



Java. Cloud. Leadership.



JBoss, Enterprise and the Internet of Things OR Alice's Adventures in Pi Land

Mark Little
JBoss CTO
Red Hat, Inc.



Overview

- What is Enterprise and Internet of Things?
 - Embedded, phones, cloud, Lego ...
 - Constrained devices?
- Applications and their requirements
- JBoss and IoT
 - Building on a Raspberry Pi or Android
- Where next?

30 years ago ...

- 16K was considered a lot of memory
- 140K floppy disks were the standard
- 10 mbps ethernet was decadent
- 8 bit 6502 processor was king for personal computing
- Wireless was what people listened to when there was nothing on TV



Today ...

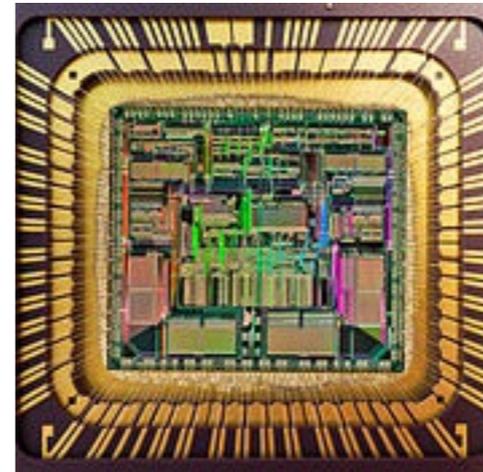
- 512Meg memory is standard on smart phones, 64Gig storage
- 256Gig USB sticks are the norm
- 100Gig ethernet at work and 30mbps to the home
- 64 bit quad core processors in laptops, 1GHz ARM in iPhone
- WiFi throughout many cities



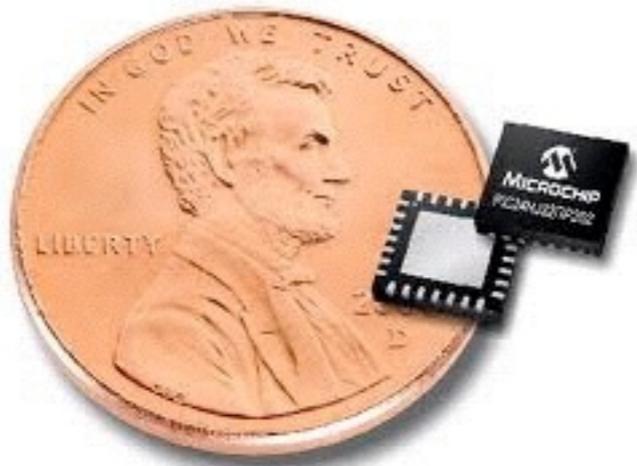
The times have changed

- There are already more mobile devices than computers
- There are 4x more processors on the planet than people
 - Most have TCP stacks
 - dsPIC33FJ12GP 16-bit microcontroller has as much horsepower as a VAX (40MIPs), can handle 16+ sensors, and is 1/8 the size of a penny
 - 30 million iPads by end of 2011
 - 1 in 2 Americans predicted to have smart phones by the end of 2011 compared to 1 in 10 in 2008

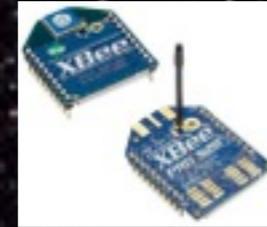
The times have changed



- Motorola 68040 (1990)



- dsPIC33FJ12GP 16-bit microcontroller (2007)



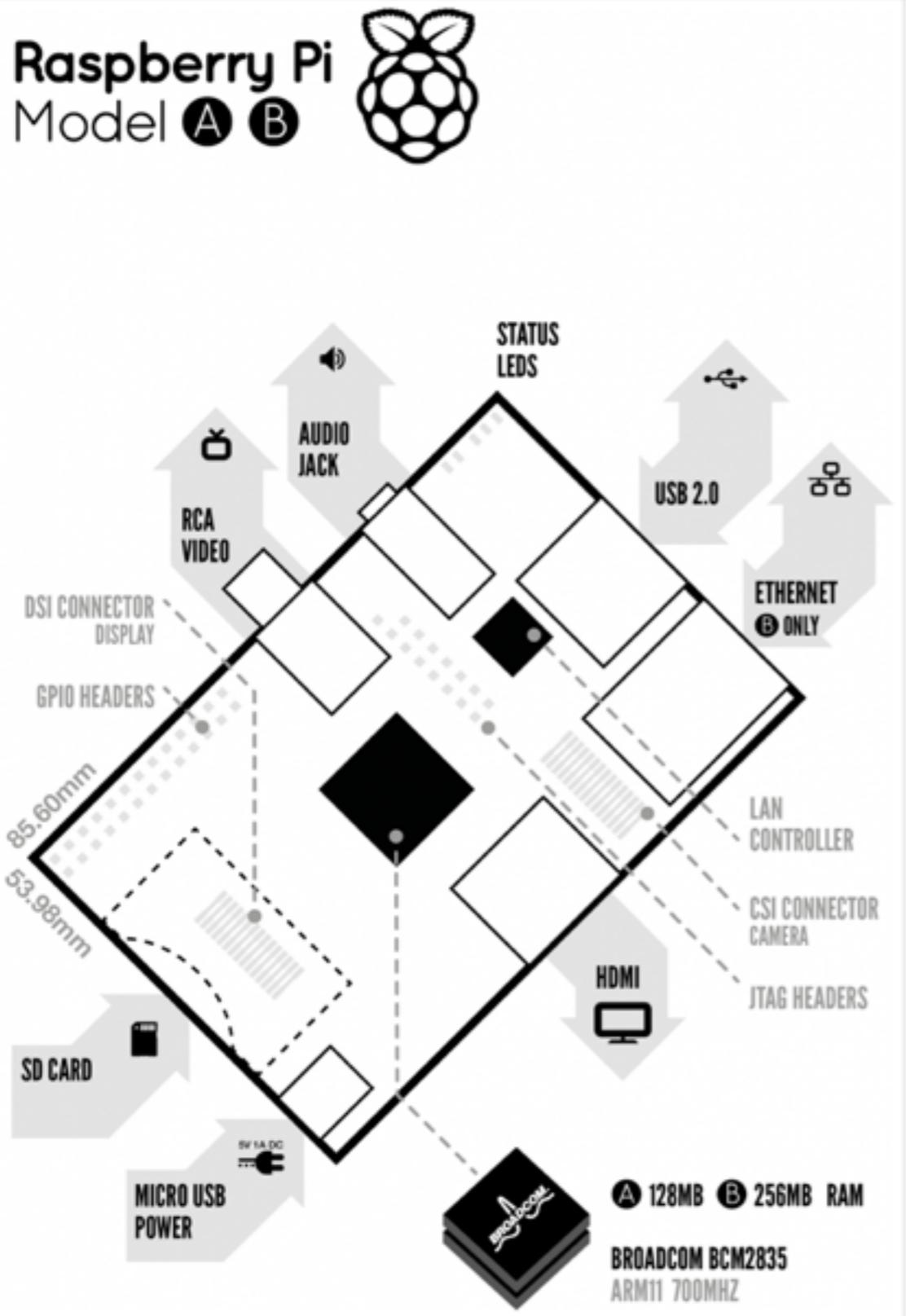
Java. Cloud. Leadership.

