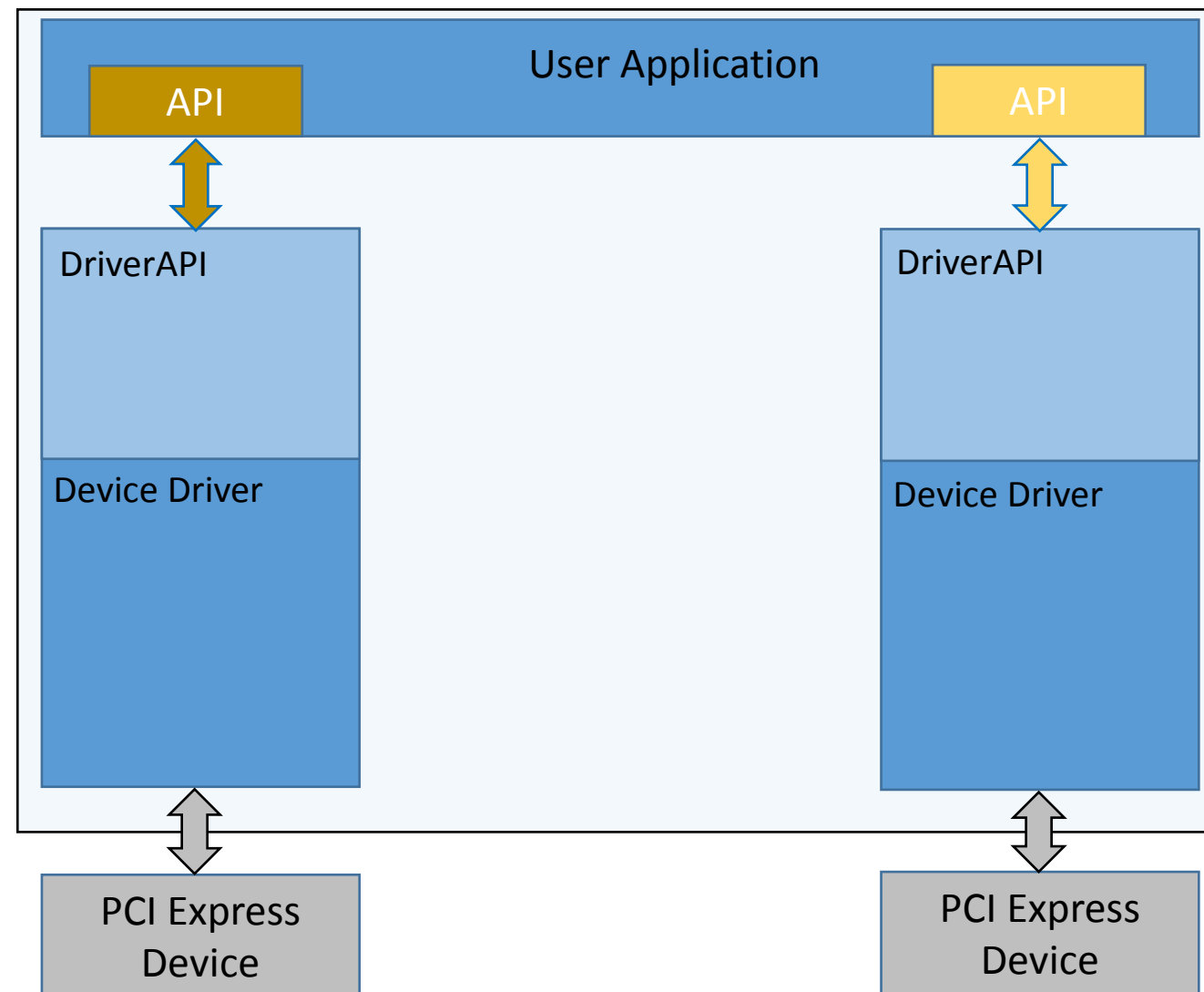


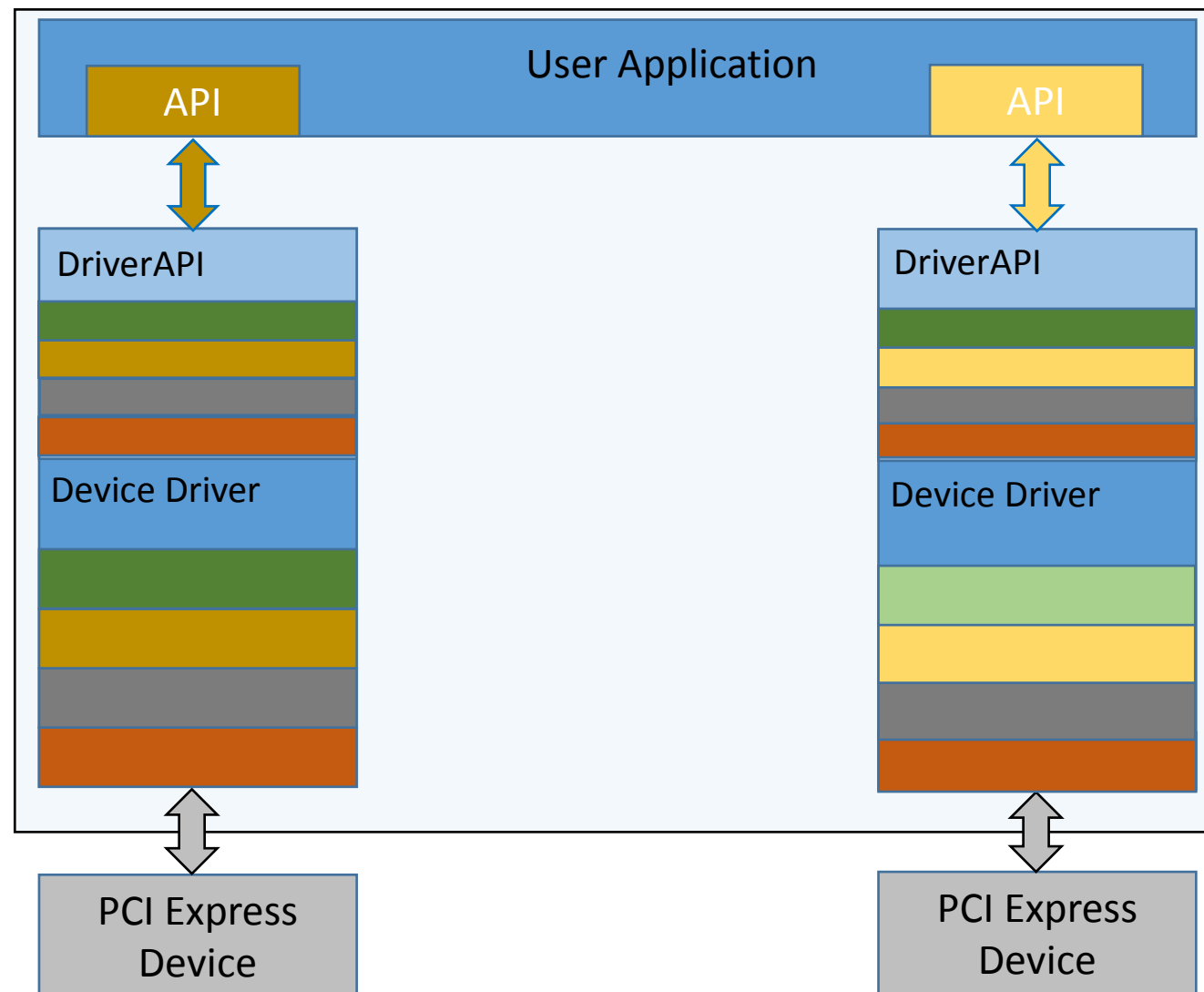
The universal PCI Express Device Driver for MTCA.4

