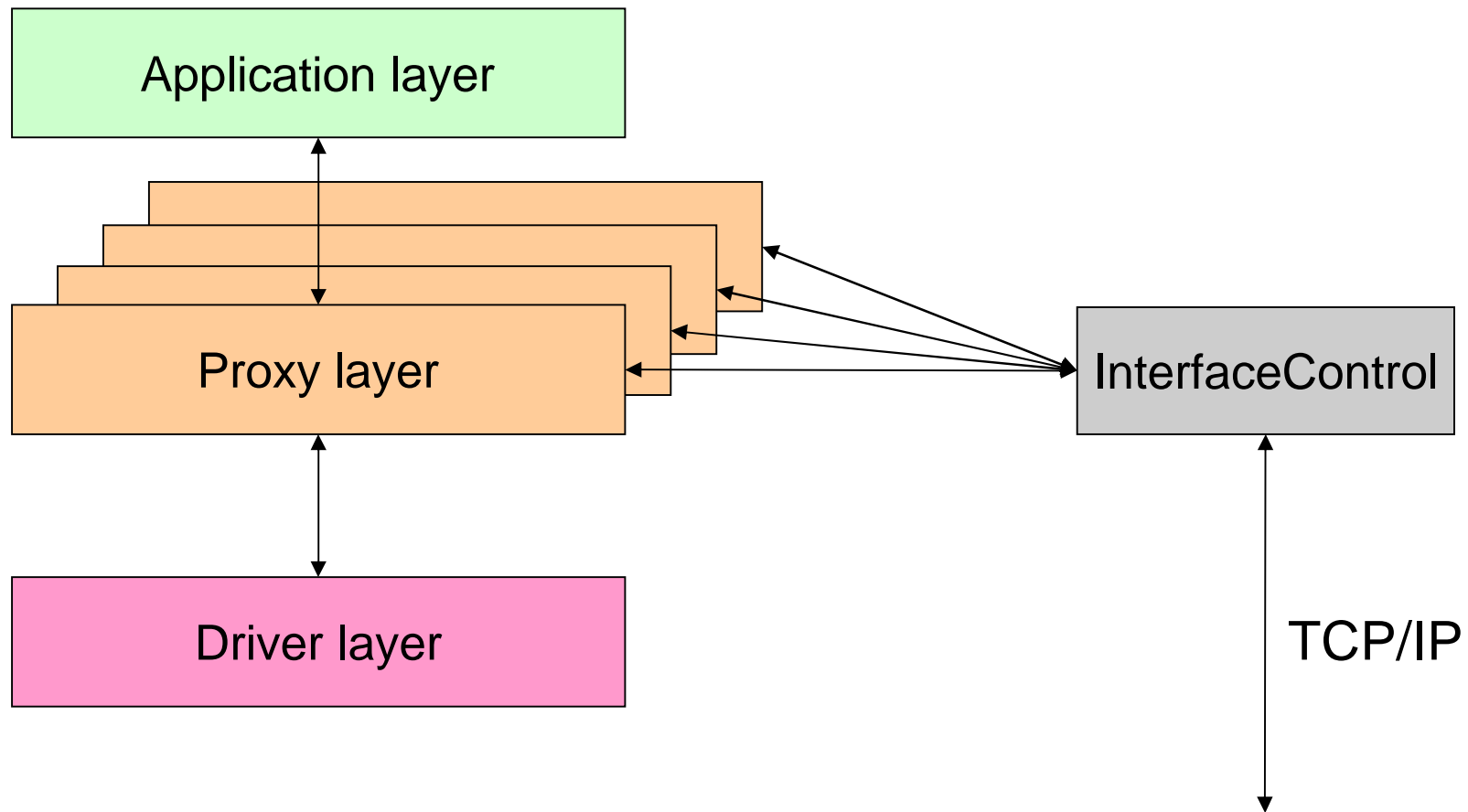
The screenshot shows the ESMOP Proxy Message Log interface. The main window displays a table of messages with columns for TOA, Interface, ID, Dir, and Message. The selected message at TOA 21:05:41,703 is a NAVIGATION_DATA message. The right-hand pane, titled 'Interpret Message', shows the decoded data for this message.