Java in 2000

- J2SE 1.3 and J2EE 1.2 to 1.3
- Typical laptop configuration
 - 1 GHz Pentium III with 512 Meg and 20 Gig disk
 - Sufficient to run full J2EE stack
- Limited mobile devices
 - HP Jornada 720, 206MHz StrongArm SA1110 32-bit processor, 32 MB SDRAM, Windows CE
 - ChaiVM JDK 1.2
 - Sufficient to run some components of J2EE

Java in 2014

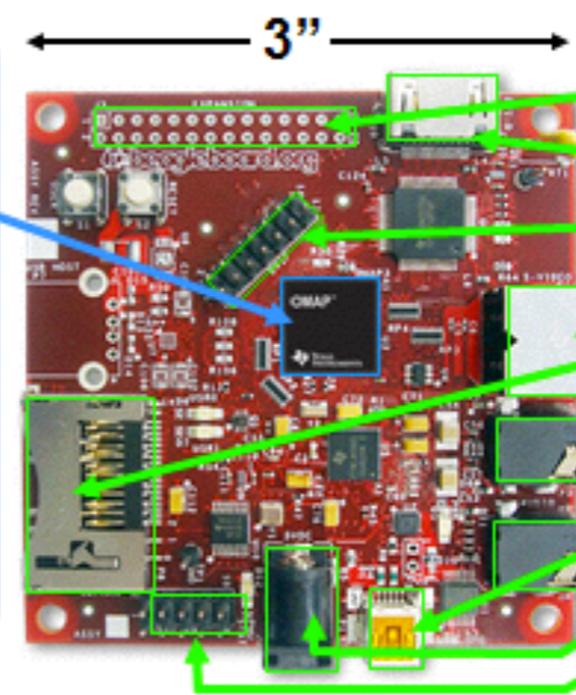
- Java SE 7 and Java EE 6
- Typical laptop configuration
 - 2.2 GHz Quad Core i7 with 16 Gig and 500 SSD
 - Sufficient to run full EE6 stack (on several different OS concurrently)
- Smartphones
 - Galaxy S5, Quad Core 2.5 GHz Krait 400, 2 Gig RAM, 128 Gig Storage
 - Sufficient to run many components of EE6



Beagleboard

Laptop-like performance

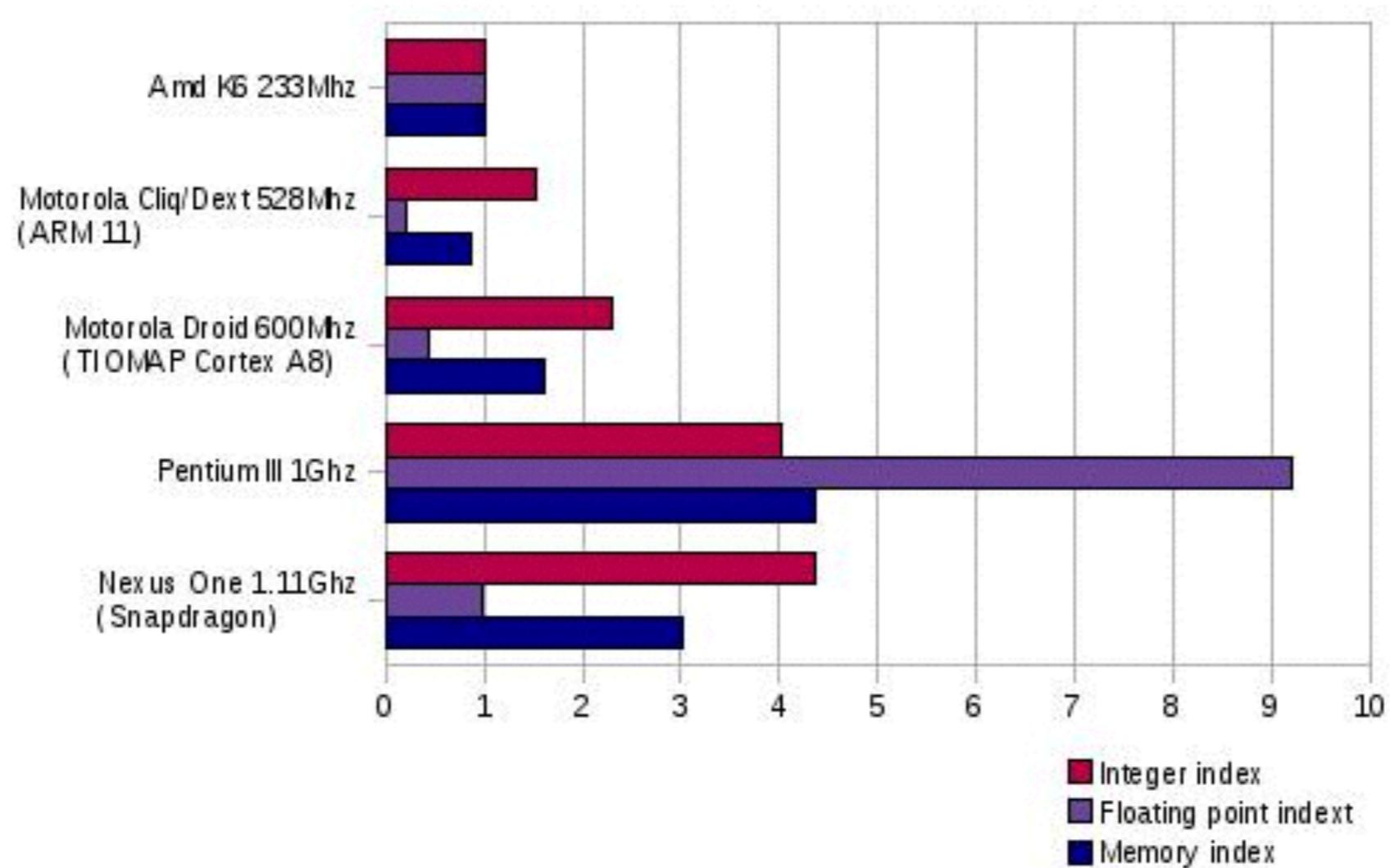
- TI OMAP3530**
- 600 MHz superscaler ARM® Cortex™-A8
 - More than 1200 Dhrystone MIPS
 - Up to 10 Million polygons per sec graphics
 - HD video capable C64x+™ DSP core
- Memory**
- 128MB LPDDR RAM
 - 256MB NAND flash