L.Petrosyan

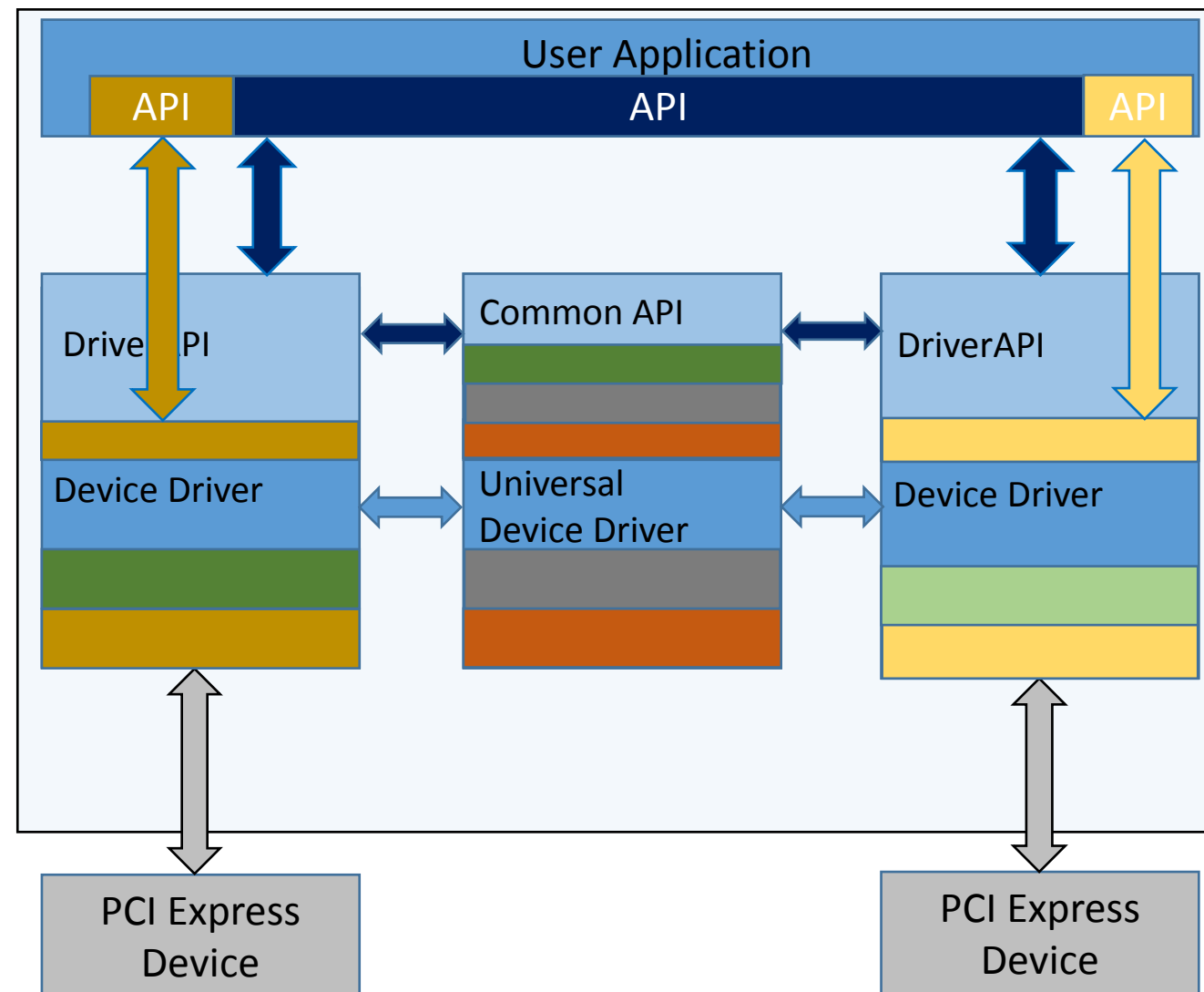
- A Device Driver is loadable kernel Module that provides access to the particular device attached to a computer (PCI Express Bus)
- User Application use the Device Driver API to access to the Device
- More Devices -> More Drivers
- Different Drivers -> different APIs



