

Imagination

Overview

October 2015

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Creating the future with our partners

Our IP plus our partners' know-how combine to drive and disrupt markets



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A global technology leader

A technology powerhouse for multimedia, processors, communications and cloud IP

Driving IP innovation with unrivalled portfolio

- Recognised leader in graphics, GPU compute and video IP
- Leading alternative mainstream CPU processor IP
- Leader in emerging RPU communications IP market
- #3 design IP company world-wide*

* source: Gartner

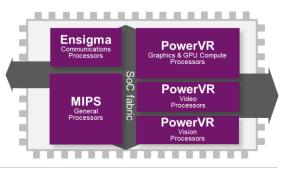
Enabling unique IP platforms

- Transforming TTM (time to market)
- Leveraging customer IP to maximise differentiation

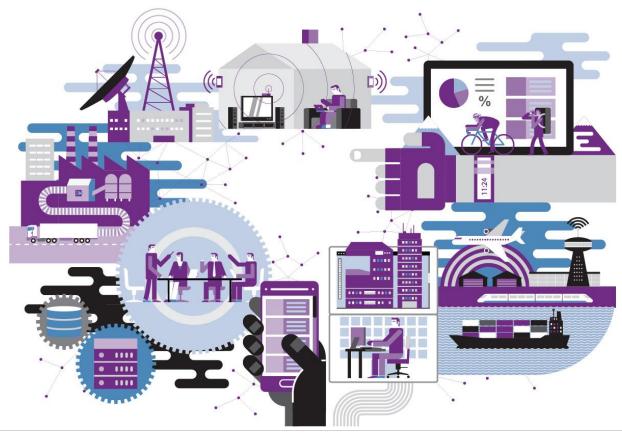
Supporting and driving major markets

- Helping our partners to create successful solutions
- Influencing new and emerging opportunities
- Showcasing and proving our technology with real products





Imagination's IP powers everything, everywhere



Markets:

- Mobile phones
- Mobile computing
- Consumer multimedia
- Automotive
- Networking
- Enterprise
- Wearables

IoT

Quick facts

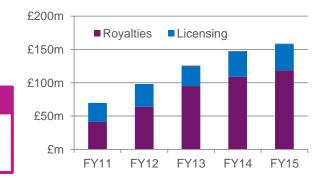
One of the world's top 3 electronics IP providers



Products

More than 8bn units shipped

- Over 3.5m per day
- Around 1.3bn in past year





People

>1,700 people world-wide

- 23 offices; HQ in UK
- >80% of staff are engineers

Revenues

FY15: £177m (US\$ 277m) - Profit: £21m (US\$33m)

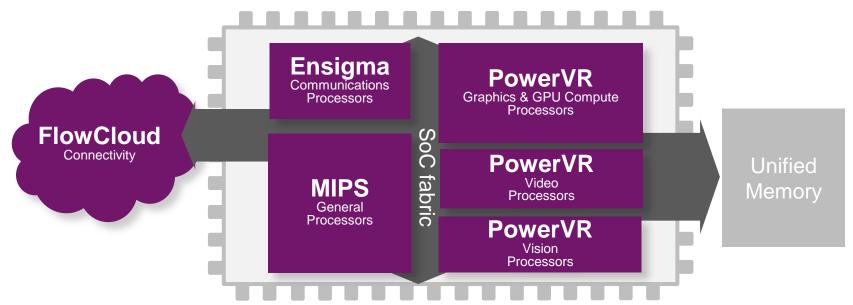
C imagination

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Imagination's IP portfolio

Comprehensive range to create connected SoC solutions

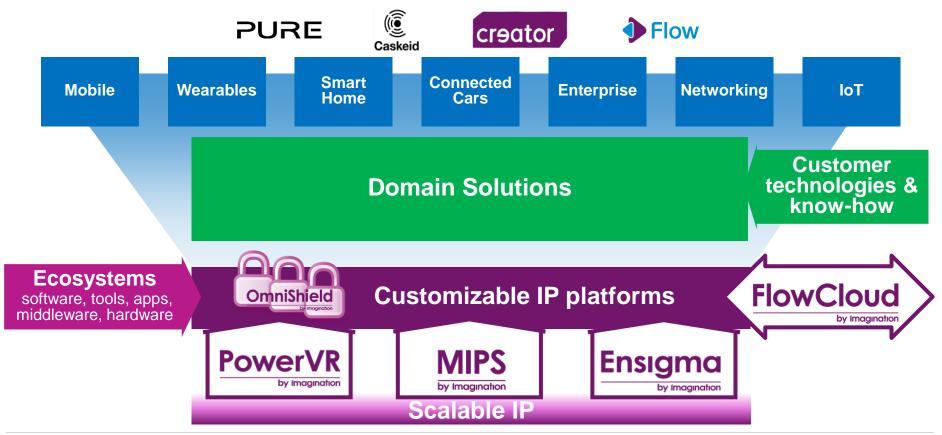


Each IP core is a class leader Lowest power; smallest silicon area Open and customer-centric business model

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Helping our customers leverage their know-how



Our licensees and partners drive our business



What makes Imagination a leader



- We have leading technologies in each of our three key IP pillars
- Our ecosystems are broad and strengthening
- We are uniquely placed to enable customisable IP platforms
- Our market and technology insight ensures we have the right product strategy
- We have innovative and flexible approach to business centred around helping our customers to differentiate

We do what it takes to ensure our partners' success

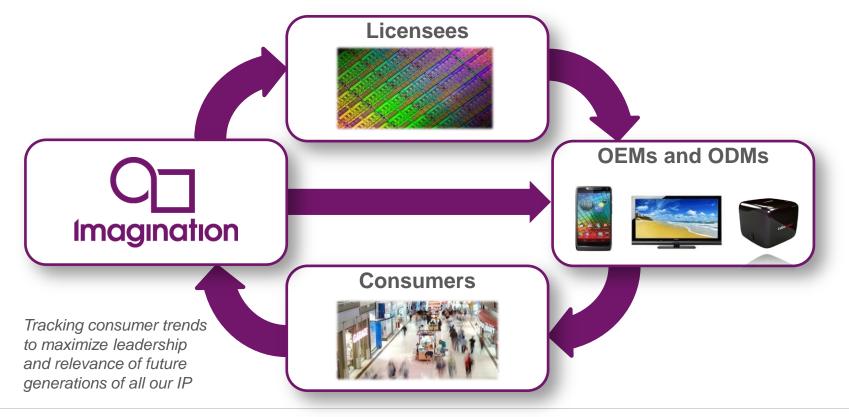


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IP, markets and trends

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Business model



Scalable IP and IP platforms enable differentiation

Enablement & Differentiation starts in silicon

- Key trend:
 - More integration => More SoCs => total solutions (SoCs + software)
- Consequences:
 - Systems complexity is high and increasing
 - Application & domain knowledge essential



