SILICON, SOFTWARE AND LINUX FOR EMBEDDED SYSTEMS

DR. XIN-XIN YANG

DIRECTOR

SOFTWARE & SOLUTION TECHNOLOGY

DIGITAL NETWORKING
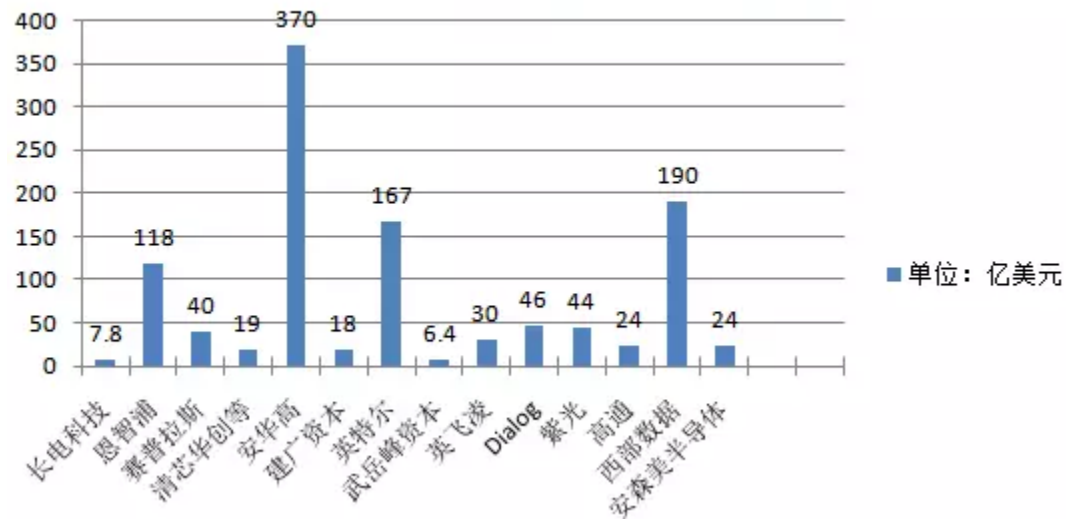

嵌入式系统联谊会
www.esbf.org.cn

NXP

SECURE CONNECTIONS
FOR A SMARTER WORLD

Merge in 2015 on Semiconductor

2015 年 1-11 月半导体企业重大并购案例

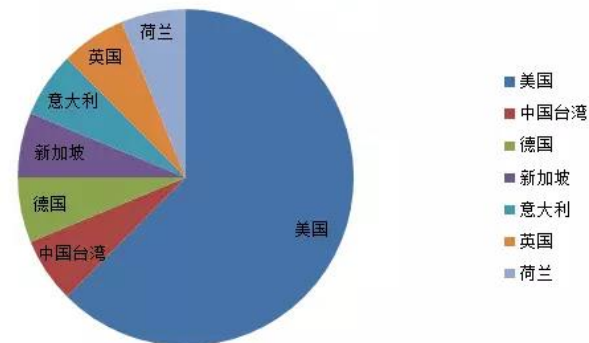| 时间	收购方	被收购方	金额（美元）	领域
2.2	英特尔（美国）	Lantiq（德国）	未知	设计
2.12	长电科技（中国）	星科金朋（新加坡）	7.8 亿	封装
3.2	恩智浦（荷兰）	飞思卡尔（美国）	118 亿	设计
3.12	赛普拉斯（美国）	飞索半导体（美国）	40 亿	设计
5.2	清芯华创、中信资本、金石投资（中国）	豪威科技（美国）	19 亿	设计
5.28	安华高（美国）	博通（意大利）	370 亿	设计
5.28	建广资本（中国）	恩智浦（荷兰）	18 亿	设计
6.2	英特尔（美国）	Altera（美国）	167 亿	设计
7.2	武岳峰资本（中国）	芯成半导体（美国）	6.4 亿	设计
8.21	英飞凌（德国）	IR（美国）	30 亿	功率器件
9.21	Dialog（德国）	Atmel（美国）	46 亿	设计
9.30	紫光（中国）	西部数据（美国）	38 亿	设计
10.15	高通（美国）	CSR（英国）	24 亿	设计
10.21	西部数据（美国）	闪迪（美国）	190 亿	IDM
10.30	紫光（中国）	力成（中国台湾）	6 亿	封装
11.19	安森美半导体（美国）	飞兆半导体（美国）	24 亿	设计
7.14	紫光（中国）	美光（美国）	230 亿（未通过）	IDM
合计金额：1730 亿美元				

2015年1-11月半导体企业重大并购出资金额

各国资本作为收购方涉及的份额

被收购企业国家（地区）占比

1

Embedded Applications

Automotive
- Advanced Driver Assistance Systems
- Powertrain
- Chassis & Safety
- Vehicle Networking & Information
- Radar & Vision Systems

Networking
- Cloud Computing / Data Centers
- Security Appliances
- Routers & Switches
- Networked Printers & Gateways
- Wireless Base Stations

Industrial
- Healthcare
- Smart Energy & Connectivity
- Home Appliances
- Factory Automation and Drives
- General Embedded

Consumer
- Smart Mobile Devices
- eReaders & Wearables
- Sensors for Phones and Games
- General Embedded

