



Imagination

IEEE Wearable Technology Seminar

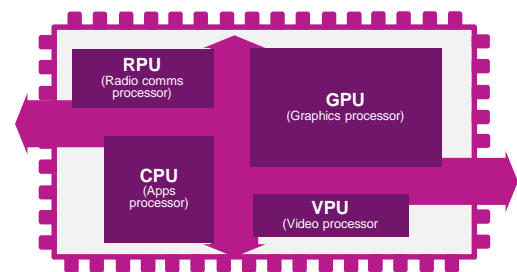
August 20th, 2014

www.imgtec.com

Imagination

Leading provider of semiconductor IP

- Established technology powerhouse
 - Founded 1985; LSE FTSE 250 (IMG.L)
 - UK HQ; global operations; ~1,600 employees
 - Fastest growing design IP provider in 2012
- Leading silicon, software & cloud IP supplier
 - 3M units a day shipping with Imagination IP
 - Cumulative > 5B units shipped
 - #1 IP supplier of graphics, video IP
- Pure: our strategic product division
 - Shipping ~ 1M devices annually
 - Digital radio, internet connected audio, home automation



*Comprehensive IP
portfolio for SoCs
& cloud connectivity*



PURE *IP business pathfinder
Market maker/driver*

Global presence

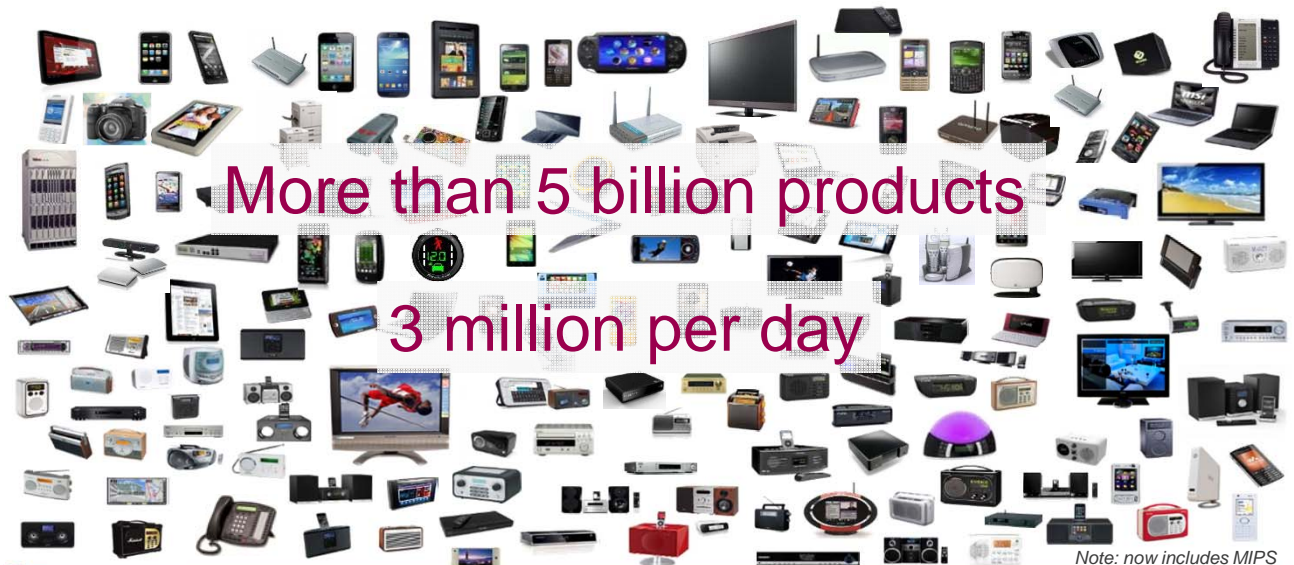
- Support closer to our growing customer base
- Sales and business development operations
- R&D across all product families



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In more products than ever before