Enabling customers to invent only what needs to be invented - reducing cost and enabling faster time to market

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From IP cores to SoCs to end products

A long innovation path demanding vision

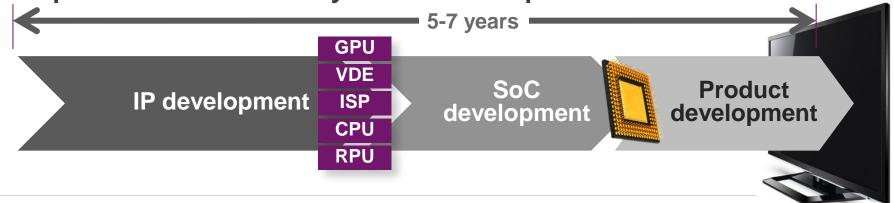
End product features massively influenced by SoC capabilities

- SoCs define what an end product can or cannot do
- End products have at least 12-18 months concept to launch cycle times

SoCs enabled by IP cores

New SoCs have around 2 year design start to production cycle times

Complex IP cores take 2-3 years to develop





Business and Market Environment

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Market opportunities evolving & emerging

Existing markets growing & changing

- Mobile phones and computing => maturity, low-end shifting up
- Home consumer => connected devices, connected consumers
- Enterprise and networking => ubiquitous connectivity, heterogeneous compute
- Automotive => connected, advanced automotive
- New markets emerging no established players
 - Wearables
 - IoT: health, energy, agriculture; transport; retail; security; toys
 - Automation & robotics
 - VR (Virtual Reality) & AR (Augmented Reality) becoming significant
 - Real-time and big data analytics

SoCs remain the key enablersSystem know-how the key differentiatorProducts + cloud services are disruptive combinations



Mega societal changes underway

The arrival of the emerging world

- China, India, Brazil size matters
- More consumers but also more competitors
- The connected and accessible world => one market
- Accelerating technological possibilities in many fields
 - IoT, robotics/automation, biomedical etc even bigger than Internet
- Global warming and the need for efficiency and conservation
- Manufacturing returning to local markets in many sectors
- The rise of the middle-class world and people's expectations
- Towards 100+ year human life spans and changing demographics
 - Today's infrastructure cannot cope with tomorrow's population's needs

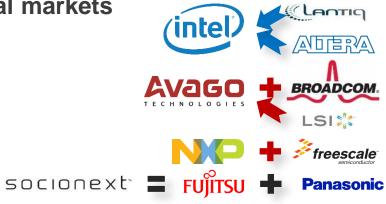


The semiconductor world is changing

Consolidation in established markets

- Mostly in West and Japan
- Largely driven by mobile market consolidation
- Rapid rise of players in emerging economies
 - Western companies investing in eastern partners
- Trend towards OEM verticalisation in several markets
 - Driven by SoC-level differentiation
- New semis even closer to applications
 - Have to become much more than just a semi





The developing landscape: four types of "semi" players

1. The super-high volume (SoC) semi

- Supporting large mainstream segments, driven by mobile
- SoC capability and/or proprietary architecture driven

2. The market focused, specialised semi

- Smaller and operating closer to more specialised applications
- Auto, Health, Home Automation, Industrial/Enterprise, ...

3. The vertical major OEM brand with internal semi

- SoCs + Cloud are key enablers & differentiators
- Branded products covering multiple segments

4. The "partnership" vertical OEM, Service Provider, Brand

- Replicating vertical model (category 3) but through partnership
- Custom SoC => an enabler and a differentiator
- Medium to large scale



Addressing customer needs

Our strategy is designed to align with and address the changing customer base

Super-high volume semis:

Three highly scalable, best-in-class core IP families

Market-focused specialist semis:

- Combination of core IP and subsystem IP
- SoC and system-level collaborations
- Ecosystem

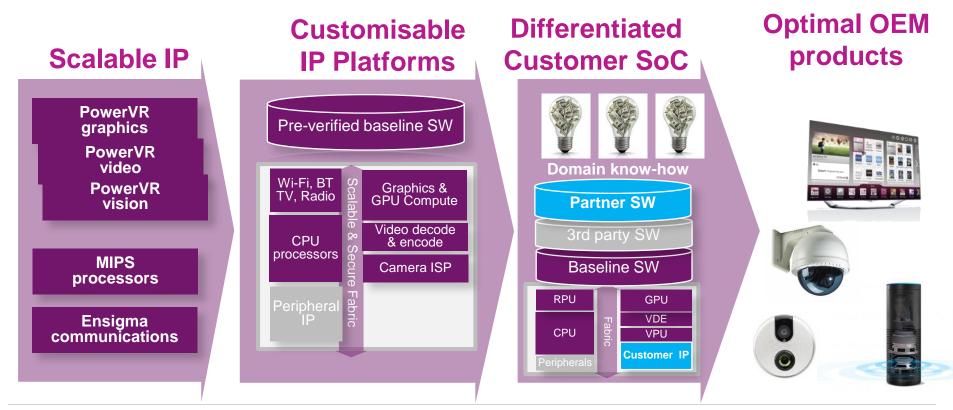
Vertical OEM brands:

- Comprehensive IP portfolio
- Strong SoC design capabilities to help in-house teams
- Partnership OEMs, Service Providers, Brands
 - Comprehensive IP portfolio and reference platforms
 - Extensive ecosystems



IP platforms: addressing the emerging demand

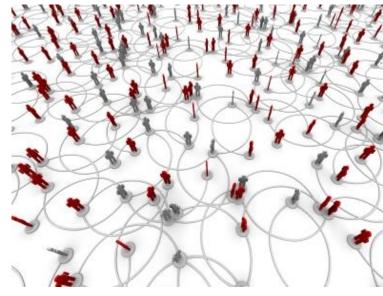
Pre-verified solutions - enabling the next wave of innovation



IoT - very large but fragmented

Both open communities and walled gardens

- The breadth of applications means no one player will dominate
- Tier-one "walled garden" communities will be first to develop and service adjacent markets
- Service level interoperability and security will be real growth enablers
- Ecosystems of many different skills will be essential to create solutions that really work
- Still early stage too much re-branding of existing technologies and products as "IoT"

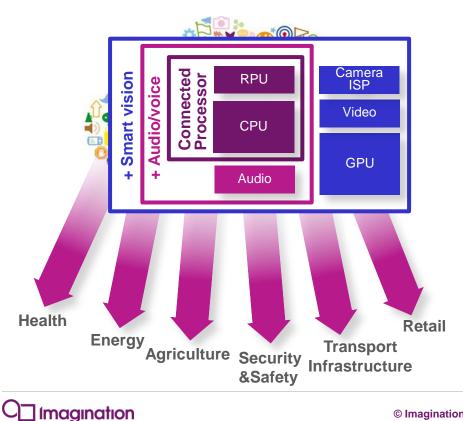


IoT = "connected embedded"