Flexible expansion

- I²C, I²S, SPI, MMC/SD
- DVI-D
- JTAG
- S-Video
- SD/MMC+
- Stereo Out
- Stereo In
- USB 2.0 HS OTG
- Alternate Power
- RS-232 Serial

2010 versus 2000

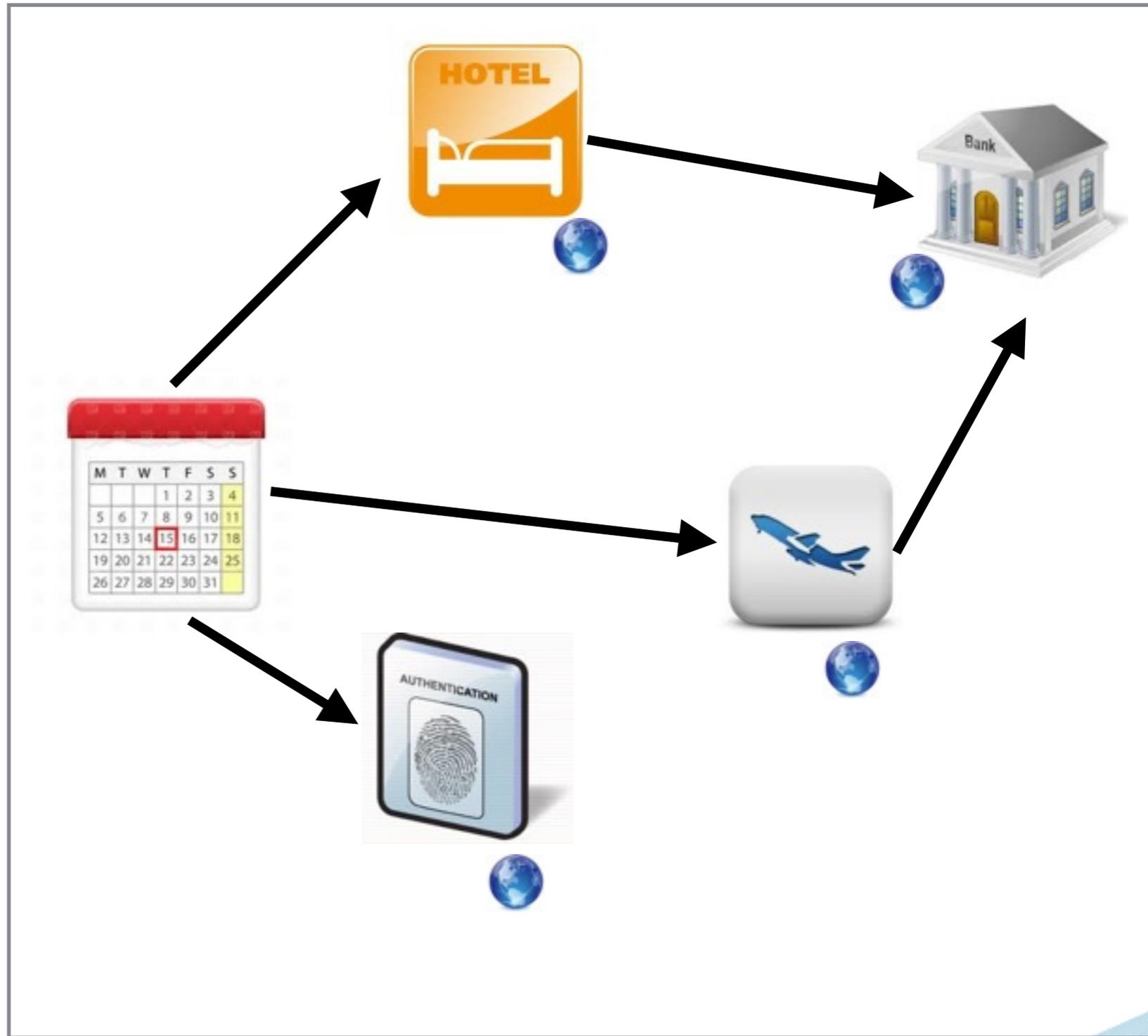
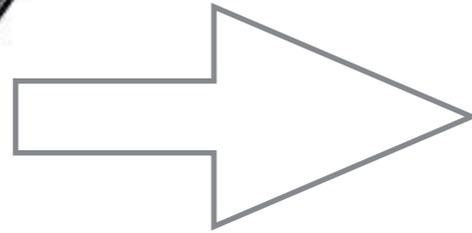
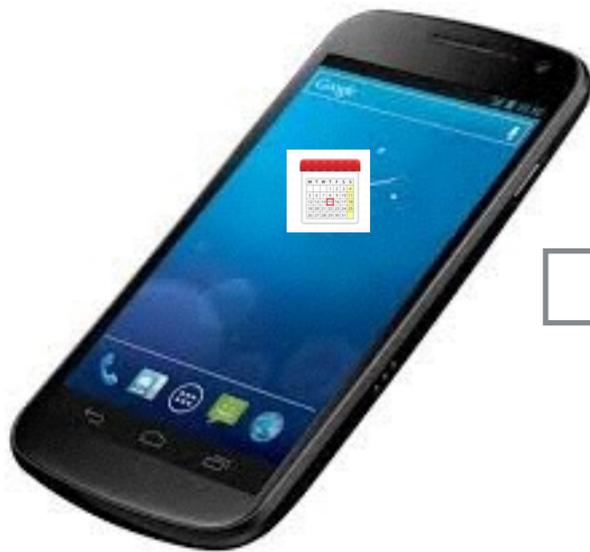