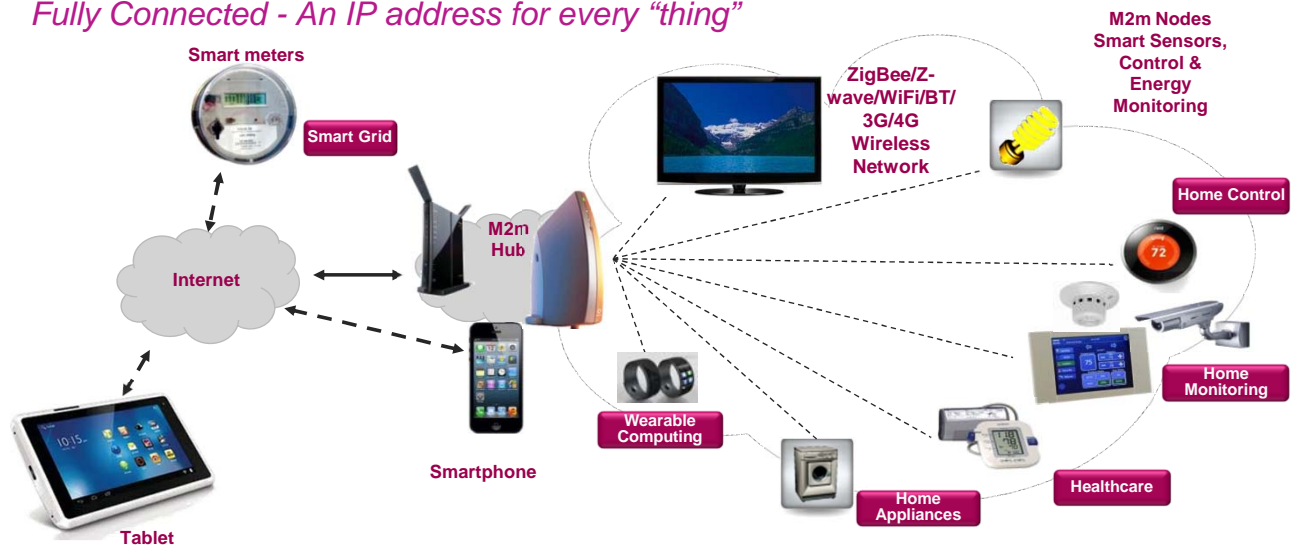


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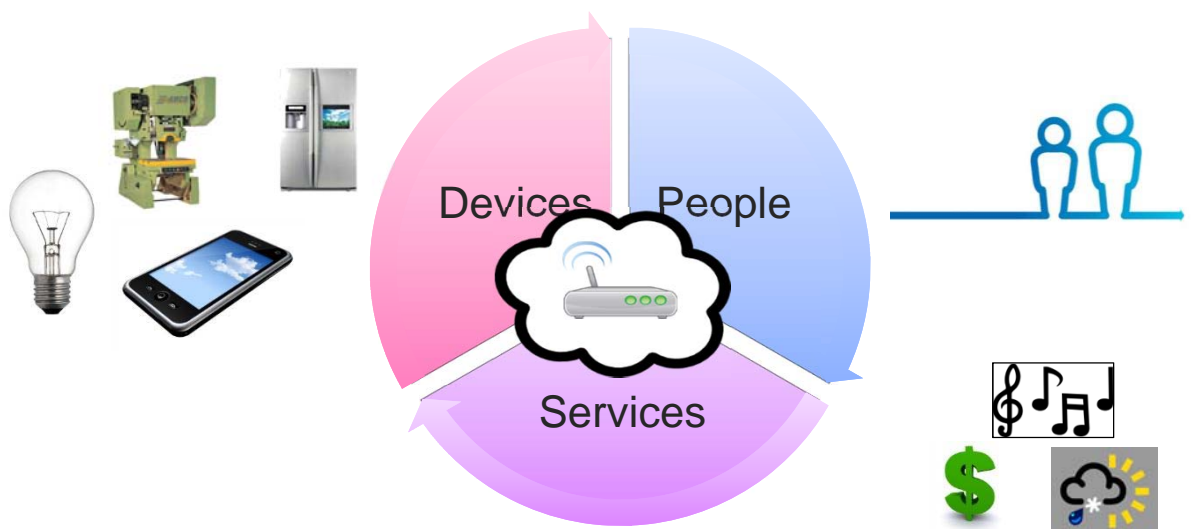
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The Internet of Things

Fully Connected - An IP address for every "thing"