- reshaping and extension of traditional embedded markets

IoT – where we can make a real difference

Biggest impact where solutions address major societal issues



• We see three main levels:

- Sensor hubs (application specific)
- Sensor hubs + audio/voice
- Sensor hubs + audio/voice + smart vision

Our silicon IP portfolio addresses the needs of all of these key markets

Connected processors central to all hubs

Smart cameras & audio demand complex local processing

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Security is another fundamental hurdle

Every application has security demands

- Fundamental to all connected devices (including IoT)
- Today's solutions simply don't meet users and application
 - Simplistic "binary in/out" model no longer good enough
 - Since so many don't understand it, most copy others who claim
- We need universal solutions to security
 - Heterogeneous goes across every processing element in the S
 - Multi-domain for multiple co-existing apps





Multi-domain, system-wide security will become a must

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Markets

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The markets we serve



Growing and diversifying: 2019 TAMs

7,000

6,000

5,000

4,000

3,000

2,000

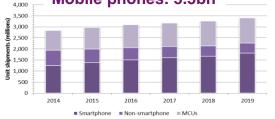
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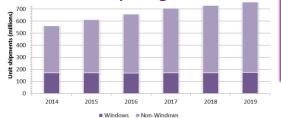
2014

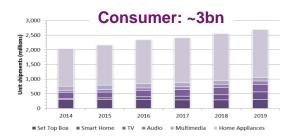
2015

Mobile phones: 3.5bn



Mobile computing: ~800m

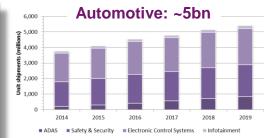






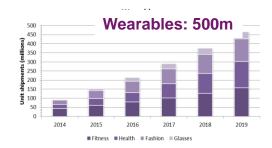
- Automotive transforming connected, ADAS, cameras
- IoT barely started in reality
- Connectivity impacting consumer, enterprise
- Wearables showcase for ultra low power design

IoT: 6bn



Networking & Enterprise: ~8bn 9,000 8,000 <u>ଜ</u> 7.000 6,000 5,000 4,000 **E** 3.000 E 2,000 1,000 2014 2015 2016 201 2018 2019

Consumer Enterprise



Sources: ABI, TSR, Gartner, Imagination internal and others. Note: Markets excluded include Smartcards

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2016

■ Agriculture ■ Healthcare ■ Energy ■ Transport Infrastructure ■ Safety & Security ■ Retail

2017

2018

2019

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Mobile devices

New form factors; overtaking traditional PCs

Product trends:

- Phone, tablet all established; phablet growing
- New form factors replacing more PCs, as mobile platforms continue to mature
- Mobile payment gaining momentum
- Richer range of sensors on every device

SoC technology trends:

- Migration to 64-bit CPU architecture
- Camera and vision-related apps developing rapidly – a key area for innovation
- GPU compute for intensive number-crunching



Wearables

Technology meets fashion – and increasingly becomes part?

Wearables is a hot new thing

- Will result in multiple segments, e.g. all-inone, lifestyle-oriented, in-clothing
- Embracing the "second wrist" market, e.g. fitness, health, music

Some treat it as IoT

- ...we don't!
- The future of wearables and their relationship to mobile and connected home will be increasingly profound
 - How they work together will be key



Cameras: more than happy snaps!

A major market for IoT as well as consumer and mobile



Highly intelligent and integrated smart cameras are a potentially enormous opportunity – and need solution IP platforms

Datacentres are evolving: Cloud takes centre stage

Maintaining compute performance whilst increasing power efficiency

Product trends:

- Maximising performance per mW
- Maximising efficiency as multimedia & IoT processing increasingly dominate
- Differentiation more than just "standard iron"

Technology trends:

- Heterogeneous computing CPU + GPU compute + media processing
- Datacentre Sog Sold edge devices



Automotive intelligence



The car is about to be transformed

- New ways to bring together all electronic systems
- More connectivity within the car
- More connectivity to the transport system
- More connectivity with the home
- Advanced Driver Assistance Systems (ADAS) is much more than driverless cars
 - Avoiding mistakes sleep, lane changing
 - Taking over in traffic
 - Increasingly intelligent cruise controls

The connected, immersive home



- Connectivity in the home will become as sophisticated as office connectivity
 - Media streaming, wireless displays, communications
- Homes will become increasingly aware of each occupant
 - Who and where they are
 - Anticipating what they want to do
- Homes will become more autonomous
 - Energy management
 - Security
 - Lighting

IoT – bringing reality to the numbers



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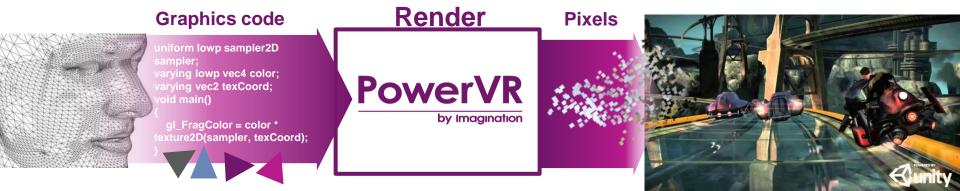
Products

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What does PowerVR graphics do?



Unrivalled graphics; GPU compute delivers exceptional performance



- Industry's leading power & area efficiency
- Unrivalled performance under real operating conditions thanks to TBDR*
- Scalable architecture addressing all performance points
- Comprehensive roadmap for graphics and compute

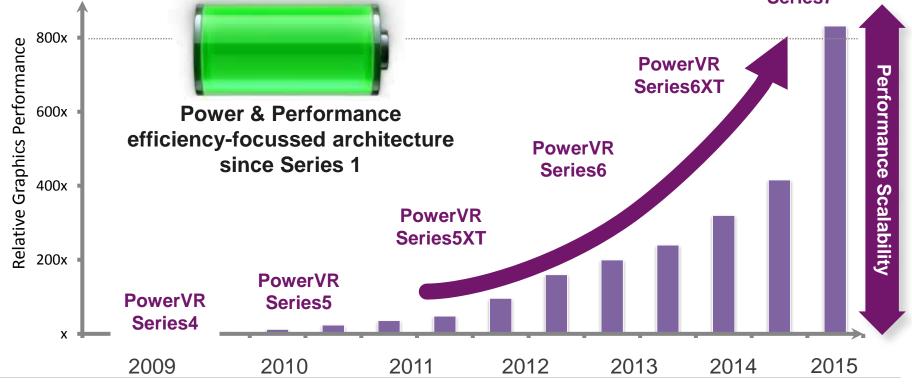
* TBDR: Tile Based Deferred Rendering

PowerVR sets the benchmark for embedded graphics & GPU compute

PowerVR graphics performance evolution

Ever more graphics performance at an ever faster pace...