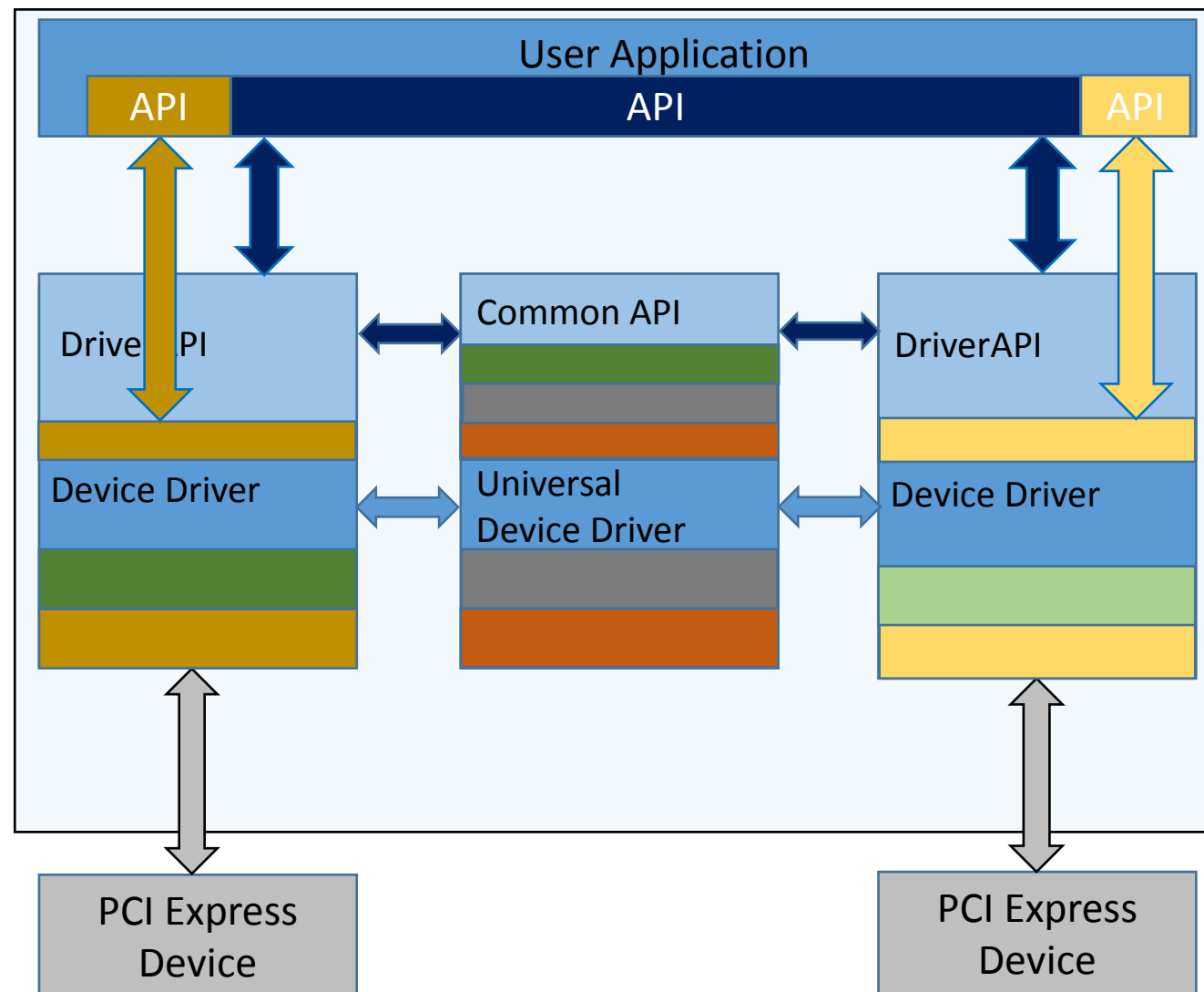
- Basic PCI Express functionality
 - Mapping memories
 - **Read, write** and some common **ioctl**
 - Error handling
 - Hot Plug
- Standards or Guidelines functionality
 - Standard Registers Set
 - SHAPI Registers Set (PICMG)
 - PICMG Standard Device Model
 - PCIe HotPlug functionality
- Device specific but has common API
 - DMA
- Device specific functionality