We Have a **Broad Portfolio**
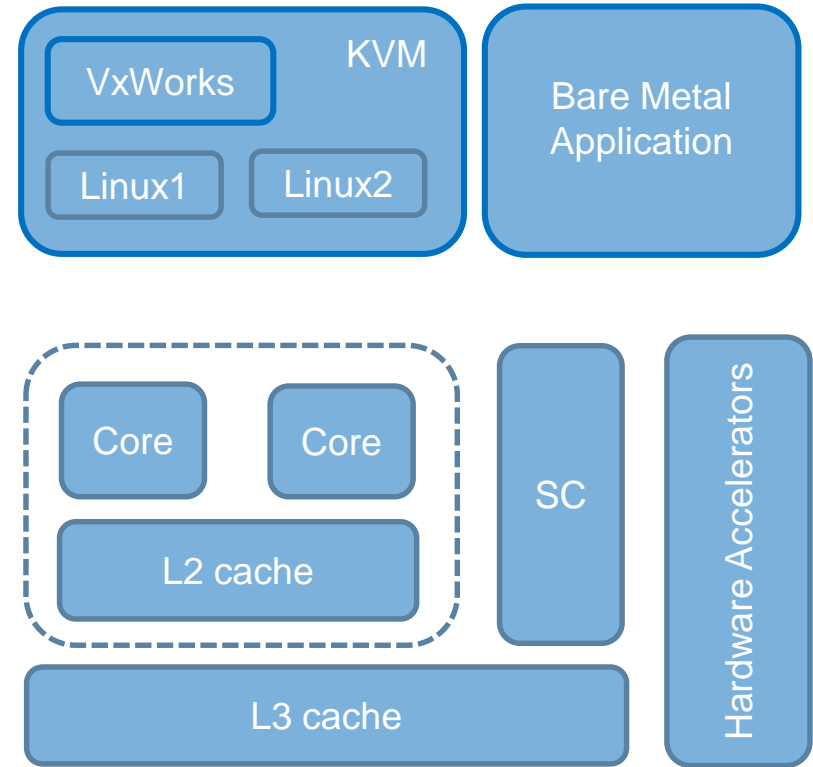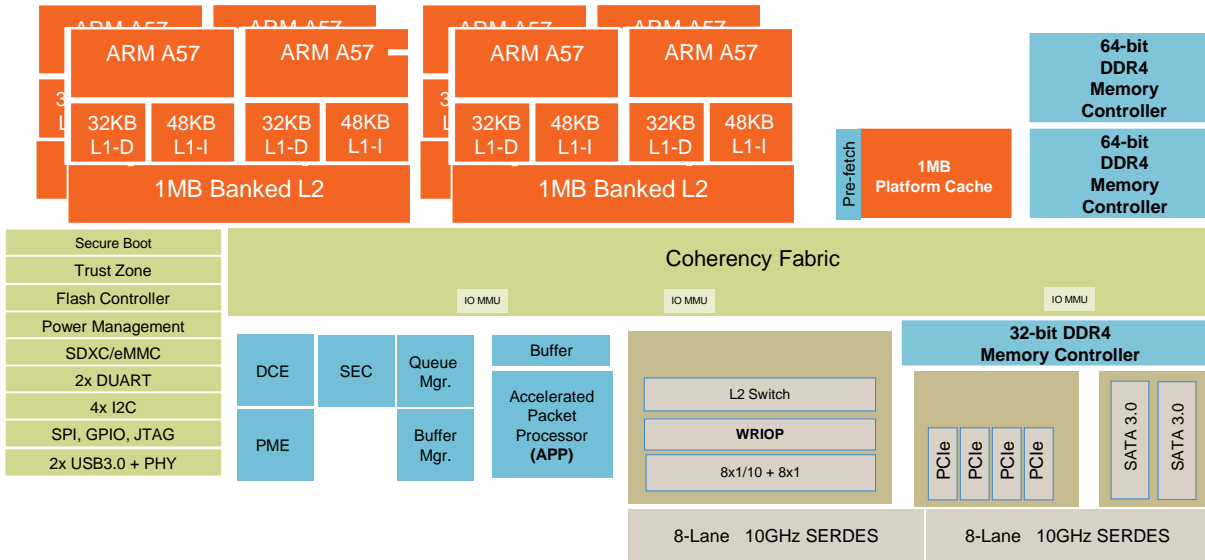
Embedded Processor Development

- Multicore
- Architecture Consolidated
  - x86, ARM dominated
  - Power, MIPS and others
- Heterogeneous
  - CPU core with different architectures
  - CPU + DSP
  - CPU + FPGA/CPLD/ASIC
  - CPU + GPU
  - …
- Data Path Acceleration
  - Graphics/Video
  - Networking

Industry's Leading ARM-64bit Networking Solution: LS2085A

Other Parametrics
- 37.5x37.5 Flipchip
- 1mm Pitch
- 1292pins

Datapath Acceleration
- **SEC** - crypto acceleration
- **DCE** - Data Compression Engine
- **PME** – Pattern Matching Engine

General Purpose Processing Layer
- 8x ARM A57 CPUs, 64b, 2.0GHz
  - 4MB Banked L2 cache
- HW L1 & L2 Prefetch Engines
- Neon SIMD in all CPUs
- 1MB L3 platform cache w/ECC
- 2x64b DDR4 up to 2.4GT/s
-

Accelerated Packet Processing Unit
- 40Gbps Packet Processing
- 20Gbps SEC- crypto acceleration
- 15Gbps Pattern Match/RegEx
- 20Gbps Data Compression Engine
- 4MB Packet Express Buffer

Express Packet IO Layer
- Supports1x8, 4x4, 4x2, 4x1 PCIe Gen3 controllers
- 2 x SATA 3.0, 2 x USB 3.0 with PHY

Network IO
- Wire Rate IO Processor:
  - 8x1/10GbE + 8x1G
  - XAUI/XFI/KR and SGMII
  - MACSec on up to 4x 1/10GbE

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NXP Delivers Industry's Best Performance Efficiency ARM-64bit Embedded Solution; Samples Q1-15
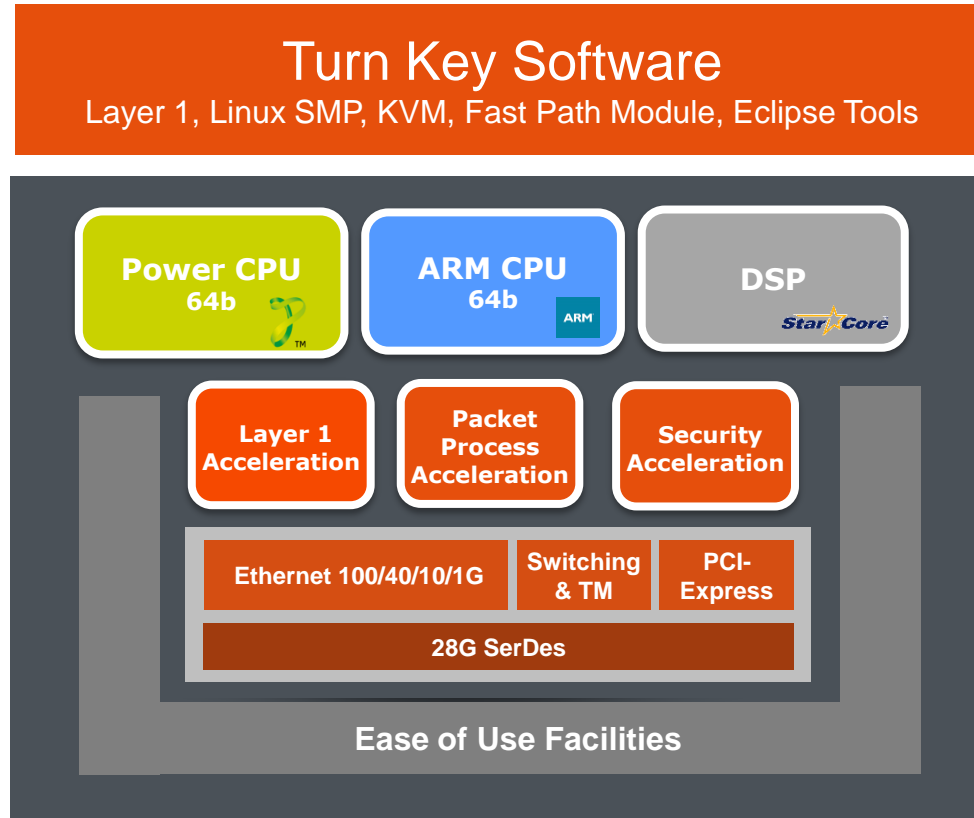
QorIQ LS1043A – Efficient Cores with Optimized Features