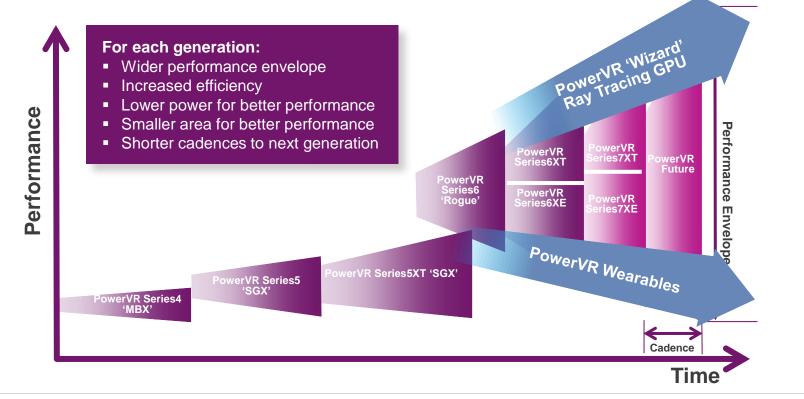


Strategy: widening the competitive gap

by Imagination

PowerVR

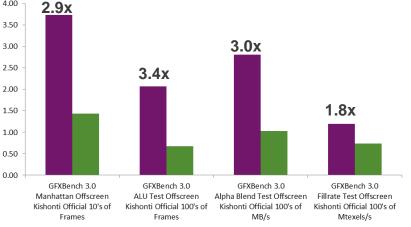
Expanding the envelope from low end to high end for each generation



Graphics & GPU Compute leads the way

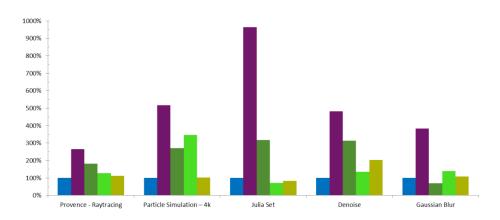


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Graphics Performance

GPU Compute Performance



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Corporate Overview October 2015 39

PowerVR Video and Vision VPUs

Complementing PowerVR GPUs and MIPS CPUs

Video IP

- Industry's leading power & area efficiency
- Best encode performance highest compression for a given quality
- Multi-standard including H.265, H.264, MPEG4/2, JPEG
- Multiple streams, up to 4K and beyond

Vision IP

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- Industry's leading power & area efficiency
- Advanced algorithms, multiple camera streams
- Scalable from low end IoT sensors to high end multi-mega pixel sensors

PowerVR VPUs setting the benchmark for embedded solutions



PowerVR





Why PowerVR multimedia?

Acknowledged industry leaders



- Leaders in a significant and growing market of 1bn+ growing to >5bn
- Scalable, comprehensive GPUs complemented by video and camera IP
- Continuing to innovate GPU compute, ray tracing, camera ISP, video
- Clear leadership in graphics for mid-high end; growing in the low end
- Best GFLOPs/mm2 in embedded GPUs will really matter for new and significant compute-rich markets



PowerVR

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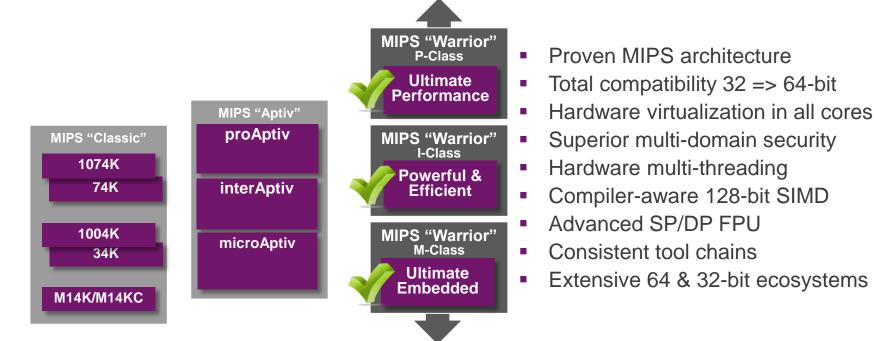


- Efficient, proven and scalable architecture
- One of the three architectures with comprehensive Android & Linux support
- Market leader in key segments including digital home & networking
- Proven 64/32-bit ISA, multi-threading, scalable virtualization, multi-domain security

Offers the industry the most credible 32/64-bit CPU IP

A proven, efficient 64/32bit architecture - 5 generations over 30 years...

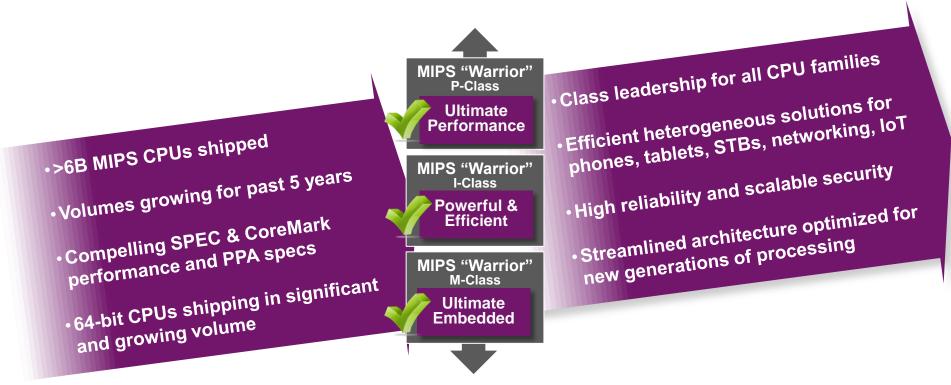
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Building the future

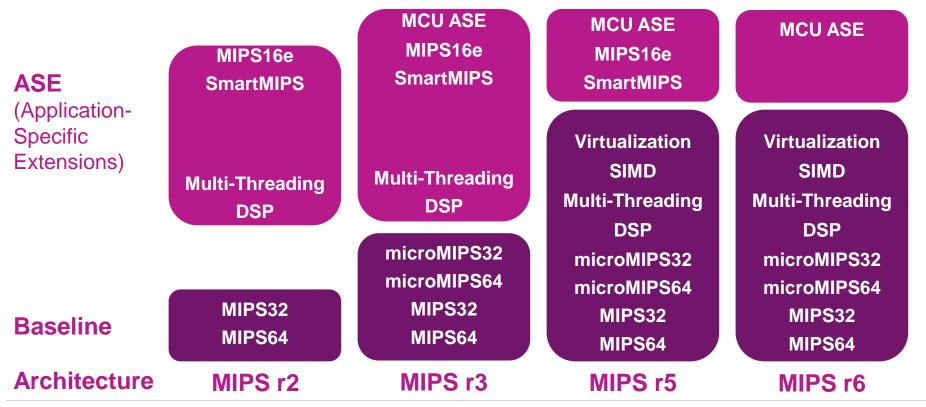




MIPS Architectures

Release Updates

MIPS by Imagination

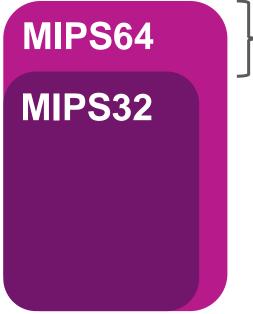


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MIPS32/64 Architectures and Release 6