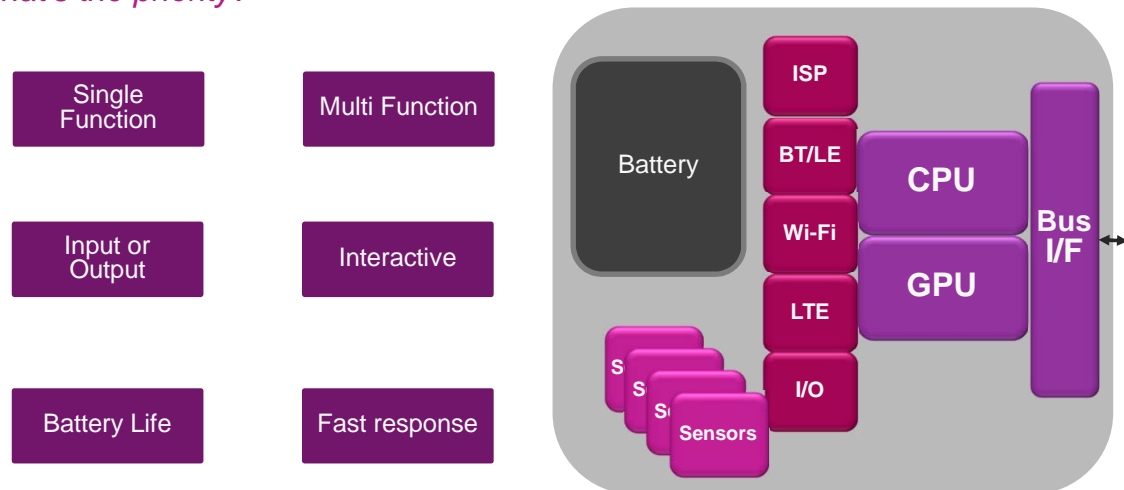


Bringing together people, devices & services



Connected SoC – easy, right?

What's the priority?



Wearable requirements, enablers and challenges

Lack of standards creates opportunities and challenges

- Low power
 - Battery operated: days/weeks (fitness) – months (home health) – years (embedded vital signs)
- Low cost
- Low memory footprint
- Information security and accuracy
 - Protecting data gathered and transmitted
- Storage
 - Processing and managing enormous amounts of new data in a useful way
- Connectivity
 - Low bandwidth and efficient power optimized network usage
 - Support for low-power mesh networks, Wi-Fi, and cellular networks
- Short design cycle

Wearable device classes

Wearable devices will vary in capabilities

Input Nodes – Fitness and Health bands



Sensors:

- Accelerometers
- Gyroscopes
- digital compasses
- inertial modules
- pressure sensors
- microphones
- temperature sensors
- touch sensors
- EEG/ECG
- Pulse
- Temperature
- Blood Pressure
- Glucose
- etc.

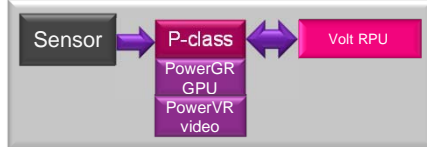
-Sensor only collects data
- Complements Smartphone
- 30 day battery life

Mainstream Output Wearables - Watches



- Information at a Glance
- Simple interaction
- Complements Smartphone
- Weeks of battery life

High End Output Wearable - Glasses



PowerGR
GPU
PowerVR
video



Data Analysis @ the Node

High end Output Nodes / Displays



- High resolution display
- Sensor/camera collects and analyzes data.
- Vision processing
- Full OS capabilities
- Augmented reality

ABI Research, BI Intelligence, IHS

Wearable devices will vary in capabilities and feature requirements



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Wearable output – possible use cases

Investigating the most convenient use cases

Communication

- Voice
- Call Alert
- Video
- “Quick” chat
- Social Media alert

Organization & Info

- Calendar alert
- News
- Weather
- Stock update
- Convenience – taxi, bus
- ID (for purchases)

Health & Wellness

- Fitness and Tracking
- Sleep Tracking
- Alarm
- Emergency

Entertainment & Leisure

- Music control
- Camera control
- Audio hub, BT enabled
- Cast
- Proximity alert – shopping, social

Home & Auto

- Home Security
- Home Control
- Google Now – turn by turn information
- Vehicle Alerts