The industry's most efficient 64-bit communications processor based on ARM® technology
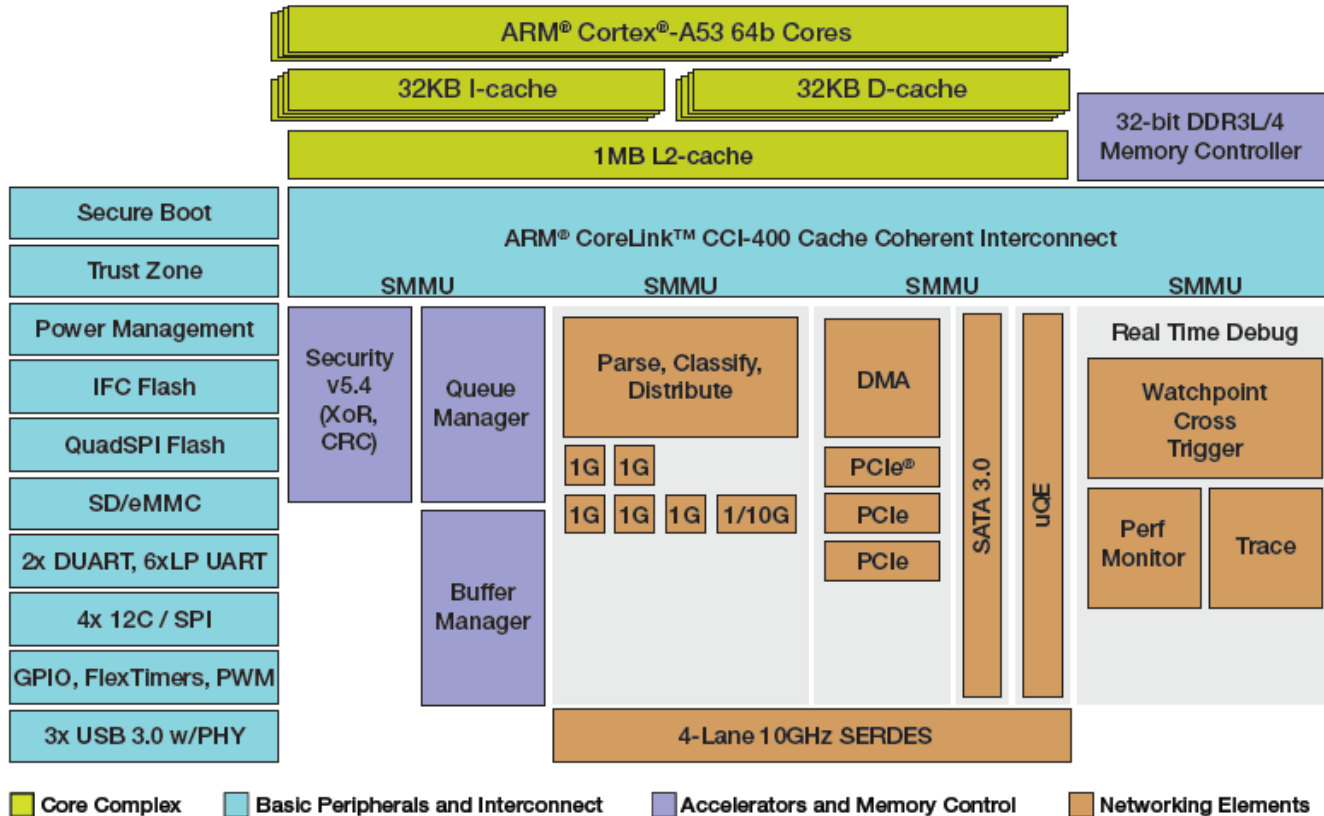
- **Targeted performance and power efficiency**
  - 4x ARM® Cortex®-A53 cores, estimated over 16,0000 CoreMarks
  - Leading packet processing offload technology: greater than 10 Gbps performance
  - Low power to 6 W

- **Purpose-built for fanless, small form factor networking applications**
  - Integrated services branch routers, SDN & NFV edge platforms, industrial PLC and control, security appliances
  - High level of integration for low Bill of Materials

- **Simplified, adaptable edge presence for reduced opex**
  - Evolves with virtualized services, OVS, NFV services platform
  - Offloads advanced and latency sensitive applications such as application ID, QoS & security
  - Secure software updates with advanced virtualization hardware

New Networks Demand a New, Open Engagement Model

Turn Key Software

Layer 1, Linux SMP, KVM, Fast Path Module, Eclipse Tools

Power CPU 64b

ARM CPU 64b

DSP
Star Core

Layer 1 Acceleration

Packet Process Acceleration

Security Acceleration

Ethernet 100/40/10/1G

Switching & TM

PCI-Express

28G SerDes

Ease of Use Facilities

Core Agnostic (ARM, Power, StarCore)
- ARM V8 product roadmap
- Power Architecture e6500
- StarCore SC3900 DSP
- Small / Large footprints

Scalable Acceleration Elements
- Sized to application needs
- Turn key or C-programmable

Ease of Use
- Real Time Monitoring / Debug
- SW management utility
- I/O virtualization

Turn-key Software
- Fast path modules
- Linux / BSP
- Hypervisor: KVM
- Eclipse-based tools
- Layer 1