- Instructions MIPS64
- dealing with

64-bit data

- Is MIPS32, plus instructions for 64-bit data types
- Runs MIPS32 software without mode switching

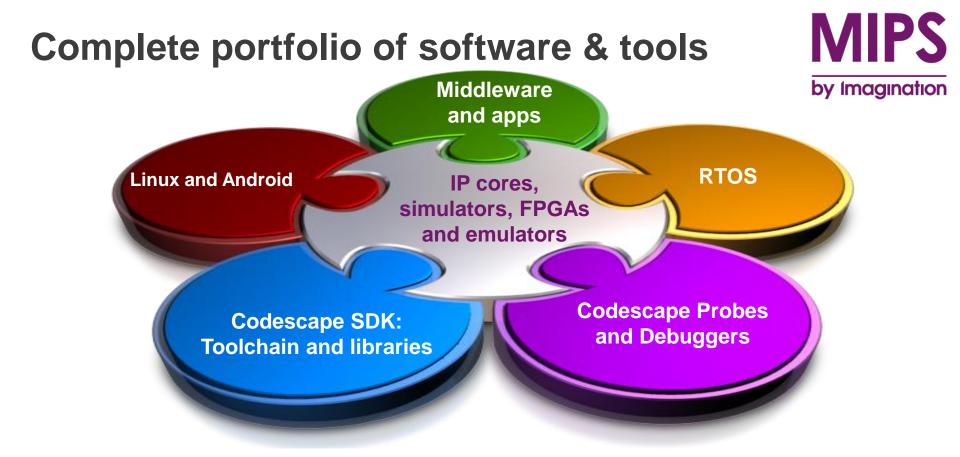
MIPS64/32 Release 6

- Streamlining a highly efficient architecture
- Modernization of architecture through:
 - Additional instructions for enhanced execution on modern software workloads =
 - JITs, VMs, PIC, etc. commonly found in Javascript, Browsers, abstracted compiler technologies (i.e. LLVM)

MIPS: the ultimate 64/32-bit architecture







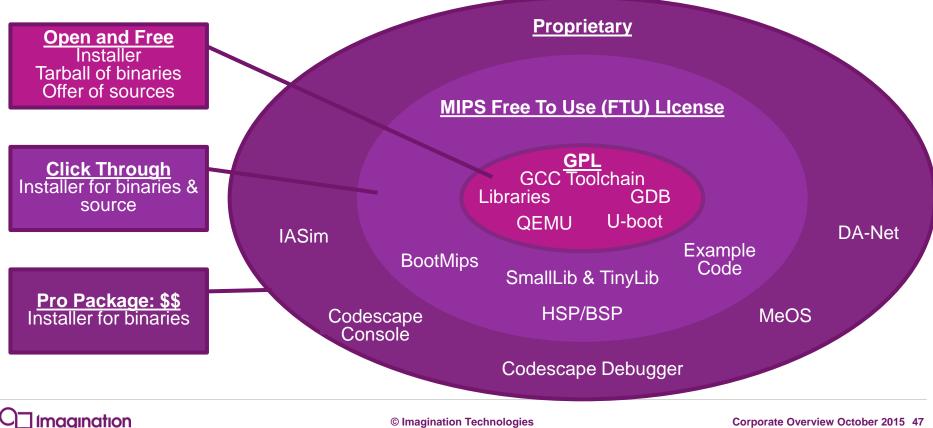
Comprehensive tools for every aspect of your development



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Codescape SDK integrates all the components

Complete Software Development Kit



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MIPS communities are growing

prpl: at the heart of MIPS open source

Virtualization & Security

To enable multi-tenant, secure software environments in datacenter, networking and storage, home, mobile and embedded

Heterogeneous Computing

To leverage heterogeneous architectures and compute resources enabling efficient processing for applications such as big data analytics

www.prplfoundation.org

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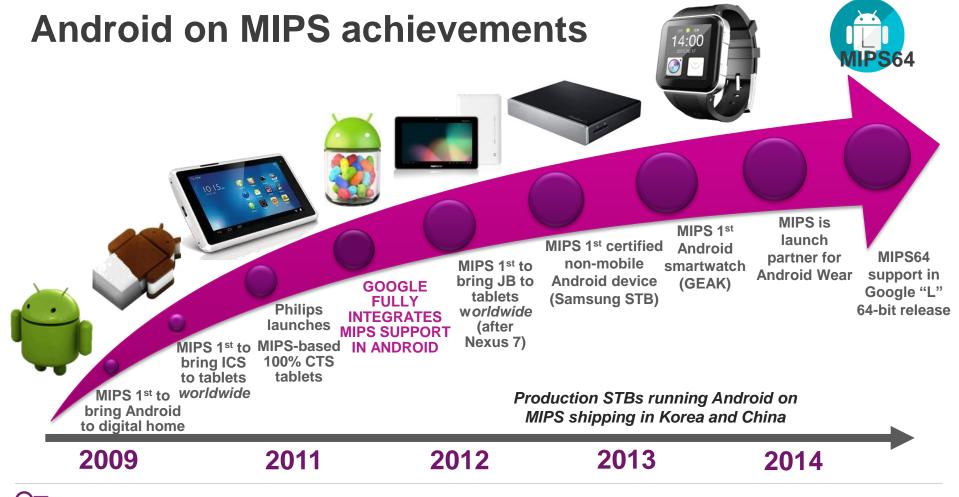
Portability

To create ISA agnostic

software for rapid deployment

across multiple architectures





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A broad and diverse ecosystem



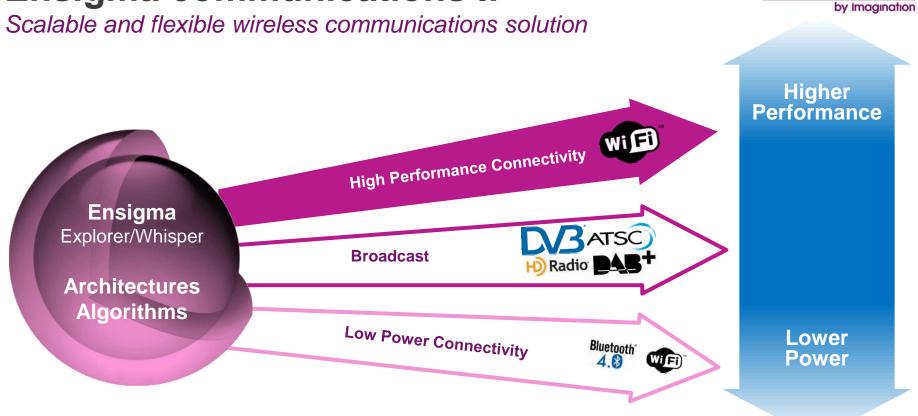
Why MIPS processors?