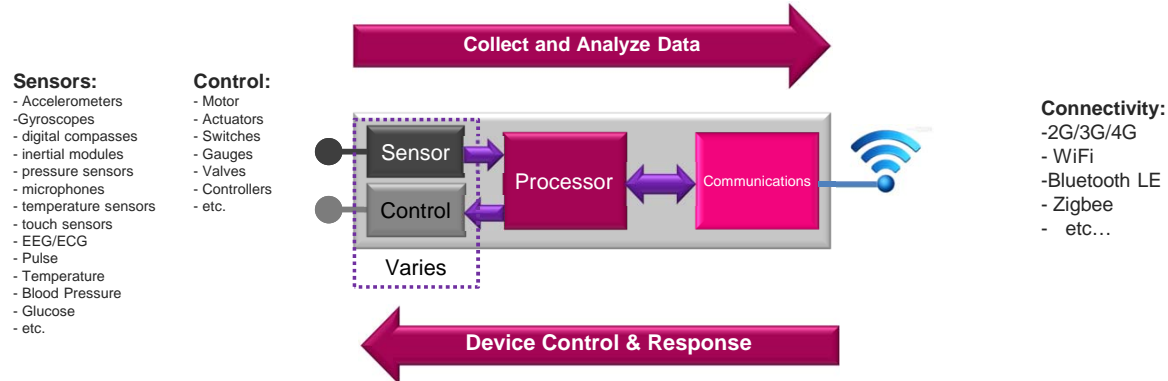


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Generic IoT/M2M module block diagram

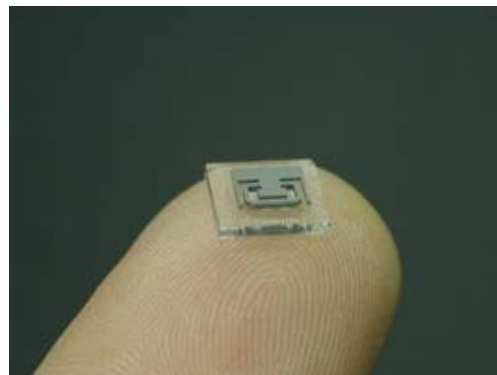
M2M -> Internet of Things



- M2M was traditionally SIM card / cellular-based applications
- Internet of Things/Everything expands this definition to any connectivity standard

(MEMS) Sensor Controller

- Motion tracking sensors – I²C/SPI
 - 6 axis
 - 3 axis accelerometer
 - 3 axis gyroscopes
 - 9 axis +digital compass
- Controller used for
 - Sampling data
 - 1 – 2000 samples (degrees/g/μT / sec)
 - Sensor data algorithms
 - Calibration
 - Fusion of sensor data



MEMS Sensor controller processing requirements

- Power consumption levels that drive **<100uA @ 100MHz**
- **100DMIPS @ 75MHz today**
- **Up to 500DMIPS in future**
- Impact on die costs **(65nm) of <\$0.005**
- Need processing power headroom to enable more intelligent sensor data analysis.
Current
- IMG Creating a solution platform
 - MIPS + Enigma + Flow + Security



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MEMS sensor controller ecosystem

- Working with Sensor and Sensor Algorithm companies to port to microMIPS
 - Movea Sensor Fusion
 - PNI Corporation
 - ST
 - Bosch
 - Invensense
- Ensuring RTOS and microkernel support for IoT
 - ContikiOS, Nucleus, MeOS, threadX
- Deliver secure IoT platform
- Enable AllSeen compatibility in FlowCloud
 - discovery of adjacent devices, pairing, message routing and security



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Fragmentation in wearable watches

Smart Accessory Watches vs. Smart OS Watches



Proprietary OS
Alerts
Caller ID
Read txt msgs
Reminders

No Standard APIs.... YET
Android Wear Watch / iWatch

Full Android or
Android Wear
Voice / video calls
Read/reply emails
Games / apps
GPS
Multimedia



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Wearable Device Requirements