16nm FinFET foundation and industry's largest selection of acceleration and I/O building blocks
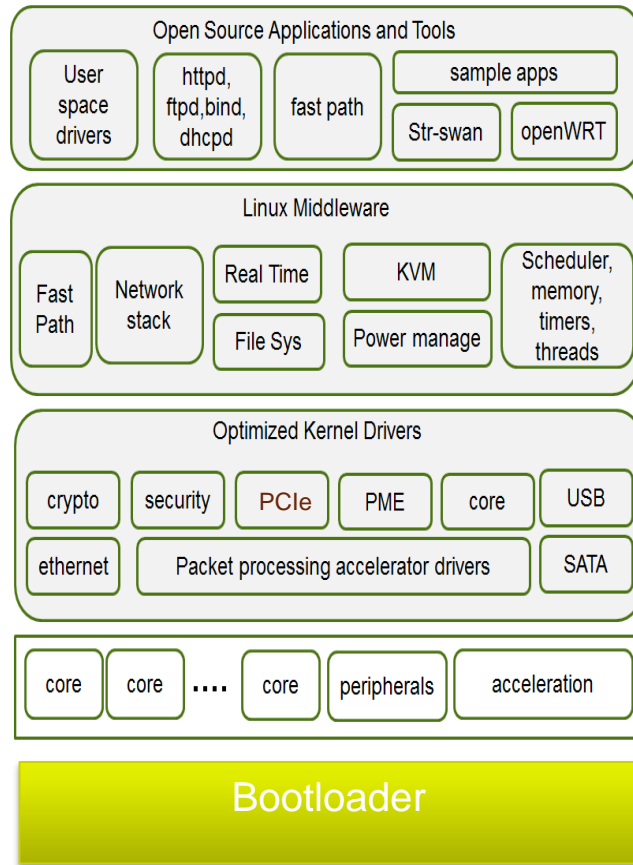
Help customers take on a higher level of SoC design by mixing Freescale IP and their own proprietary IP

NXP

Embedded Software Development

- Linux & Opensource
- Virtualization
- Real Time
- Power Management
- Linaro
- ODP
- VNP
- Distribution