“Little’s law” (thanks to Parkinson)

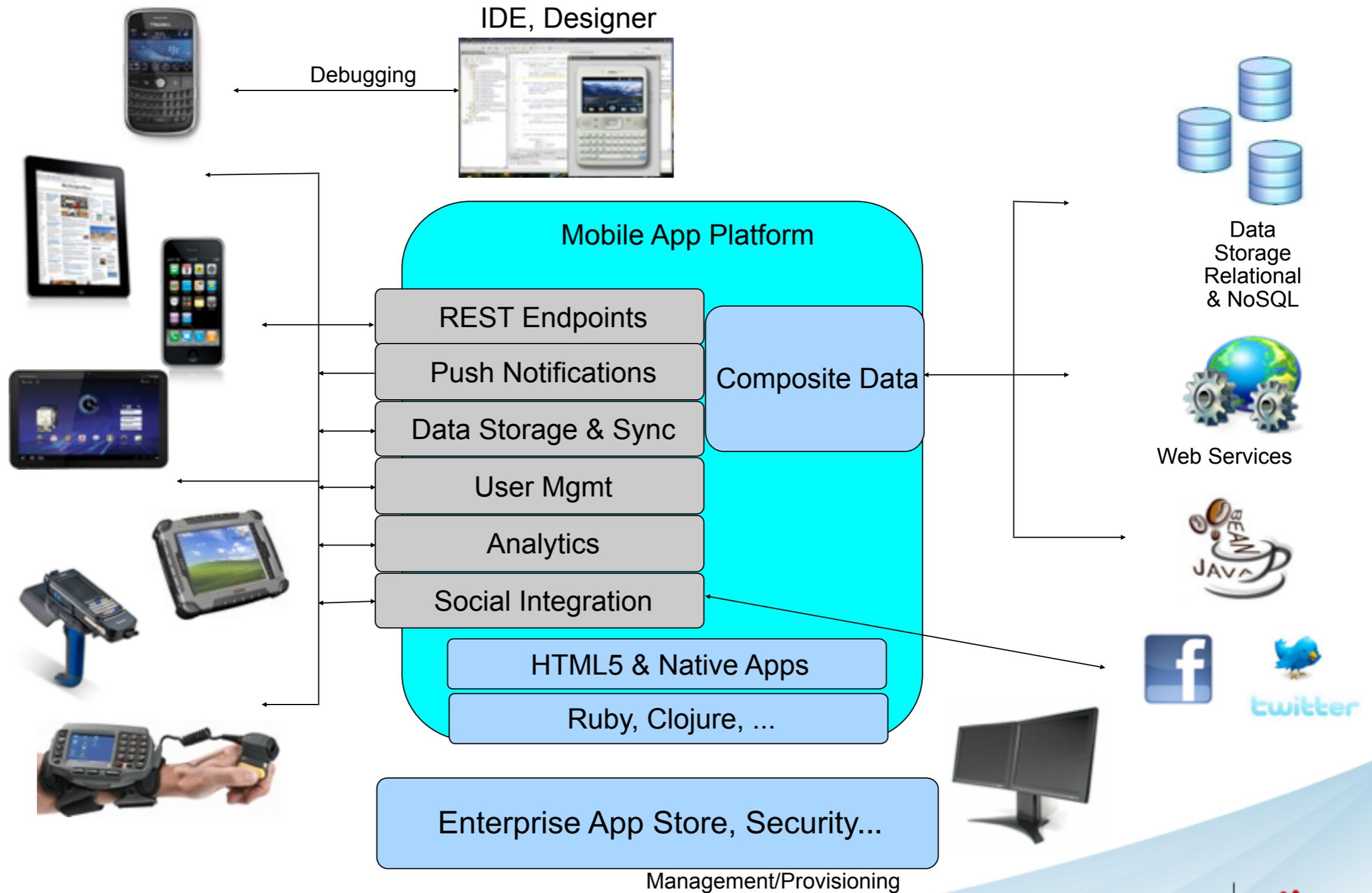
- “Work expands to use the power available”
 - Basic word processors on first PCs
 - Publisher-quality implementations now on laptops
 - Games pushing the envelope from Pong through Space Invaders to CoD
 - Distributed systems
 - Grids
 - Mobile devices contain more and more personal data
 - Wallets via NFC
 - Disconnected operation is the normal situation

Applications for IoT

- Types of application increasing in complexity
 - Online purchases
 - Distributed peer-to-peer interactions
- More requirements becoming a necessity
 - Security and identity
 - High performance, low latency, reliable messaging
 - Database updates with transactions
 - Workflows as inter-app interactions increase