SoC requirement	Wearable Fitness	Smartphone accessory Watches	SmartWatches	Glasses/Goggles/AR
Processor	<100MHz microcontroller µActiv UC or M51xx	200MHz ->500MHz single core – interActiv. Power optimized. Additional sensor controller µActiv UC or m51xx	300MHz dual core – 1GHz quad core InterActiv. Quad core for mktg (Sony). Power optimized Additional sensor controller µActiv UC or M51xx	500MHz – 1GHz dual/quad core InterActiv
Graphics	N/A	SGX	PowerVR 6XE	PowerVR 6/6XE
Vision				V2500
Video	N/A	N/A	Optional E4500 /Jasper / D4500	h.264 BP/VP8/JPEG E4500 / Jasper Optional D4500
Display	N/A	eInk	~QVGA / 320x320	VGA - WXGA
Memory requirements	16KB – 64KB SRAM	OS dependent <128KB SRAM (RTOS) <256MB DDR (Linux-based)	128MB – 512MB DDR	256MB – 1GB DDR
Connectivity	BT 4.0 Smart(LE)	BT 4.0 Smart(LE)	BT 4.0 Smart(LE) + WiFi b/g/n	BT 4.0 Smart(LE) + WiFi b/g/n
Sensors	Accelerometers, inertial	Accelerometers, pulse, inertial, gyro	Accelerometers, pulse, inertial, gyro, mic	Accelerometers, pulse, inertial, gyro, mic
Battery Life	1 month	1 week	3 days	1 day
Battery Size	200-300mAH	300-500mAH	300-500mAH	500 – 700mAH

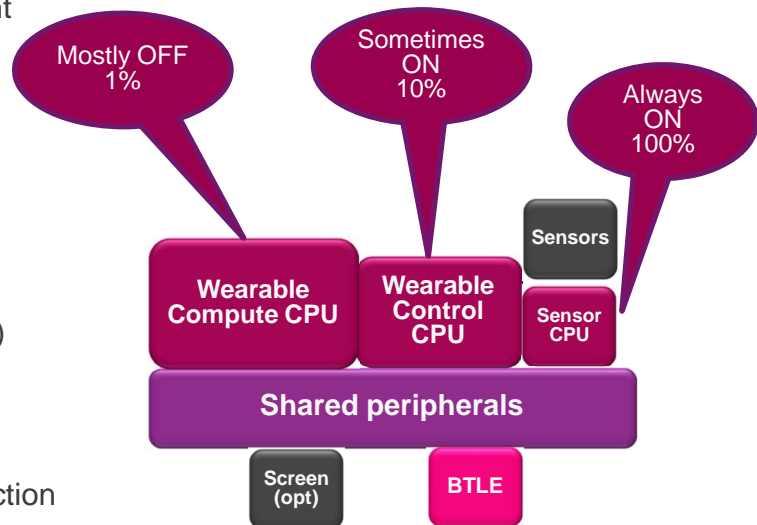


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Wearable compute devices

- Low power consumption dominant
- Hierarchy of CPUs
- Little or no GPUs
- Small 1.5" screens (optional)
- Small batteries (~250 – 350 mAh)
- Low power Bluetooth 4.0
- Watch, Notifications, voice interaction

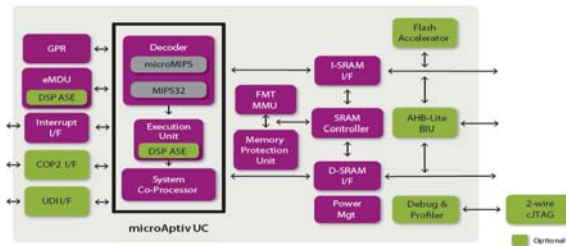


SoCs need to be designed specifically for wearables

- Up to 10x better battery life
 - Battery life that are months, not days
- Designed for wearable use cases
 - Sensors, BLE, and speech always on
 - Screen information available at a glance
- Use IP cores that are highly configurable for reuse

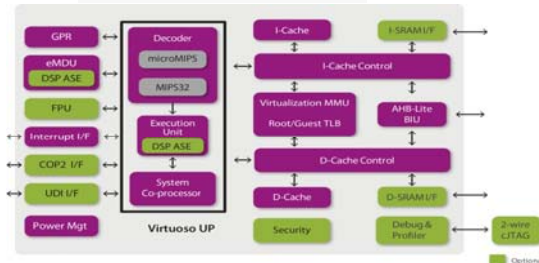
Wearables processing requirements

microAptiv UC Core Features



- Microcontroller level performance and functionality
- Optional FPU and DSP
- Designed for embedded, real-time systems
- RTOS/kernel
- Ideal for wearable input