- MIPS is now in a different, much better place
 - Investment, growing customer engagement, ecosystem energised
- Three key phases:
 - Existing customers: reassuring & rebuilding relations
 - New markets: Wearables, IoT, data servers
 - Mobile: more accessible as ISA dependency becomes a nonissue

Strong technology with compelling roadmap

- 64-bit, multithreading, hardware virtualisation, security, coherency
- MIPS is the much needed choice
 - addressing all markets



Ensigma communications IP

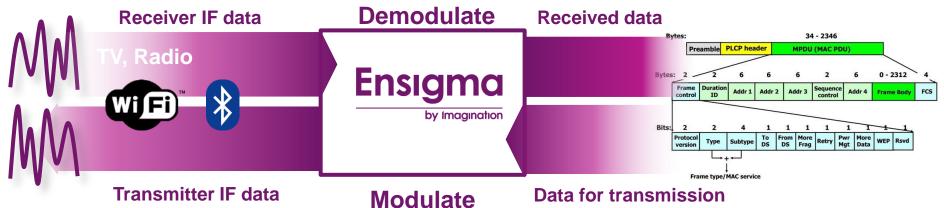
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Ensigma

What do Ensigma RPUs do?



Receive signals from a tuner – and also transmit



- Unique programmable multi-standard radio processor
- High performance: all Wi-Fi standards 802.11b/g/n/ac MIMO
- Low power: Bluetooth; 802.11 low power
- All TV and radio standards

Ensigma RPUs lead the way in scalable communications IP

Widest range of communications IP

Ensigma communications IP available today





- Unique complete end-to-end
 Wi-Fi & Bluetooth IP solution
 - Software
 - Hardware including RF
 - Wi-Fi Alliance pre-certification testing
 - System level integration
- Most comprehensive Broadcast demodulation IP
 - Support for all open Digital TV standards
 - Market leading Radio demodulation: 85% of Digital radios use Ensigma IP

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Why Ensigma communications?

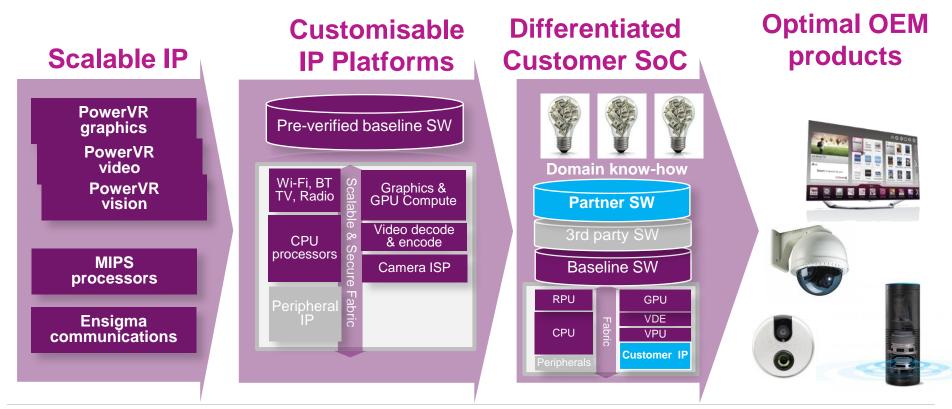


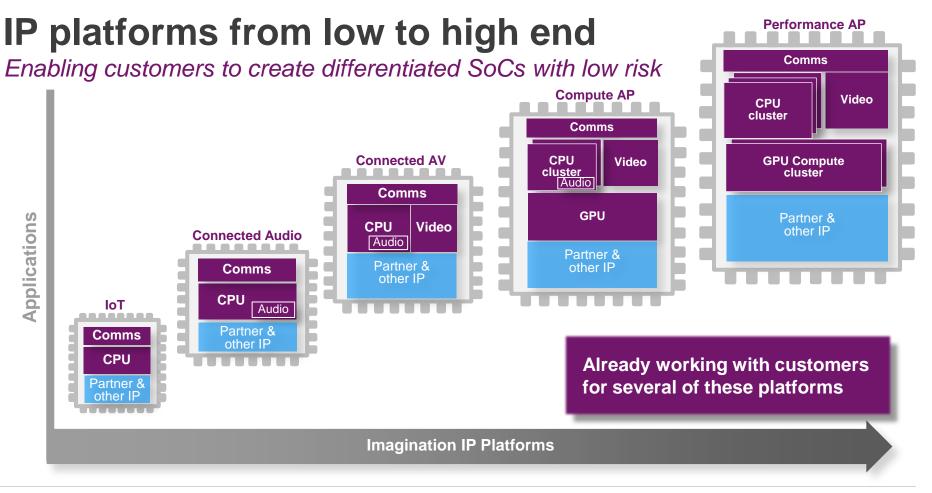
- A massive opportunity
 - Uniquely positioned for the industry's transition to integrated communications IP
 - Same transition we saw in graphics
 - Licensing partners growing
- Efficient, scalable and flexible integrated communications IP
- End-to-end solution software to antenna
- Industry's largest centre of excellence for connectivity IP



IP platforms: addressing the emerging demand

Pre-verified solutions - enabling the next wave of innovation



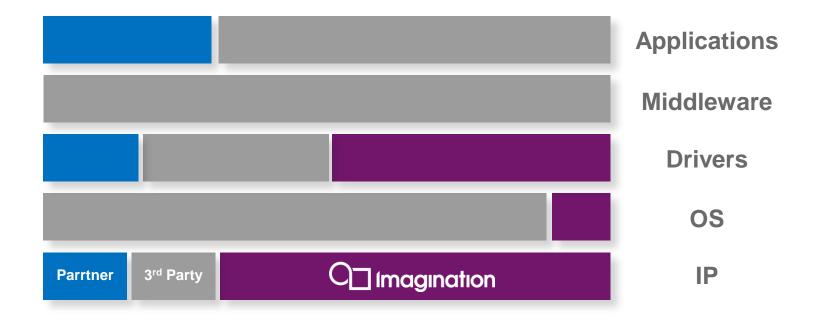


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Differentiation from chip to app

Partner differentiation enabled at every level





Platforms & cloud tech enabling IoT ecosystems

- Expanding ecosystems around our market-leading IP
 - Microchip & partners, e.g. Digilent, Onion
 - Samsung Artik
 - Toshiba

FlowCloud and Creator programme

- Offering developers early access to exciting, new technologies from Imagination
- Powering our engagements with universities and STEM programs
- Enabling crowdfunded projects and start-ups to design fantastic new products
- Production-ready can support volume growth



Why Imagination's IP platforms?