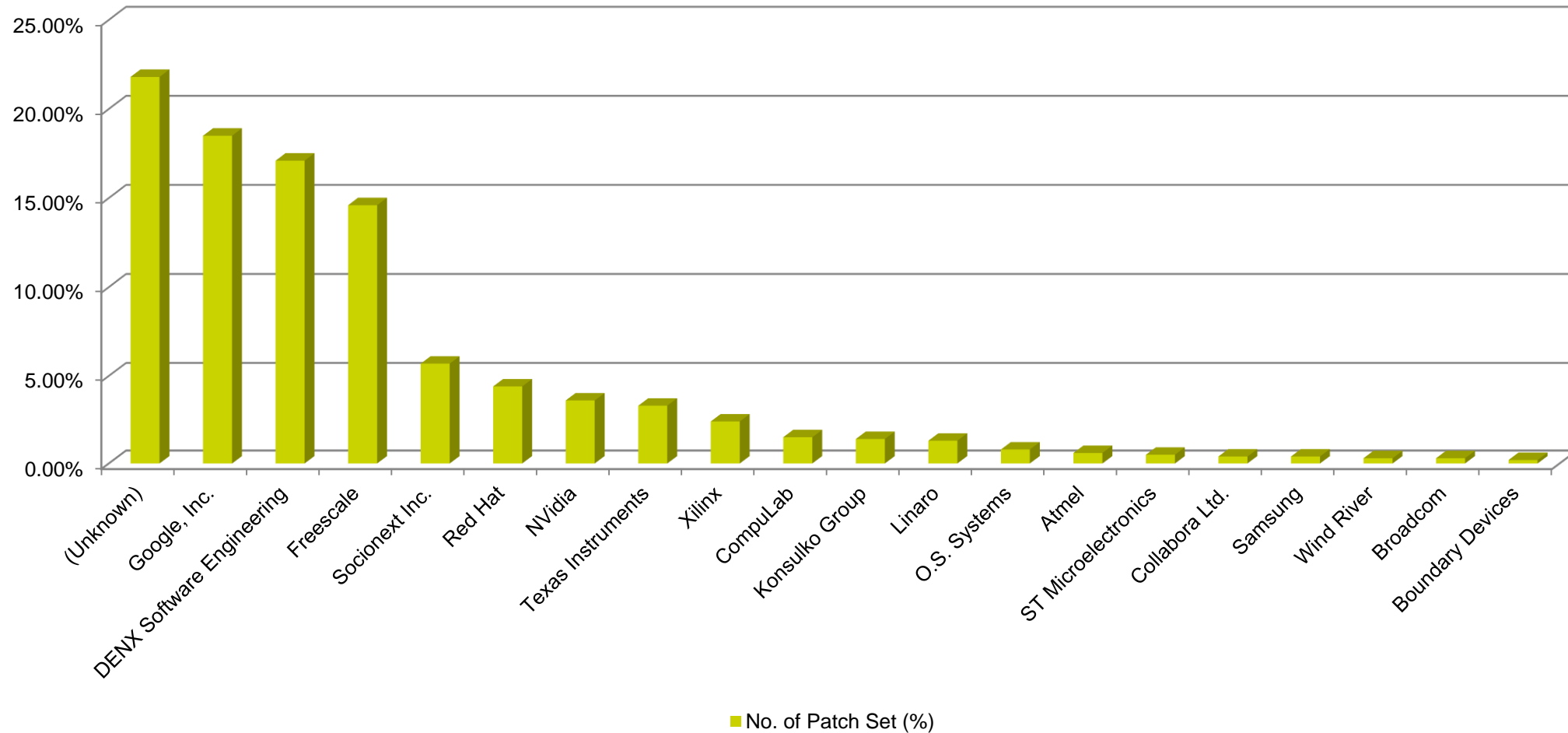# Embedded Software and Opensource

Opensource Community – Kernel Contributors

No. of Patch Set (%) in Kernel 4.1 Version
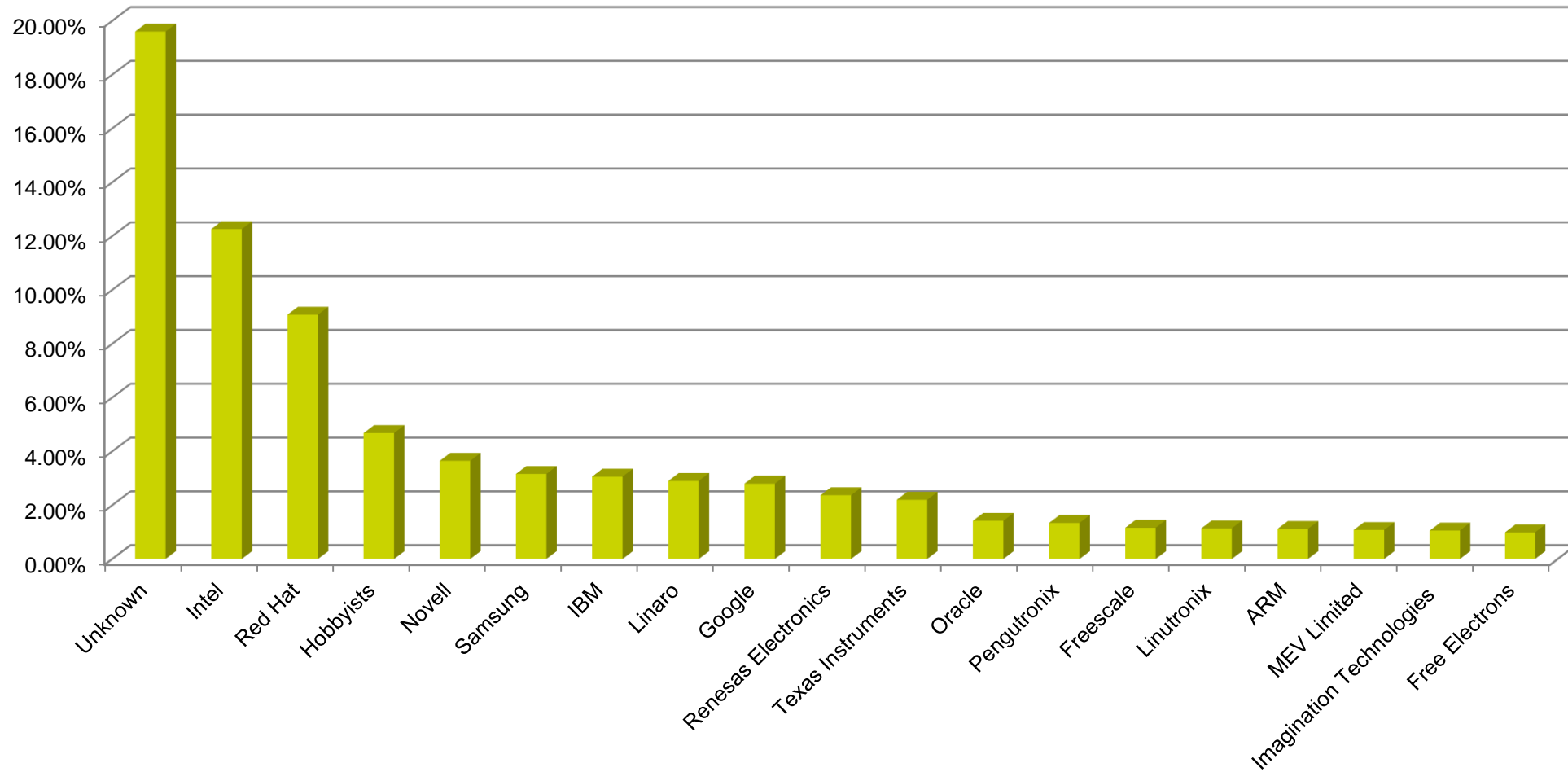
Opensource Community – U-Boot Contributors

No. of Patch Set (%) in U-Boot 2015.10 Version
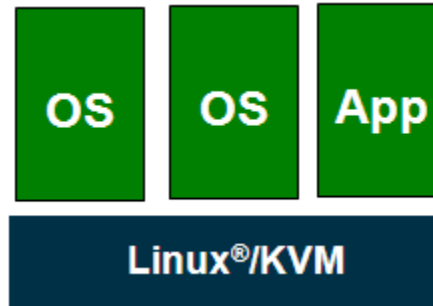

■ No. of Patch Set (%)

# Flexibility and Differentiation - Virtualization
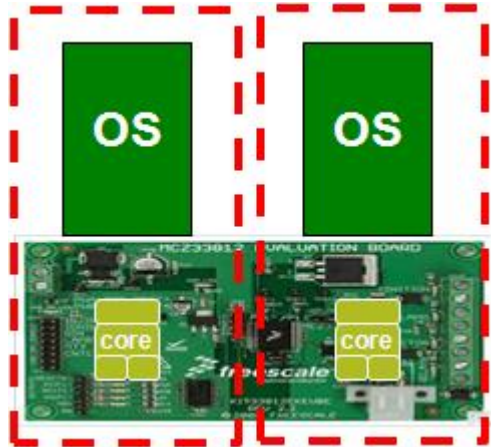
Topaz

- Static partitioning of hardware (supervised AMP)
- CPUs, memory and I/O devices can be divided into logical partitions isolated from one another
- Advanced features such as HA Failover
- Mapped well to Si

KVM

- Based on Linux, OSS
- Virtual machines completely isolated from each other
- Multiple virtual machines supported per CPU using full capabilities of Linux scheduler
- Number of virtual machines is only limited by available resources (CPU cycles, memory)
- PCI-E endpoint partitioning
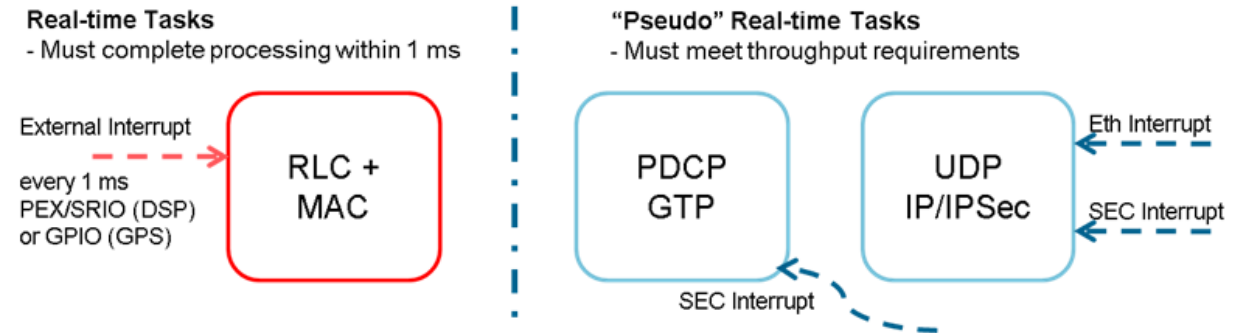- Virtual I/O
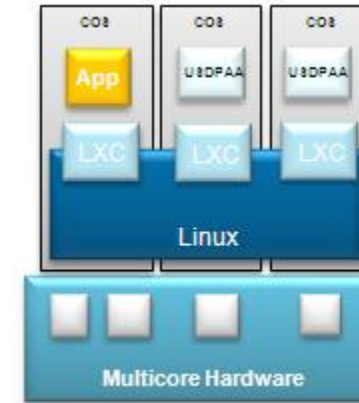
Containers

- Containers provide OS level virtualization
- Low overhead, lightweight, secure partitioning of Linux applications into different domains
- Can control resource utilization of domains– CPU, I/O bandwidth

Real-Time

- Linux PREEMPT_RT patch from http://git.kernel.org/?p=linux/kernel/git/rt/linux-stable-rt.git;a=summary converts Linux into a fully preemptible kernel with below features:

  - It makes in-kernel locking-primitives (using spinlocks) preemptible though reimplementation with rtmutexes.

  - Critical sections protected by i.e. spinlock_t and rwlock_t are preemptible.