- Split Device Driver into two parts follow the Linux Device Driver stacking Model
- Add all common functionality and API into universal part
 - Basic PCI Express functionality
 - Standards or Guidelines functionality
- Add Common API for Device specific functionality into universal part but keep functionality in Device Driver side
 - Device specific but has common API



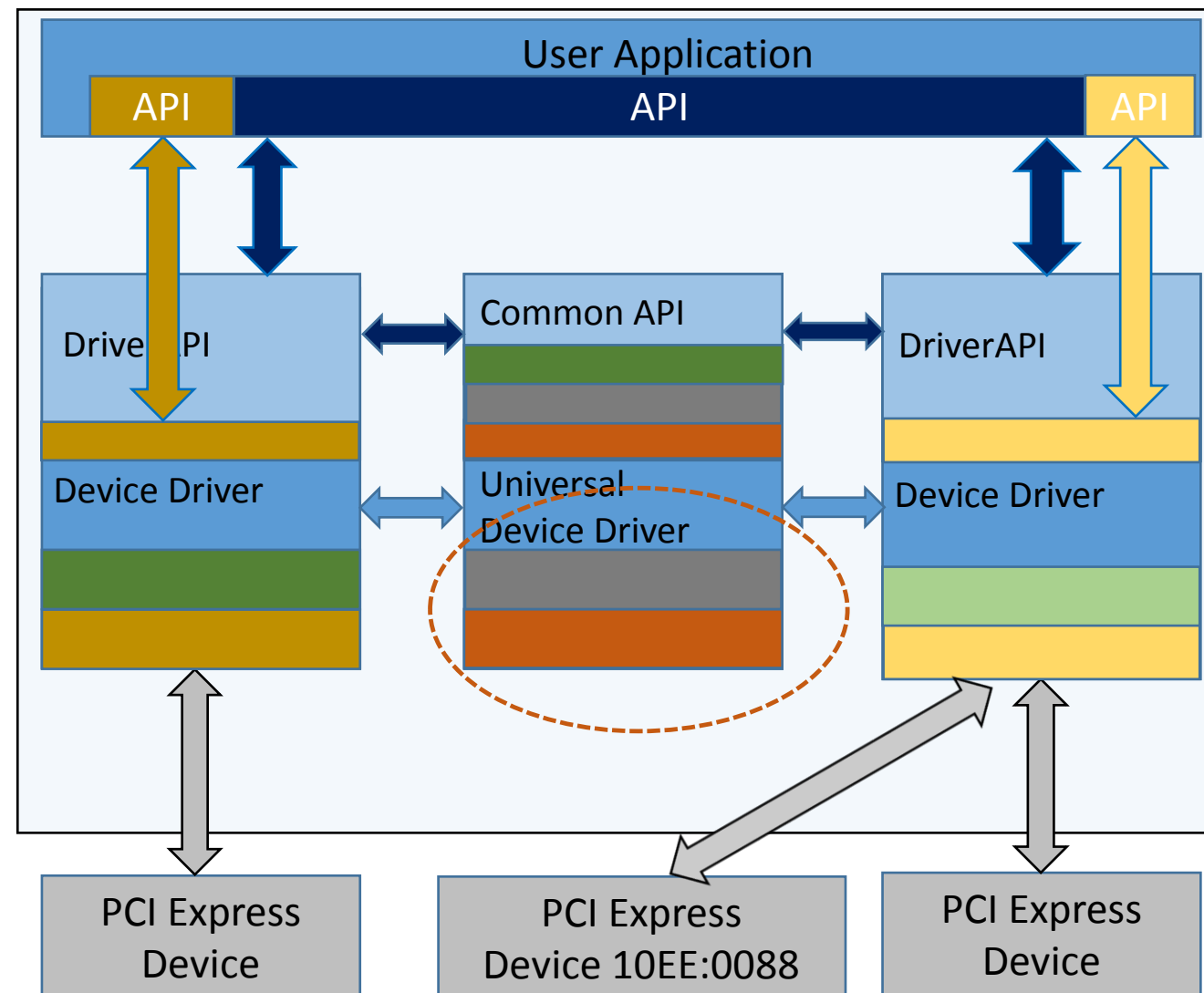
- this approach facilitates creation of new drivers and user applications