IoT architecture



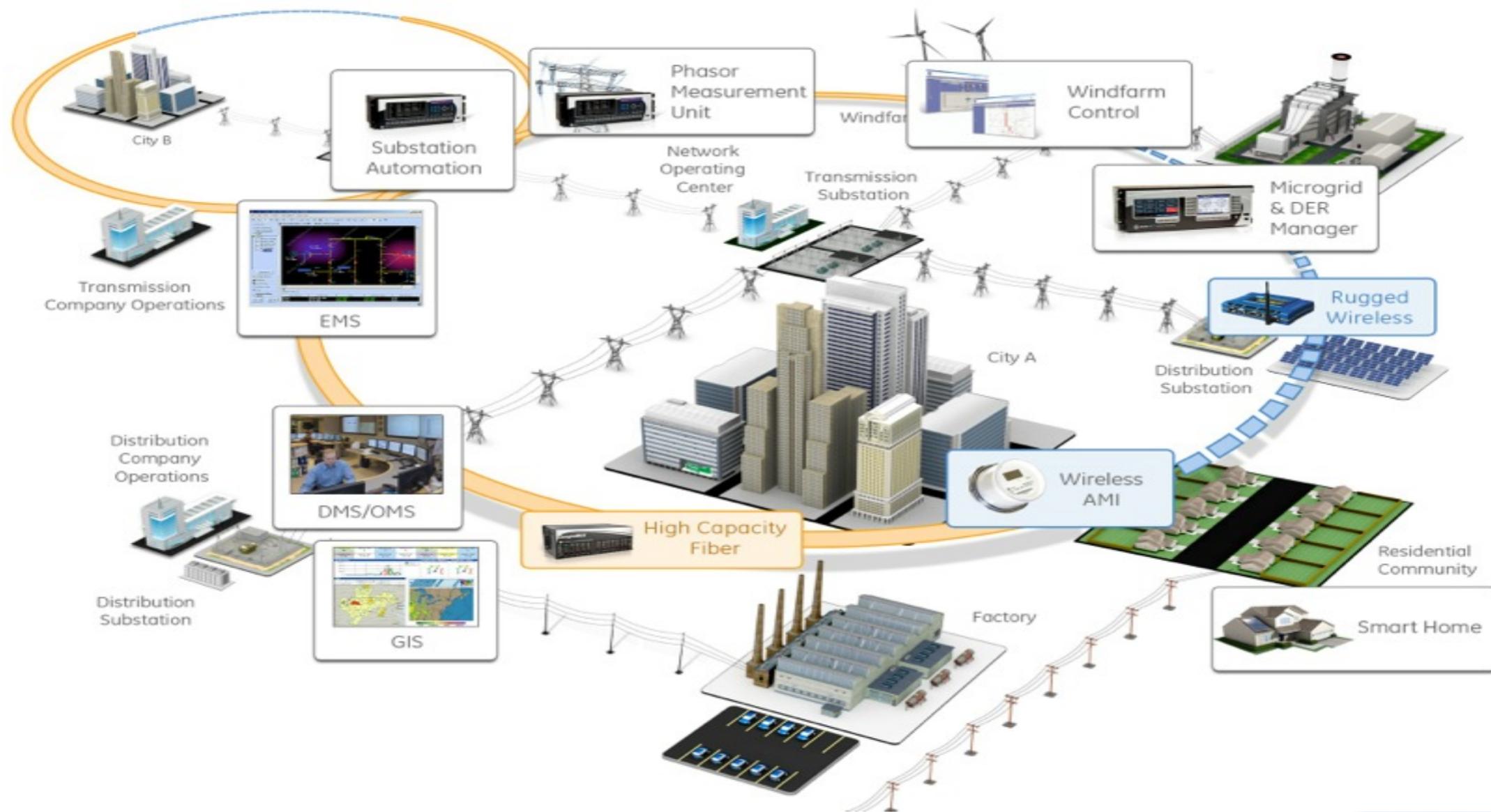
Richard Hamming, 1968 Turing speech

- Whereas Newton could say, "If I have seen a little farther than others, it is because I have stood on the shoulders of giants," I am forced to say, "Today we stand on each other's feet." Perhaps the central problem we face in all of computer science is how we are to get to the situation where we build on top of the work of others rather than redoing so much of it in a trivially different way.

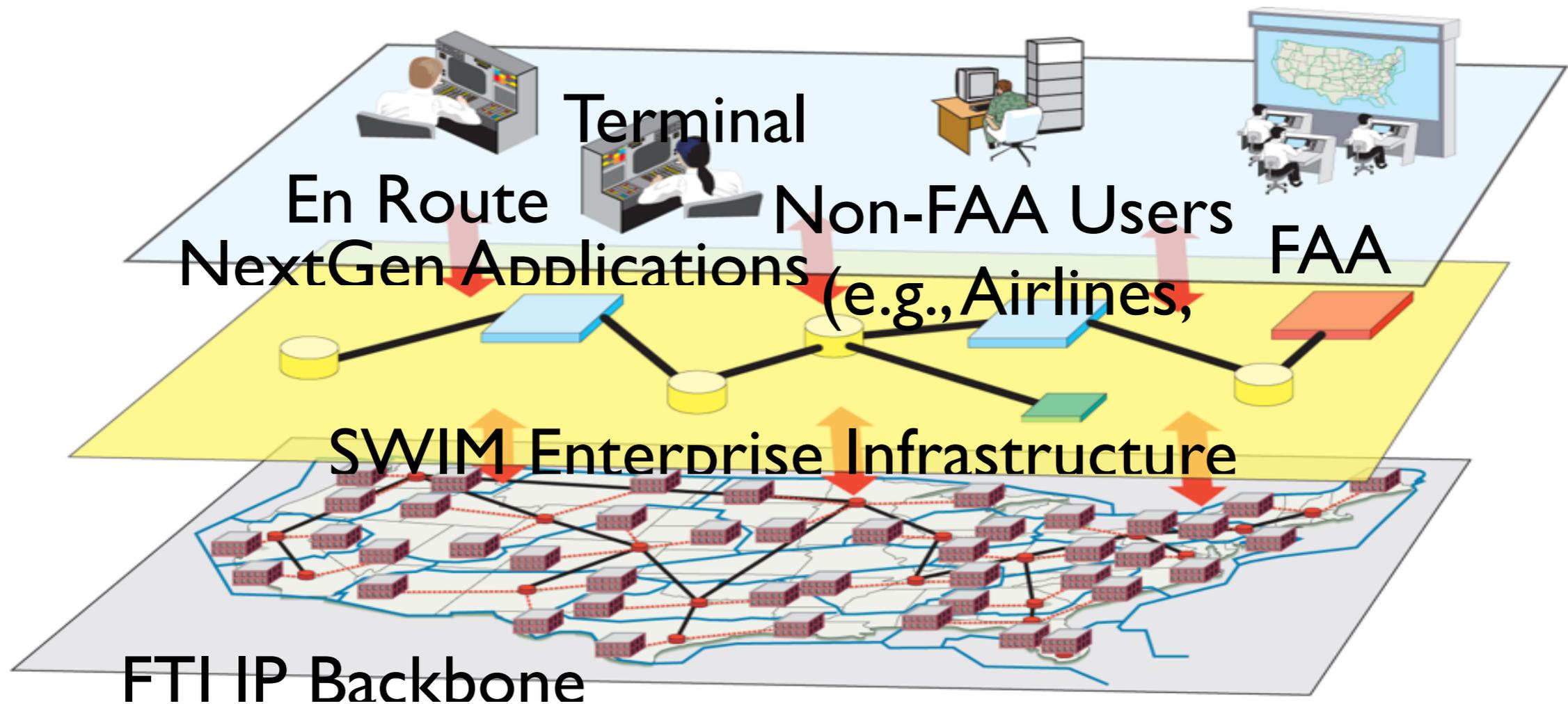
Examples of JBoss and IoT

- Raspberry Pi/embedded
 - Narayana, Switchyard, Infinispan, AS7/WildFly 8, Arquillian, ActiveMQ
 - Fuse Fabric, Vert.x
 - ...
- Mobile
 - AS7
 - Narayana
 - jBPM 5
 - ...