  - It implements priority inheritance for in-kernel spinlocks and semaphores.

  - It converts interrupt handlers into preemptible kernel threads.

  - It converts the old Linux timer API into separate infrastructures for high resolution kernel timers plus one for timeouts, leading to user space POSIX timers with high resolution.

Real-time Tasks
- Must complete processing within 1 ms

External Interrupt

every 1 ms
PEX/SRIO (DSP)
or GPIO (GPS)

RLC + MAC

"Pseudo" Real-time Tasks
- Must meet throughput requirements

PDCP GTP

UDP IP/IPSec

Eth Interrupt

SEC Interrupt

SEC Interrupt

- Latency requirements
  - 10 μsec avg., 50 μsec max wake-up latency for RT tasks
  - Total 1ms TTI for entire round-trip processing
- Throughput requirements
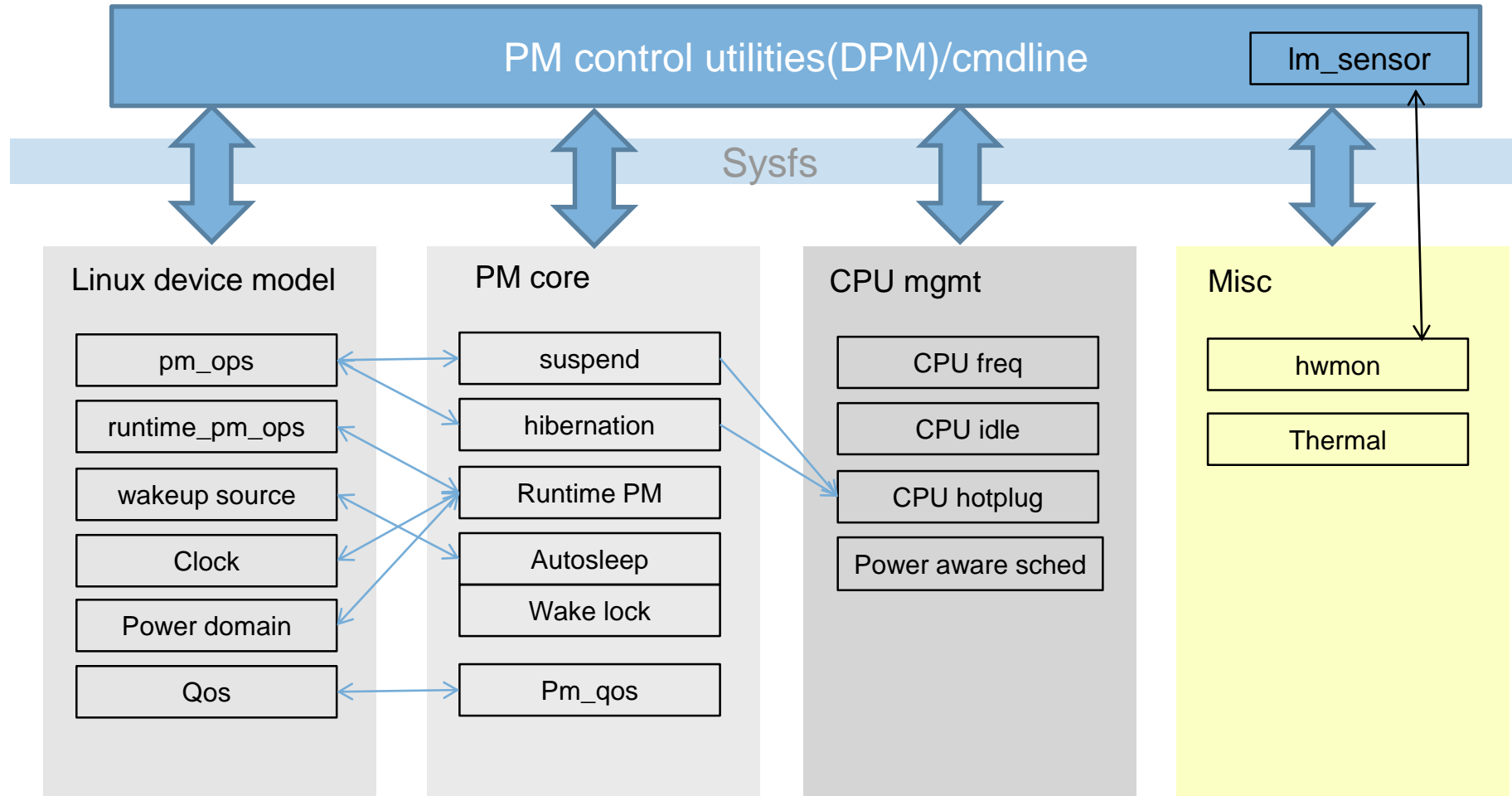 - 50 Mbps UL, 100 Mbps DL @ 512B packets