- this approach facilitates creation of new drivers and user applications
- The Device Driver created on the top of **universal** driver has all necessary PCI Express functionality
- It could be binded to any PCI Express Device

`echo „10EE:0088“ > /sys/bus/devices/xxx/driver/new_id`

facilitates integration of new devices into the existing software



Scan PCIe Bus			Run PCIe-Monitor			Rescan Bus			Quit	
10 Dev: 0000:04:10.0 10b5:8748 SWITCH ON	11 Dev: 0000:04:0a.0 10b5:8748 SWITCH OFF	12 Dev: 0000:04:0b.0 10b5:8748 SWITCH OFF	2 Dev: 0000:04:02.0 10b5:8748 SWITCH ON	3 Dev: 0000:04:01.0 10b5:8748 SWITCH ON	4 Dev: 0000:04:00.0 10b5:8748 SWITCH OFF	5 Dev: 0000:04:08.0 10b5:8748 SWITCH OFF	6 Dev: 0000:04:09.0 10b5:8748 SWITCH ON	7 Dev: 0000:04:13.0 10b5:8748 SWITCH OFF	8 Dev: 0000:04:12.0 10b5:8748 SWITCH ON	9 Dev: 0000:04:11.0 10b5:8748 SWITCH ON
DEV:	DEV:	DEV:	DEV:	DEV:	DEV:	DEV:	DEV:	DEV:	DEV:	DEV:
	0000:0a:00.0	0000:0c:04.0			0000:05:00.0	0000:08:00.0		0000:10:00.0		
IDs:	IDs:	IDs:	IDs:	IDs:	IDs:	IDs:	IDs:	IDs:	IDs:	IDs:
	10ee:0020	10b5:9056			1796:0018	10ee:0088		10ee:0088		
	3300:0020	12fe:0600			1796:0018	3300:0088		3300:0088		
Driver:	Driver:	Driver:	Driver:	Driver:	Driver:	Driver:	Driver:	Driver:	Driver:	Driver:
	x1timer	NO DRIVER			sis8300	pciedev		pciedev		
	1.8.0				1.4.0	1.6.0		1.6.0		
BARs:	BARs:	BARs:	BARs:	BARs:	BARs:	BARs:	BARs:	BARs:	BARs:	BARs:
	16777215	511			16383	67108863		67108863		
	0	255			0	67108863		67108863		
	0	65535			0	16777215		16777215		
	0	0			0	0		0		
	0	0			0	0		0		
PCIe-monitor	PCIe-monitor	PCIe-monitor	PCIe-monitor	PCIe-monitor	PCIe-monitor	PCIe-monitor	PCIe-monitor	PCIe-monitor	PCIe-monitor	PCIe-monitor
Bind pciedev	Bind pciedev	Bind pciedev	Bind pciedev	Bind pciedev	Bind pciedev	Bind pciedev	Bind pciedev	Bind pciedev	Bind pciedev	Bind pciedev
INFO	INFO	INFO	INFO	INFO	INFO	INFO	INFO	INFO	INFO	INFO

Scan PCIe Bus			
10 Dev: 0000:04:10.0 10b5:8748 SWITCH ON	11 Dev: 0000:04:0a.0 10b5:8748 SWITCH OFF	12 Dev: 0000:04:0b.0 10b5:8748 SWITCH OFF	2 Dev: 0000:04:0 10b5:874 SWITCH C
DEV:	DEV: 0000:0a:00.0	DEV: 0000:0c:04.0	DEV:
IDs:	IDs: 10ee:0020 3300:0020	IDs: 10b5:9056 12fe:0600	IDs:
Driver:	Driver: NO DRIVER	Driver: NO DRIVER	Driver:
BARs:	BARs: 16777215 0 0 0 0	BARs: 511 255 65535 0 0	BARs:
PCIe-monitor	PCIe-monitor	PCIe-monitor	PCIe-monit
Bind pciedev	Bind pciedev	Bind pciedev	Bind pcied
INFO	INFO	INFO	INFO