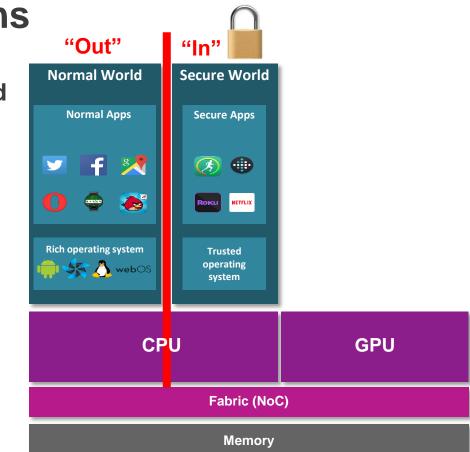


- Enables differentiation
- Shortens time to market
- Lower development cost
- Reduced risk
- Lowers barrier to entry for startups and entrants to new markets
- Protects our partners' in-house IP and expertise

Current security solutions

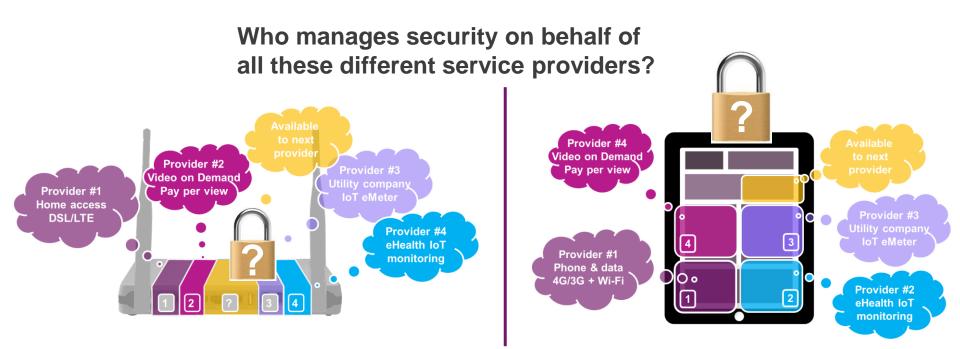
Designed for yesterday's needs

- Optimal for products that are defined in the factory and never change
- CPU centric
- Segment SoC in to two worlds
 - Normal World
 - Secure World
- Secure applications all co-exist in the secure world



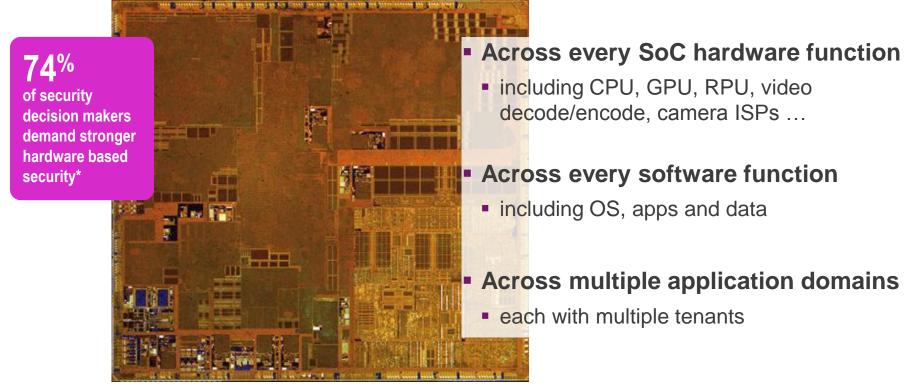


Users need better security



Current security solutions don't address the needs of operators & brands, who want to deliver portfolios of dynamic, upgradeable cloud-based services

Service providers demand better security

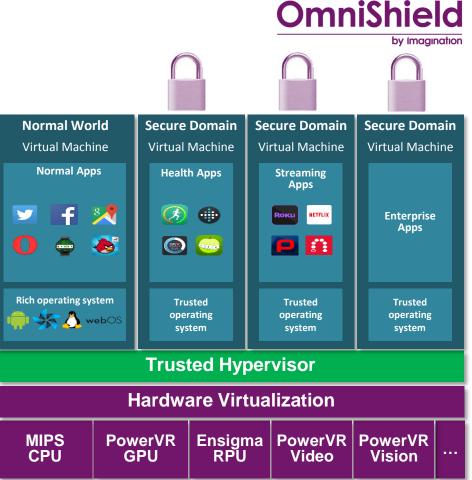


* Source: Decisive Analytics LLC, Multinational Security Decision Makers Study 2015 Report commissioned by CUPP Computing

OmniShield™ Benefits

Multi-domain

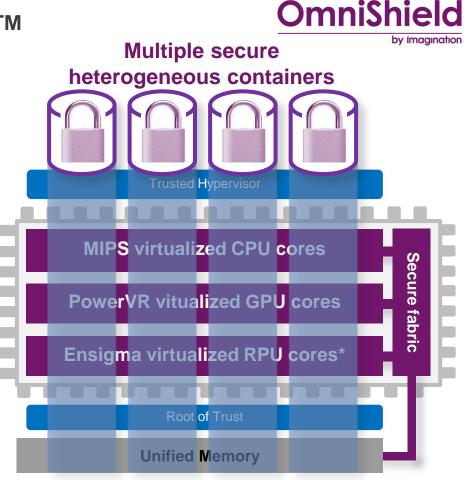
- 2 255 secure domains
- Hardware enforced separation
 - Using hardware virtualization
- Heterogeneous
 - CPU / GPU / RPU / video / vision / …
- Scalable
 - Multiple threads, cores, clusters
- Simple, well understood SW model
 - SW world already familiar with virtualization
- Accelerate time-to-market & revenue
 - Reduced QA, testing, certification
 - Upgradeable in the field