M51xx Core Family Features



- Microprocessor level performance and functionality
- MMU & cache controller
- Optional FPU and DSP
- Supports virtualization
- anti-tamper and debug security
- RTOS/Linux/Android

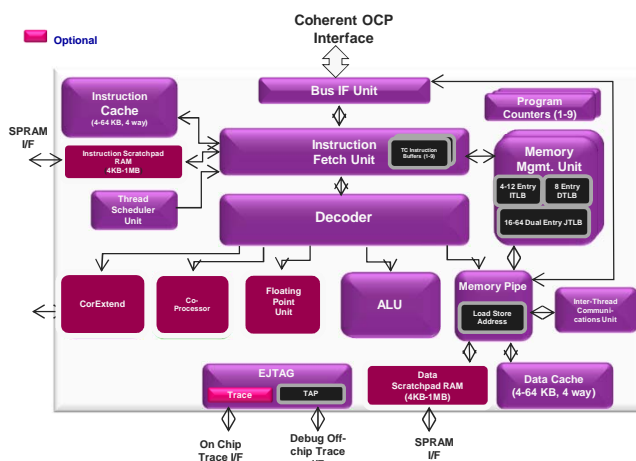


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Wearables processing requirements

interAptiv Core Features



- Multi core options
- MIPS32 multi-threading enabled
 - Dual virtual processing elements (VPEs)
 - Up to 9 thread contexts mapped to VPEs
 - Hardware thread resources for:
 - Policy manager provides scheduling and QoS
 - Inter-thread communication (ITC) w/i core & cluster
 - Yield qualifier
- Optional FPU and DSP
- Ideal for Android enabled devices



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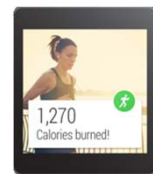
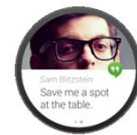
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Android Wear

New Google OS targeted for wearables

android wear

- Android Wear extends the Android platform to a new generation of wearable devices.
 - The user experience is designed specifically for wearables
 - Based on current notification APIs and Google Now cards
- Glance-able information
 - Short snippets of information
- Zero to low user interaction
 - Touch swipes or voice
- Imagination has MIPS-based silicon partners that are currently working on delivering Android Wear compatible products



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Imagination IP fit and value propositions

Wearable computing

PowerVR Graphics PowerVR <small>by imagination</small> <ul style="list-style-type: none"> - Necessary in high end wearable displays and smartwatches - small die size and battery life drives requirement - Helpful when video/vision hardware not present - Required in Augmented reality use case 	PowerVR Video PowerVR <small>by imagination</small> <ul style="list-style-type: none"> - Necessary in high end wearable displays - Encoding for video capture devices - e.g. Google Glass - Possible video decoder requirement for video conferencing
MIPS Processors MIPS <small>by imagination</small> <ul style="list-style-type: none"> - M2M modules - μControllers – microAptiv or SMALLER - Sensor data analysis – filter out unnecessary data and send only valuable data - Extremely low power – battery life should approach μW 	PowerVR Vision - Camera ISP PowerVR <small>by imagination</small> <ul style="list-style-type: none"> - Photo/Video capture devices in high end wearable displays - Augmented reality
Enigma - Communication Enigma <small>by imagination</small> <ul style="list-style-type: none"> - BT 4.0LE (Smart) will dominate low end of market - Communicates with Hub. Either Smartphone or Home Hub or other BT devices. - Wi-Fi 	FlowCloud – Cloud connected platform FlowCloud <small>by imagination</small> <ul style="list-style-type: none"> - Allows cloud based infrastructure for wearables - Ready to use solution - Enables data analysis modules for specific sensor data (e.g. – Accelerometers, Gyroscope, temperature sensors, etc.)



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Summary – wearable computing

Providing ecosystem, solutions, and platforms for wearable computing

- Imagination understands the business, dynamics, and relationships of wearable computing
- One stop IP shop for wearable computing devices!
 - Low-power and efficient processor technology - MIPS
 - Low-power connectivity technology - Enigma
 - Low-power graphics/imaging/vision technology - PowerVR
 - Ready to use cloud connected platform - FlowCloud
- Developing reference solutions and ecosystem to ease customer time-to-market



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Thank You!

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