Power Management

- It is **NOT** about reducing **maximum** power consumption
- It is about **matching** the runtime **workload** requirements with runtime **performance/capacity**
- **Turn off** everything else as much as possible
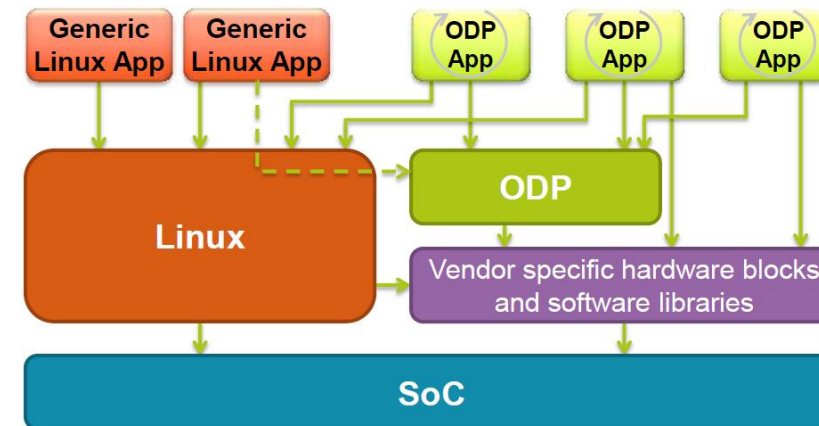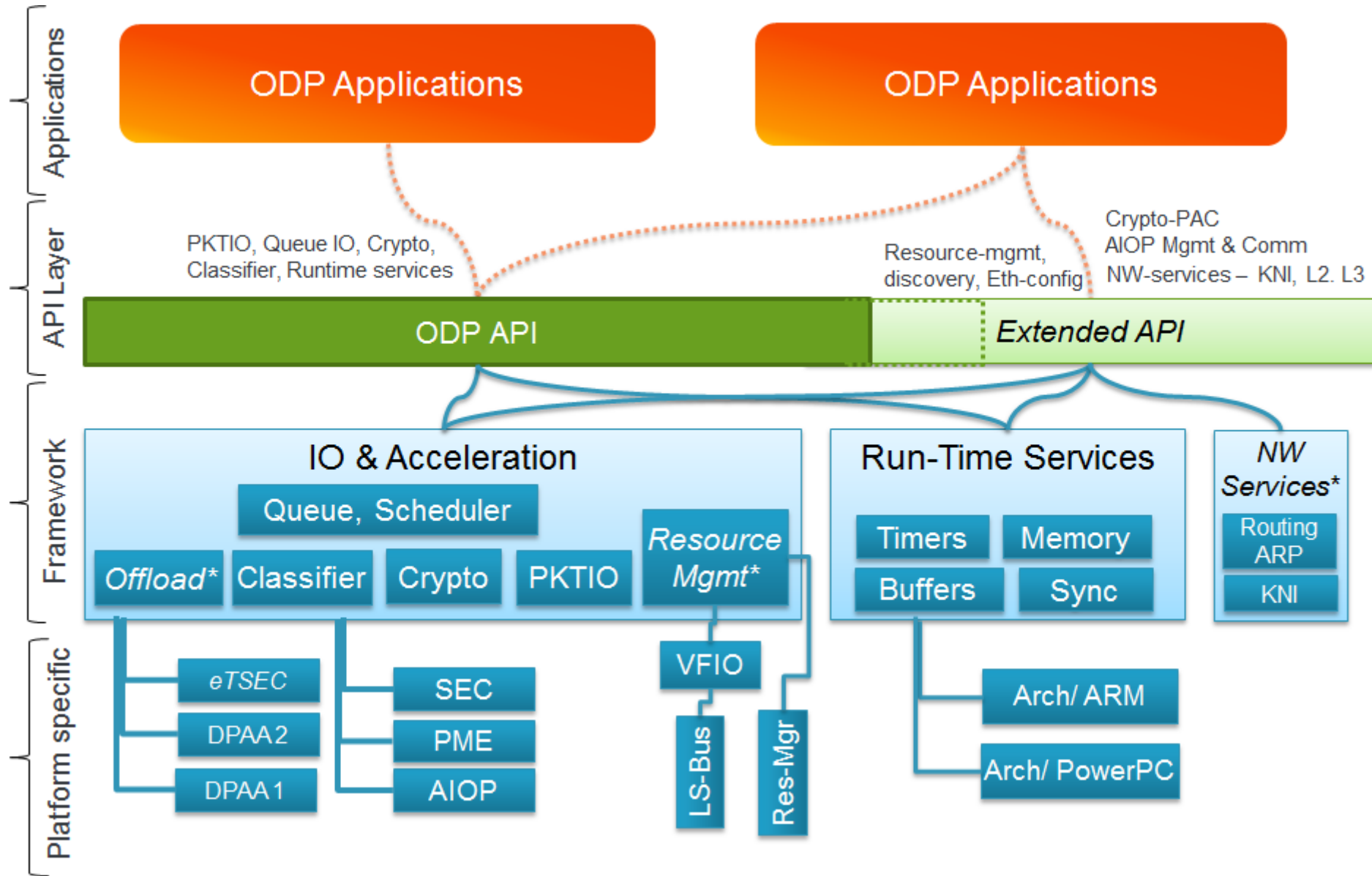- **PM** is all about providing ways to do so
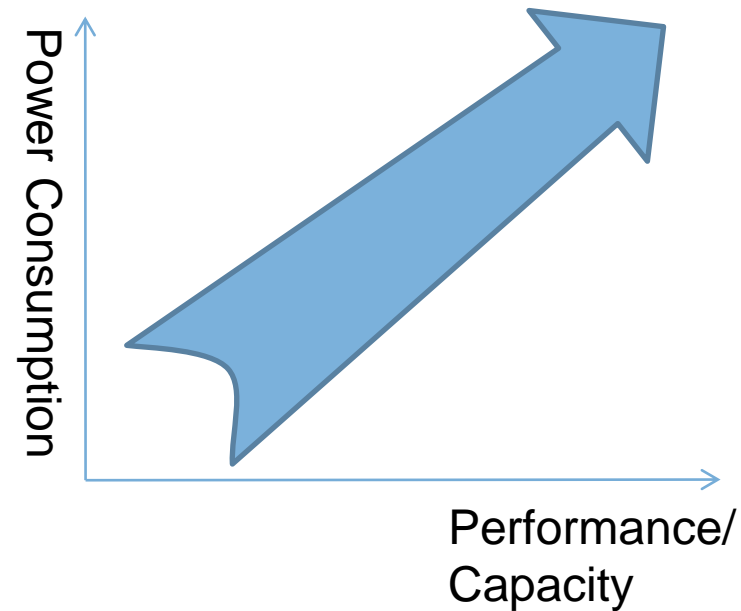
Linux PM frameworks

User Space

Kernel Space

Linaro Introduction

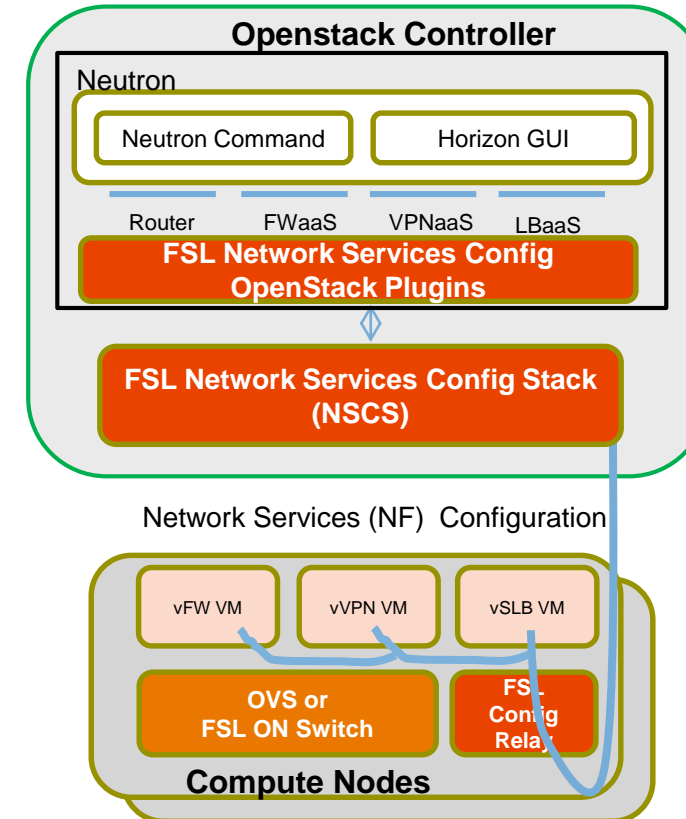**Freescale Founder Member of Linaro Networking Group, 2013**