Scan PCIe Bus			
10 Dev: 0000:04:10.0 10b5:8748 SWITCH ON	11 Dev: 0000:04:0a.0 10b5:8748 SWITCH OFF	12 Dev: 0000:04:0b.0 10b5:8748 SWITCH OFF	2 Dev: 0000:04:0 10b5:874 SWITCH C
DEV:	DEV: 0000:0a:00.0	DEV: 0000:0c:04.0	DEV:
IDs:	IDs: 10ee:0020 3300:0020	IDs: 10b5:9056 12fe:0600	IDs:
Driver:	Driver: NO DRIVER	Driver: NO DRIVER	Driver:
BARs:	BARs: 16777215 0 0 0 0	BARs: 511 255 65535 0 0	BARs:
PCIe-monitor	PCIe-monitor	PCIe-monitor	PCIe-monit
Bind pciedev	Bind pciedev	Bind pciedev	Bind pcied
INFO	INFO	INFO	INFO



Scan PCIe Bus		
10 Dev: 0000:04:10.0 10b5:8748 SWITCH ON	11 Dev: 0000:04:0a.0 10b5:8748 SWITCH OFF	12 Dev: 0000:04:0b.0 10b5:8748 SWITCH OFF
DEV:	DEV: 0000:0a:00.0	DEV: 0000:0c:04.0
IDs:	IDs: 10ee:0020 3300:0020	IDs: 10b5:9056 12fe:0600
Driver:	Driver: pciedev 1.6.0	Driver: NO DRIVER
BARs:	BARs: 16777215 0 0 0 0	BARs: 511 255 65535 0 0
PCIe-monitor	PCIe-monitor	PCIe-monitor
Bind pciedev	Bind pciedev	Bind pciedev
INFO	INFO	INFO

The image displays three sequential screenshots of the 'Scan PCIe Bus' application, illustrating the driver installation process for a specific PCI Express device (Device 11).

First Screenshot: Shows the device details for Device 11 (0000:04:0a.0) with the driver status as 'NO DRIVER'. A white arrow points to the 'Bind pciudev' button.

Second Screenshot: Shows the same device details, but the driver is now 'pciudev' (version 1.6.0). A blue arrow points from this state to the third screenshot.

Third Screenshot: Shows the 'LSPCI' terminal window displaying the output of the command `cat /proc/pciudevsl1`. The output provides detailed information about the device and the driver, including:

```

cat /proc/pciudevsl1
UPCIEDEV Driver Version: 1.6
Driver Version: 1.6
Board NUM: 2
Slot NUM: 11
Board ID: 3
Board Version; 1010000
Board Date: 20130109
Board HW Ver: 1020A
Board Next Prj: 0
Board Reserved: 0
Number of Proj: 3
Project ID: 6
Project Version: 1010000
Project Date: 20130109
Project Reserver: 0
Project Next: 0
Project ID: A
Project Version: 1010000
Project Date: 20130109
Project Reserver: 0
Project Next: 14000
Project ID: C
Project Version: 1010000
Project Date: 20130109
Project Reserver: 0
Project Next: FFE4
  
```

The image displays three sequential screenshots of the 'Scan PCIe Bus' application, illustrating the process of loading the 'pcidev' driver for a specific PCI Express device.

First Screenshot (Left): Shows the 'Scan PCIe Bus' window with four columns representing different devices. Device 11 (0000:04:0a.0) is currently without a driver, showing 'NO DRIVER' in the Driver field. A white arrow points to the 'Bind pcidev' button for device 11.

Second Screenshot (Middle): Shows the same window after the driver has been loaded. The Driver field for device 11 now contains 'pcidev' and '1.6.0'. A blue arrow points from the 'Bind pcidev' button in the first screenshot to this state.