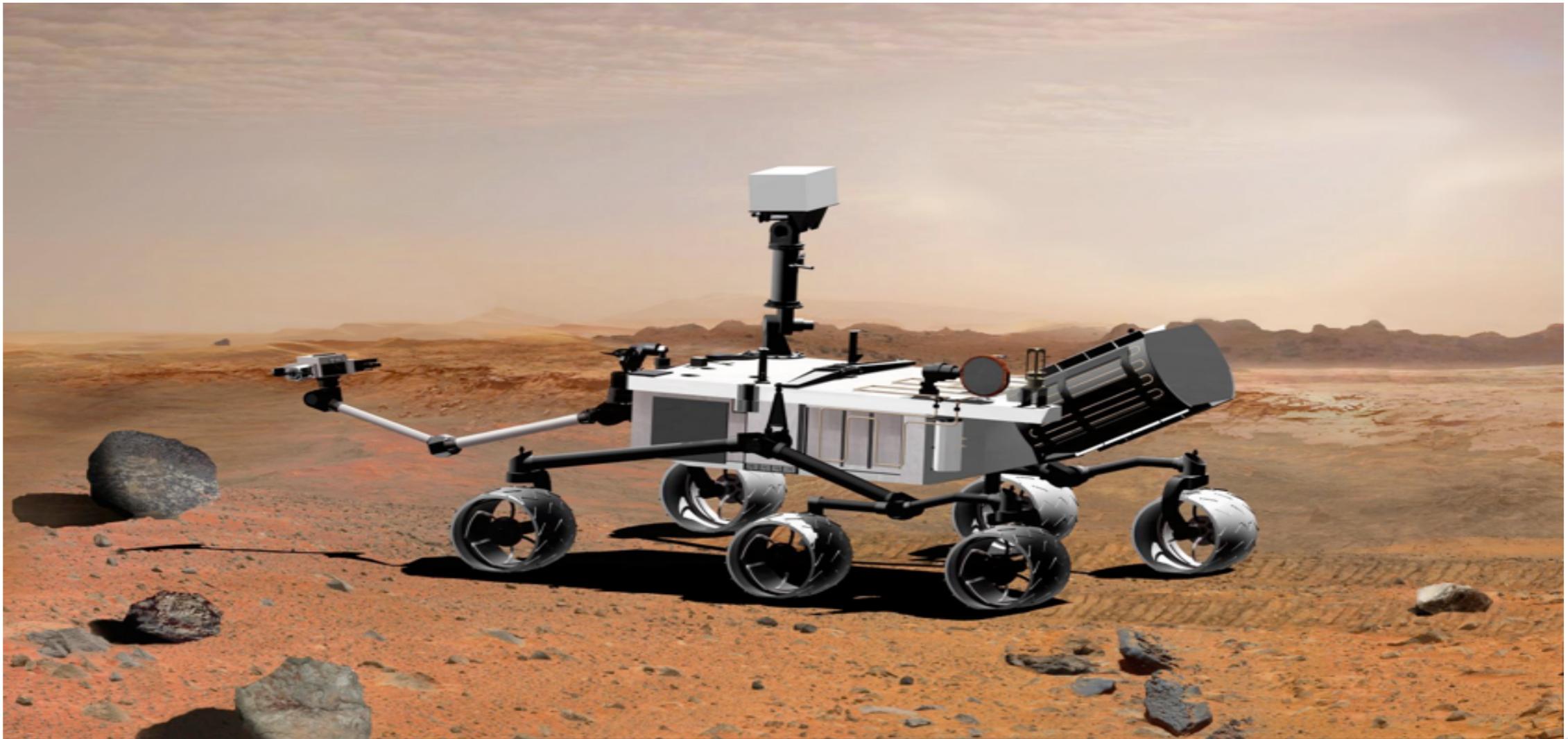
GE Energy and Smart Grid (Fuse & A-MQ)



FAA Next Generation (Fuse & A-MQ)



ActiveMQ In Space!



Apollo and High Energy Physics

LHC: The Large Hadron Collider

The protons have not yet been accelerated to their full energy.
You need to supply more energy by raising the accelerator handle...

SPS Ring
LHC Ring

ALICE
ATLAS
LHCb
CMS

SPS now at 306.0 GeV (68)%...
Lift handle to accelerate the stream

PPEP
pp4SS
particle physics for scottish schools

Examples on the Pi

- Raspberry Pi Model B

- Wheezy, JDK 1.7

- 512 Meg, 8Gig SD card

- <http://www.pcmag.com/article2/0,2817,2388408,00.asp>

- Modify swap

- /etc/dphys-swapfile

- /etc/init.d/dphys-swapfile stop

- /etc/init.d/dphys-swapfile start

- Go with 256 Meg initially. And a FAST SD card!

- Maven 3

Fuse Fabric on a Pi after 6 hours

- [ERROR] Failed to execute goal
org.apache.maven.plugins:maven-surefire-plugin:
2.12:test (default-test) on project archetype-
builder: Error while executing forked tests.;
nested exception is java.io.IOException: Cannot
run program "/bin/sh" (in directory "/home/pi/
fusesource/fuse/tooling/archetype-builder"):
java.io.IOException: error=12, Cannot allocate
memory -> [Help 1]

Increase swap to 1024 Meg!