Elements of OmniShield™

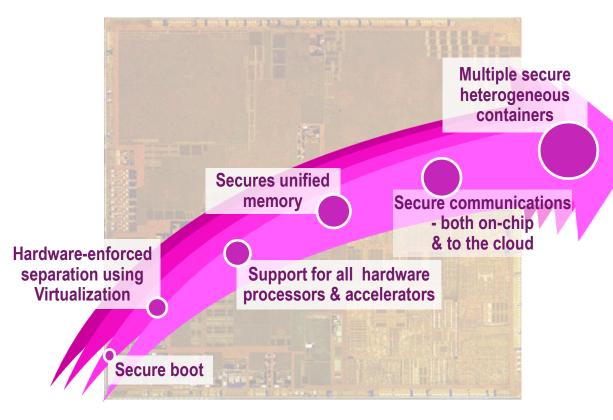
Comprehensive portfolio of technologies

- + Hardware virtualized CPU
- + Hardware virtualized GPU
- + Secure fabric
- + Trusted hypervisor
- + Virtualized (or para-virtualized) connectivity and offloads
- + Root of Trust
- = OmniShield technologies





prpl OpenSecurity[™] delivers the answers



- Based on multi-provider, multi-tenant use cases
 - Vastly superior to simple
 "in or out" security solutions
 - Strong hardware-enforced separation model
 - Ideal for heterogeneous, multicore processor-based SoC application platforms
- Microkernel based
 - Does not require OS modifications
- Open source framework and APIs
 - No royalties
- Reference framework open
 - Continuous evolution & innovation by prpl's ecosystem partners

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prpl

Defining the future of security



OmniShield[™] will be Imagination's implementation of prpl's open, cross-industry APIs

Prpl Board of Directors

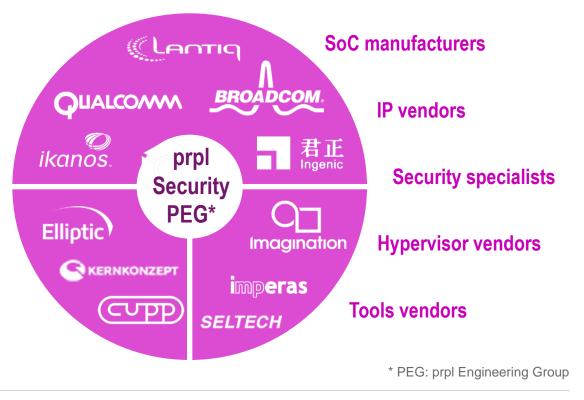
- Dan Artusi
 VP and GM, Lantiq an Intel Company
- Matt Grob
 Executive VP and CTO, Qualcomm
- Tony King-Smith
 Executive VP Marketing, Imagination

Dan Marotta

Executive VP and GM, Broadcom

Art Swift

President, prpl Foundation CEO, Cupp Computing





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Complementary capabilities

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Pure's products help drive our strategy PURE

Driving digital radio

Ensigma RPU delivers superior receivers

Driving connected audio

- Caskeid® delivers leading-edge multiroom audio performance
- FlowCloud enables connected products with updates, content & management



Enabling strategic engagements

 Growing engagements with key players developing around our audio platform

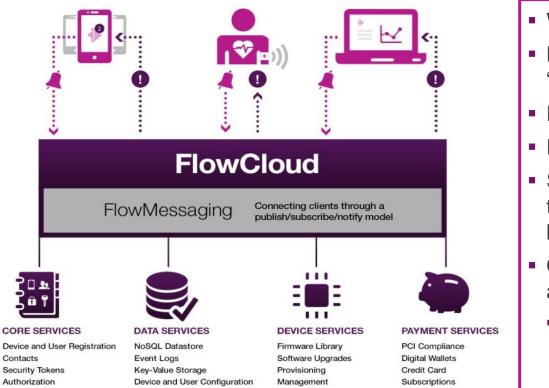




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Making the Internet of Things reality

Our technologies power devices – and the best way to connect them



Well-defined APIs

- Basic services "shrink-wrapped"
- Device to Cloud
- Device to Device
- Subscription & transaction-based business model
- Optional valueadded services
 - Music, radio, VoIP

Examples of 3rd party apps powered by Flow

by Imagination

FlowCloud



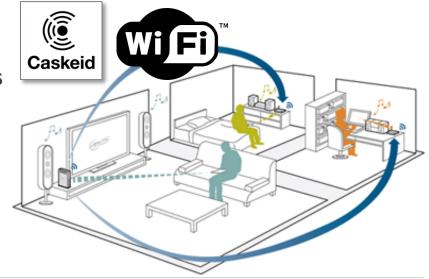
C Imagination

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Wireless audio as good as wired: Caskeid®

Example of technologies developed by Pure

- Patented technology to precisely synchronize audio streams over Wi-Fi
- Uses industry standard Wi-Fi (802.11)
- Wireless speaker solutions built around SoCs using Imagination's Ensigma and FlowCloud connectivity IP
- Perfectly synchronised multiple speakers
 - …as many as you like!
- Fully integrated with FlowAudio
- Available for licensing now



Enabling rich video &voice over IP

FlowTalk

VoIP, VoLTE & RCS software delivers ultimate solution



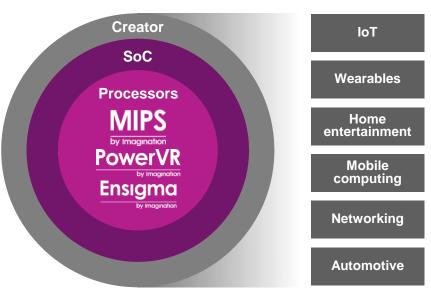
Live Video Steaming and 2-way Voice from multiple IP cameras to WebRTC-enabled Chrome/FireFox/Opera

- Integrated and unified solution
 - Includes voice, video and rich communications
 - EVQM (Enhanced Voice Quality Management)
 - DVQM (Dynamic Video Quality Management)
- Common stack and optimized media engine
- Any platform
- Android, iOS, Linux, Windows, RTOS
- Multiple access networks
- Wi-Fi, 3G, 4G/LTE, 10/100 Ethernet
- Any mobile or consumer device
- Smartphones, tablets, PCs, TVs, STBs, CPE, cars
- Any processor
- MIPS, x86, ARM, other DSPs and CPUs

The Creator programme

A new family of development boards:

- Expanding the ecosystem around our market leading IP
- Offering developers early access to exciting, new technologies from Imagination
- Powering our engagements with universities and STEM programs
- Enabling crowdfunded projects and start-ups to design fantastic new products
- Production-ready: these scale to volume



Imagination

creator

Ci20 key specifications

Superior performance and rich feature set

- 1.2 GHz MIPS-based, dual-core processor designed for superior performance and low power computing
- PowerVR SGX540 graphics offering full support for OpenGL 2.1 and OpenGL ES 2.0
- Multiple connectivity options including fast Ethernet, 802.11 b/g/n Wi-Fi and Bluetooth 4.0
- Dedicated video hardware for low power 1080p decoding
- IGB DDR3 memory
- 8GB flash memory and an SD card expansion slot
- A comprehensive set of peripherals





Price: £49/ \$65



Imagination

Overview

October 2015

www.imgtec.com