Third Screenshot (Right): Shows the 'PCIE Monitor v2.0' window for device 11. The 'Device' field is set to '/dev/damcbpms6'. The 'Status' is 'OK'. A white arrow points from the 'Bind pcidev' button in the second screenshot to this window. The 'I/O' section shows 'Read', 'Write', 'Plot', and 'List' buttons. The 'DMA' section shows 'Write', 'Plot', 'List', and 'Mb/sec: 0'.

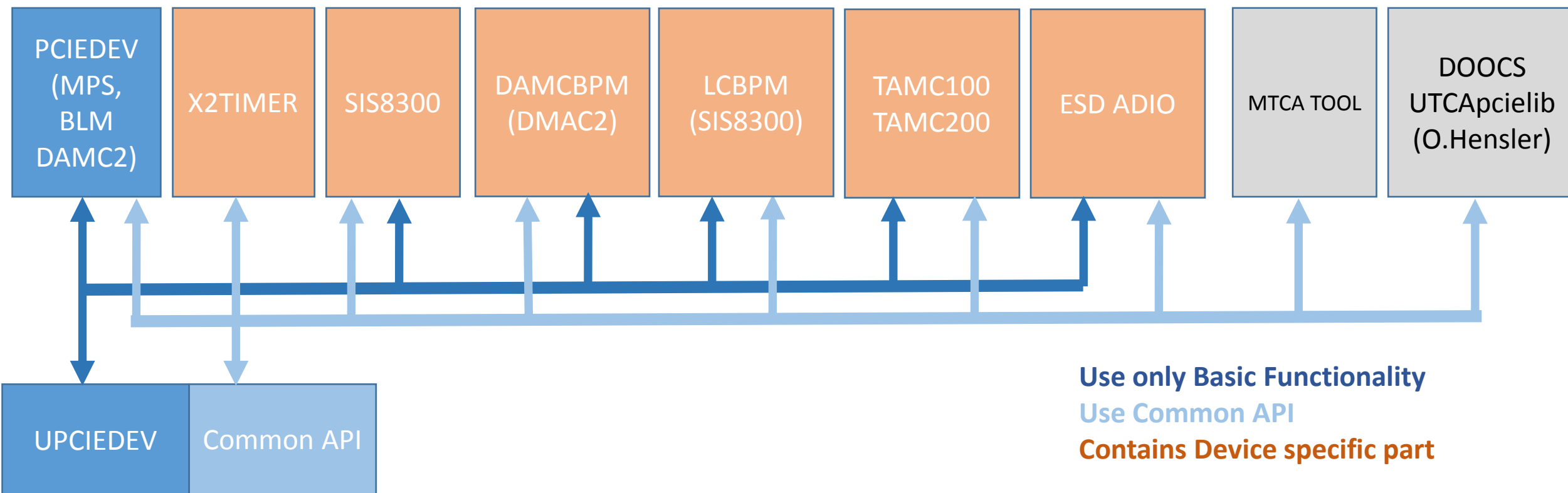
Below the 'PCIE Monitor v2.0' window, a status window displays the following project information:

```

Project Next: 14000
Project ID: C
Project Version: 1010000
Project Date: 20130109
Project Reserver: 0
Project Next: FFE4
    
```

Status

- this architecture was developed in DESY group MCS4 and till today with success is used
- the following drivers, tools and libraries are developed used



Plans

Add more functionality to the universal driver

- More PCI Express specific tasks (PCI Express Error Handling, Transaction Ordering ...)
- Hide more Linux Kernel calls in the universal driver (top level driver does not depend on Kernel Version)
- Code cleaning, better documentation
- ...

Info

- All sources of the Drivers and Libraries are Open Source
- The source codes can be found on a DOOCS web page <http://doocs.desy.de>
 - Go to *Source Code Repository*
 - *source/unixdriver/utca/linux/upciedev* and *pciedev* (all others as an example)
 - *source/UTCApcielib*
- The packages can be download from <http://doocs.desy.de/pub/doocs/>
- Mail doocs@desy.de



The Universal PCI Express Device Driver



THANK YOU