Open Data Plane (ODP)

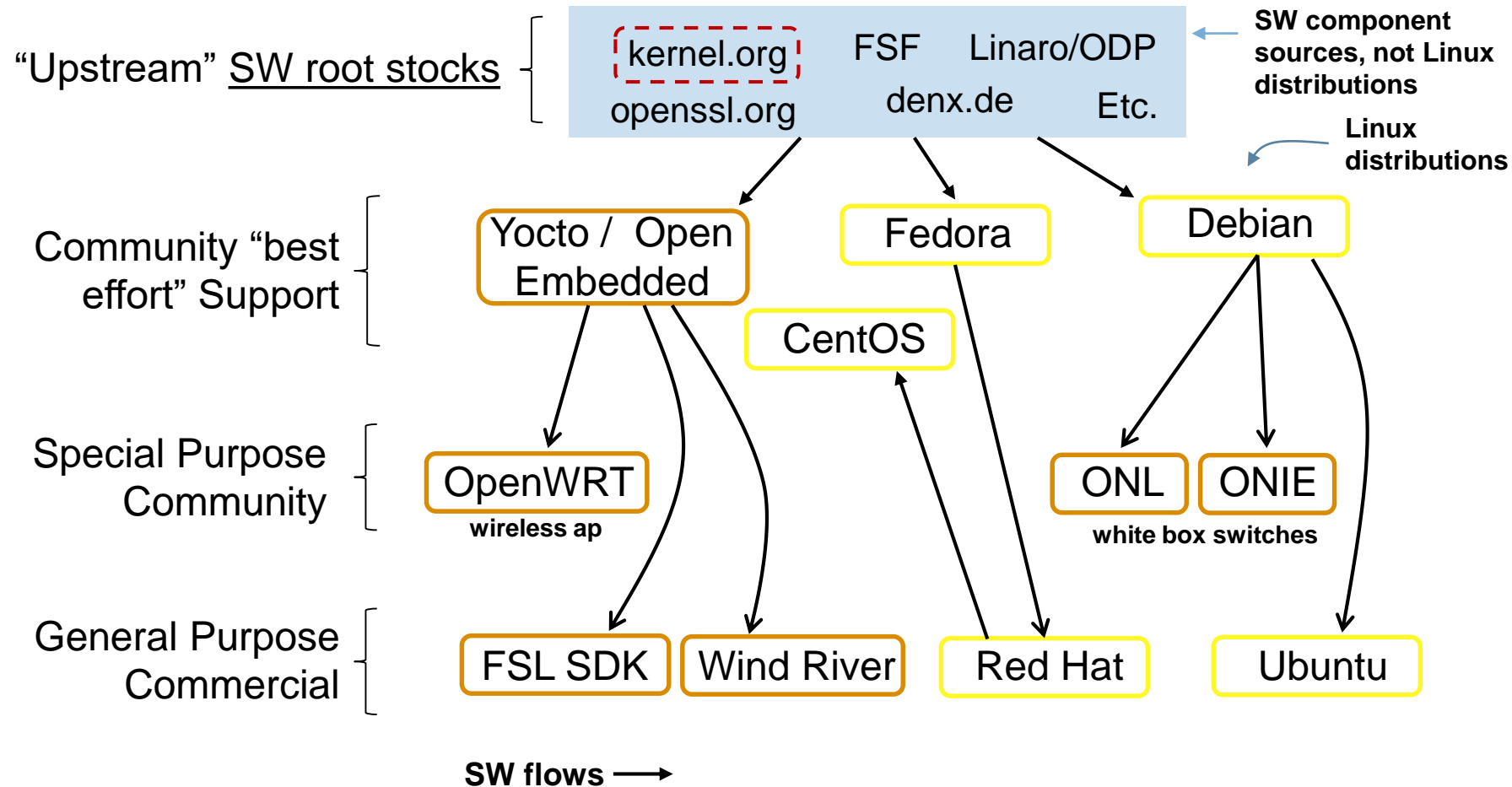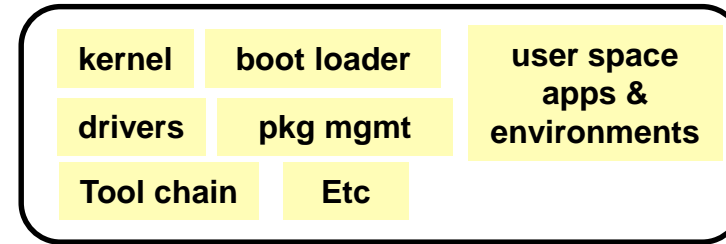# Open source VNFs- Contributing VNFs to ARM community

vFirewall
IP Tables based
Main features : Firewall and NAT
Integration: FWaaS configuration of Openstack

vVPN
Strongswan based
Main features : IKEv1/IKEv2 with IPSec
Integration VPNaaS configuration of Openstack

vSLB
HA Proxy based
Main features : SLB, HTTP key word based Load balancing
Integration: LBaaS configuration of Openstack

vRouter
OSPF, XORP based & Linux Stack
Main features : Routing , Various L2 interfaces
Integration: Router-aaS of Openstack

Freescale VNF Open source details
Linux Distribution : Ubuntu Platforms supported : X86, PowerPC, ARM (In progress)
https://github.com/Open-SFC/VNFS

Openstack Controller

Neutron

Neutron Command   Horizon GUI

Router   FWaaS   VPNaaS   LBaaS

FSL Network Services Config OpenStack Plugins

FSL Network Services Config Stack (NSCS)

Network Services (NF) Configuration

vFW VM   vVPN VM   vSLB VM

OVS or FSL ON Switch   FSL Config Relay

Compute Nodes

Linux Distribution Ecosystem

- <u>Linux distribution</u>: a complete Linux SW kit
- Many flavors and support models.
- Embedded oriented or Enterprise

kernel	boot loader	user space apps & environments
drivers	pkg mgmt	
Tool chain	Etc	

"Upstream" <u>SW root stocks</u>

kernel.org   FSF   Linaro/ODP
openssl.org   denx.de   Etc.

← SW component sources, not Linux distributions

Linux distributions

Community "best effort" Support

Yocto / Open Embedded   Fedora   Debian

CentOS

Special Purpose Community

OpenWRT
wireless ap

ONL   ONIE
white box switches

General Purpose Commercial

FSL SDK   Wind River   Red Hat   Ubuntu

SW flows ⟶

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