Tasks: 62 total, 1 running, 61 sleeping, 0 stopped, 0 zombie
 %Cpu(s): 98.7 us, 1.0 sy, 0.0 ni, 0.0 id, 0.0 wa, 0.0 hi, 0.3 si, 0.0 st
 KiB Mem: 188112 total, 175792 used, 12320 free, 27484 buffers
 KiB Swap: 102396 total, 0 used, 102396 free, 72252 cached

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
1938	pi	20	0	215m	51m	5824	S	97.6	27.9	3:02.63	java
1959	pi	20	0	4664	1416	1048	R	1.3	0.8	0:00.41	top
1661	pi	20	0	9868	1524	900	S	0.6	0.8	0:00.44	sshd
1058	root	20	0	1720	512	436	S	0.3	0.3	0:01.46	ifplugd
1064	root	20	0	1720	488	412	S	0.3	0.3	0:01.06	ifplugd
1	root	20	0	2128	704	604	S	0.0	0.4	0:01.81	init
2	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kthreadd
3	root	20	0	0	0	0	S	0.0	0.0	0:00.00	ksoftirqd/0
5	root	20	0	0	0	0	S	0.0	0.0	0:00.23	kworker/u:0
6	root	-2	0	0	0	0	S	0.0	0.0	0:00.92	rcu_kthread
7	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	khelper
8	root	20	0	0	0	0	S	0.0	0.0	0:00.01	kdevtmpfs
9	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	netns
10	root	20	0	0	0	0	S	0.0	0.0	0:00.01	sync_supers
11	root	20	0	0	0	0	S	0.0	0.0	0:00.00	bdi-default
12	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	kblockd
13	root	20	0	0	0	0	S	0.0	0.0	0:00.27	khubd
14	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	rpciod
16	root	20	0	0	0	0	S	0.0	0.0	0:00.00	khuntd
17	root	20	0	0	0	0	S	0.0	0.0	0:00.36	kswapd0
18	root	20	0	0	0	0	S	0.0	0.0	0:00.00	fsnot
19	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	nfsiod

top - 19:44:02 up 1 day, 7:43, 2 users, load average: 5.15, 3.78, 2.79
 Tasks: 63 total, 2 running, 61 sleeping, 0 stopped, 0 zombie
 %Cpu(s): 0.4 us, 9.1 sy, 0.0 ni, 0.0 id, 88.3 wa, 0.0 hi, 2.3 si, 0.0 st
 KiB Mem: 188112 total, 178268 used, 9844 free, 44 buffers
 KiB Swap: 1048572 total, 162232 used, 886340 free, 3084 cached

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
33	root	20	0	0	0	0	R	4.2	0.0	29:42.98	mcpd/0
17	root	20	0	0	0	0	D	3.8	0.0	15:26.36	kswapd0
8529	pi	20	0	209m	3384	248	S	3.3	1.8	0:09.95	java
8537	pi	20	0	4664	528	160	R	2.1	0.3	0:00.93	top
7852	pi	20	0	9868	120	0	S	0.9	0.1	0:01.34	sshd
8030	pi	20	0	749m	137m	136	S	0.7	74.7	65:48.72	java
1058	root	20	0	1720	164	124	S	0.3	0.1	2:47.33	ifplugd
1510	ntp	20	0	5832	168	80	S	0.3	0.1	1:10.27	ntpd
6	root	-2	0	0	0	0	S	0.2	0.0	0:44.42	rcu_kthread
1065	root	20	0	0	0	0	S	0.2	0.0	0:45.90	RTKTHREAD
8476	root	20	0	0	0	0	S	0.2	0.0	0:01.45	kworker/0:0
1	root	20	0	2128	24	4	S	0.0	0.0	0:13.31	init

A faster SD card!

```
FuseFabric:karaf@root> container-connect broker1
Connecting to host 192.168.0.28 on port 8182
Connected
```



```
Type 'help' to get started
and 'help [cmd]' for help on a specific command.
Hit ^ctrl-d^ or ^osgi:shutdown^ to shutdown this Fuse Fabric Container.
```

```
Create a new Fabric via 'fabric:create'
or join an existing Fabric via 'fabric:join [someUris]'
```

```
FuseFabric:admin@broker1> activemq:list
BrokerName = broker1
```

```
FuseFabric:karaf@root> container-create-child --profile example-camel root camel1
```

The following containers have been created successfully:

camel1

```
FuseFabric:karaf@root> container-list
```

[id]	[version]	[alive]	[profiles]	[provision status]
root*	1.0	true	fabric, fabric-ensemble-0000-1	success
broker1	1.0	true	mq	success
camel1	1.0	false	example-camel	

```
FuseFabric:karaf@root> container-list
```

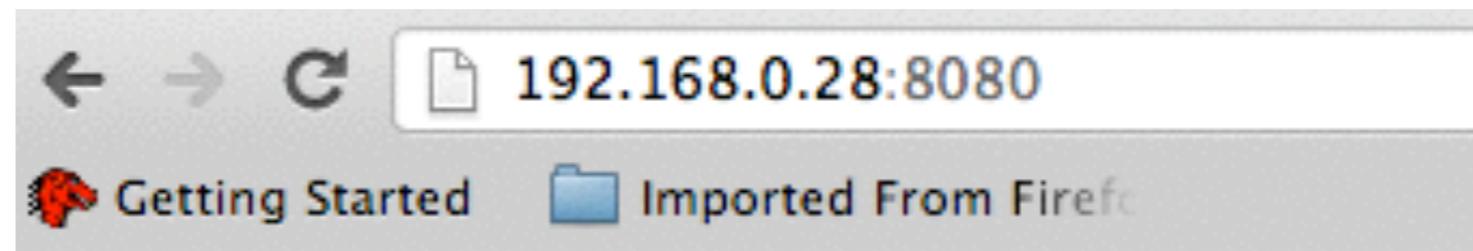
[id]	[version]	[alive]	[profiles]	[provision status]
root*	1.0	true	fabric, fabric-ensemble-0000-1	success
broker1	1.0	true	mq	success
camel1	1.0	false	example-camel	

```
FuseFabric:karaf@root> container-list
```

[id]	[version]	[alive]	[profiles]	[provision status]
root*	1.0	true	fabric, fabric-ensemble-0000-1	success
broker1	1.0	true	mq	success
camel1	1.0	false	example-camel	

Vert.x on a Pi

```
pi@raspberrypi ~/examples/vertx $ vertx version  
vert.x-1.3.0.final  
pi@raspberrypi ~/examples/vertx $ █
```



Hello World!

MongoDB?