TOA	Interface	ID	Dir	Message
21:05:40,500	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:40,687	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:40,890	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:41,093	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:41,296	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:41,500	R5-IRS-106793 (HMI)	38	Int	SYSTEM_STATUS
21:05:41,500	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:41,703	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:41,890	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:42,093	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:42,296	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:42,500	R5-IRS-106793 (HMI)	38	Int	SYSTEM_STATUS
21:05:42,500	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:42,703	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:42,890	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:43,093	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:43,296	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:43,500	R5-IRS-106793 (HMI)	38	Int	SYSTEM_STATUS
21:05:43,500	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA
21:05:43,703	R5-IRS-106793 (HMI)	22	Int	NAVIGATION_DATA

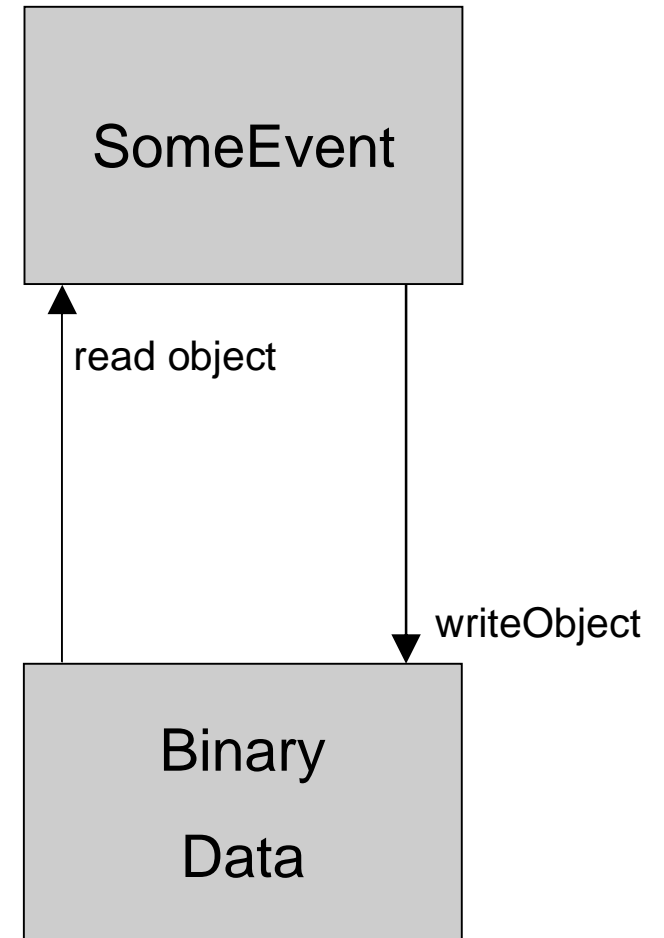
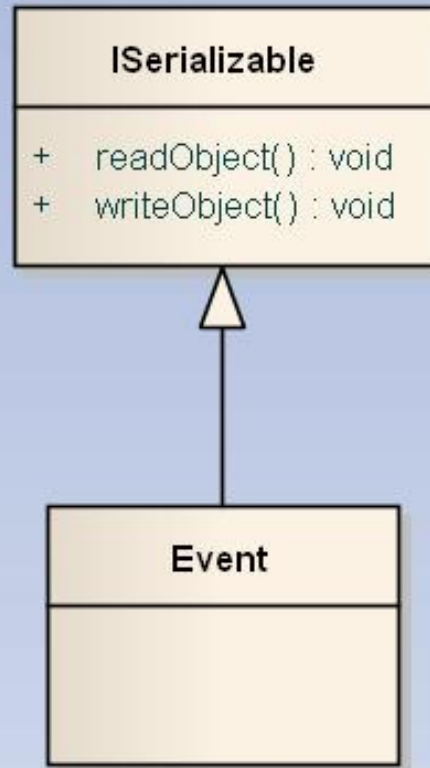
Name	Value
Nav_Data_Available	0 = FALSE
Date_Time	463
Position_Valid	0 = FALSE
Latitude	0
Longitude	0
Own_Heading	9999 = Angle NOT available
Own_Speed	9999 = Invalid speed
Own_Altitude	65535 = NOT available
Own_Roll	9999 = Angle NOT available
Own_Pitch	9999 = Angle NOT available

The technology behind it

The technology behind it



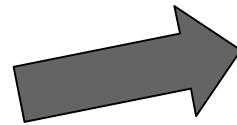
The technology behind it



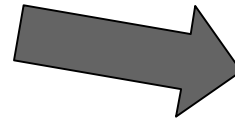
Taking it one step further

Taking it one step further

- ▶ The XML descriptions of the interface descriptions becomes much more important than the paper version!
- ▶ Tedious job to implement all Events by hand

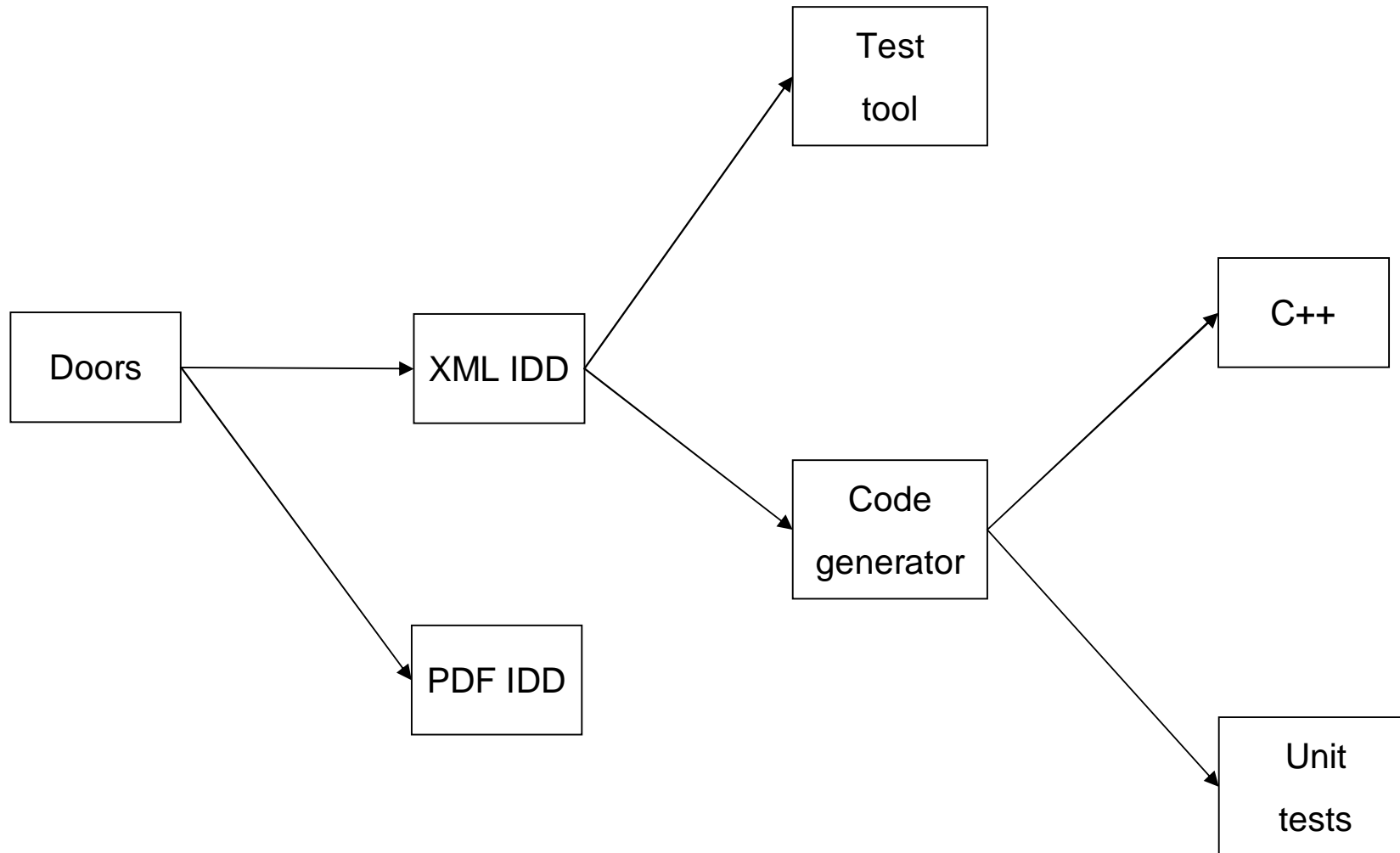


`<?xml?>`



`C++`

Taking it one step further



Conclusion

Conclusion

- ▶ The integrators loves this functionality!
 - ▶ Developers can test the integrated software on a desktop computer
 - ▶ Automated unit test on system level (for a small cost)
-
- ▶ It's important to consider integration testing when working with the architecture

Questions?

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