- After 10 hours of building ...

```
g++ -o build/linux2/normal/mongo/db/queryutil.o -c -Wnon-virtual-dtor -Woverloaded-virtual -fPIC -fno-strict-aliasing -Wstrict-aliasing -ggdb -pthread -Wall -Wsign-compare -Wno-unknown-pragmas -Wcast-align -Winvalid-pch -O3 -DBOOST_ALL_NO_LIB -D_SCONS -DMONGO_EXPOSE_MACROS -DSUPPORT_UTF8 -D_FILE_OFFSET_BITS=64 -DJS_C_STRINGS_ARE_UTF8 -DMONGO_HAVE_HEADER_UNISTD_H -DMONGO_HAVE_EXECINFO_BACKTRACE -DHAVE_SYNC_FETCH_AND_ADD -DALIGNMENT_IMPORTANT -DHAVE_BSWAP32 -DHAVE_BSWAP64 -DXP_UNIX -Ibuild/linux2/normal/third_party/boost -Isrc/third_party/boost -Ibuild/linux2/normal/third_party/pcre-8.30 -Isrc/third_party/pcre-8.30 -Ibuild/linux2/normal -Isrc -Ibuild/linux2/normal/mongo -Isrc/mongo -Ibuild/linux2/normal/third_party/snappy -Isrc/third_party/snappy -Ibuild/linux2/normal/third_party/js-1.7 -Isrc/third_party/js-1.7 src/mongo/db/queryutil.cpp
scons: *** [build/linux2/normal/mongo/db/queryutil.o] Build interrupted.
scons: Build interrupted.
scons: building terminated because of errors.
scons: writing .sconsign file.
```

A little magic, fingers crossed and 12 hours later ...

warning: 32-bit servers don't have journaling enabled by default. Please use --journal if you want durability.

```
[initandlisten] MongoDB starting : pid=2139 port=27017 dbpath=/data/db/ 32-bit host=raspberrypi
[initandlisten]
[initandlisten] ** NOTE: This is a development version (2.1.1) of MongoDB.
[initandlisten] **       Not recommended for production.
[initandlisten]
[initandlisten] ** NOTE: when using MongoDB 32 bit, you are limited to about 2 gigabytes of data
[initandlisten] **       see http://blog.mongodb.org/post/137788967/32-bit-limitations
[initandlisten] **       with --journal, the limit is lower
[initandlisten]
[initandlisten] db version v2.1.1, pdfile version 4.5
[initandlisten] git version: f457ff42ec37f2562d1a5ff06b4d96a861414c94
[initandlisten] build info: Linux raspberrypi 3.1.9+ #272 PREEMPT Tue Aug 7 22:51:44 BST 2012 armv6l BOOST_LIB_VERSION=1_49
[initandlisten] options: {}
```

• <https://github.com/nmcl/mongo4pi>



28



Java. Cloud. Leadership.

Order total:
\$0.00

Username

Password

Login

Logged in as
tim

Welcome to vToons

I hope you will enjoy our fantastic selection of music

Shop

Cart

Please choose from our wonderful selection of songs:

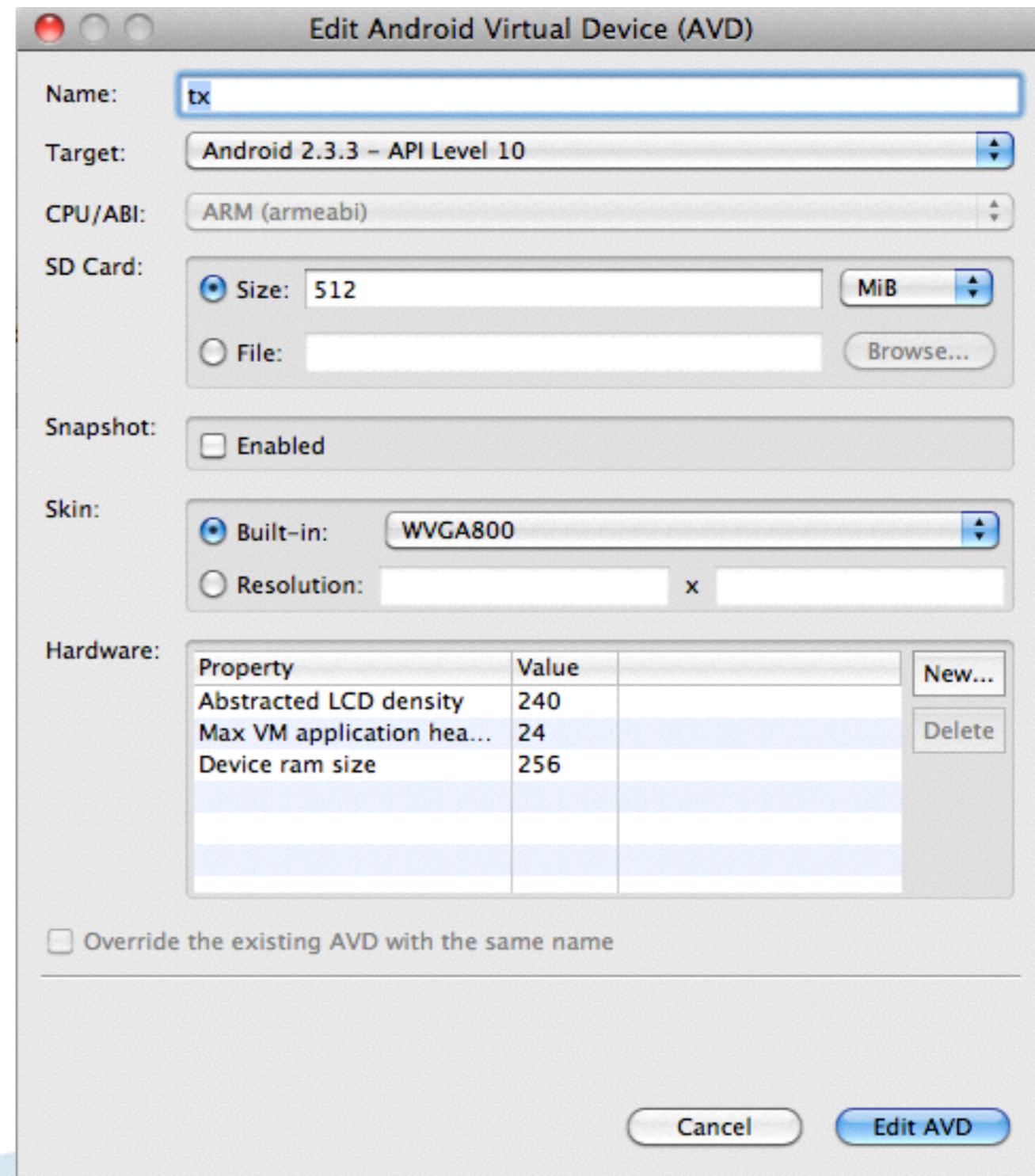
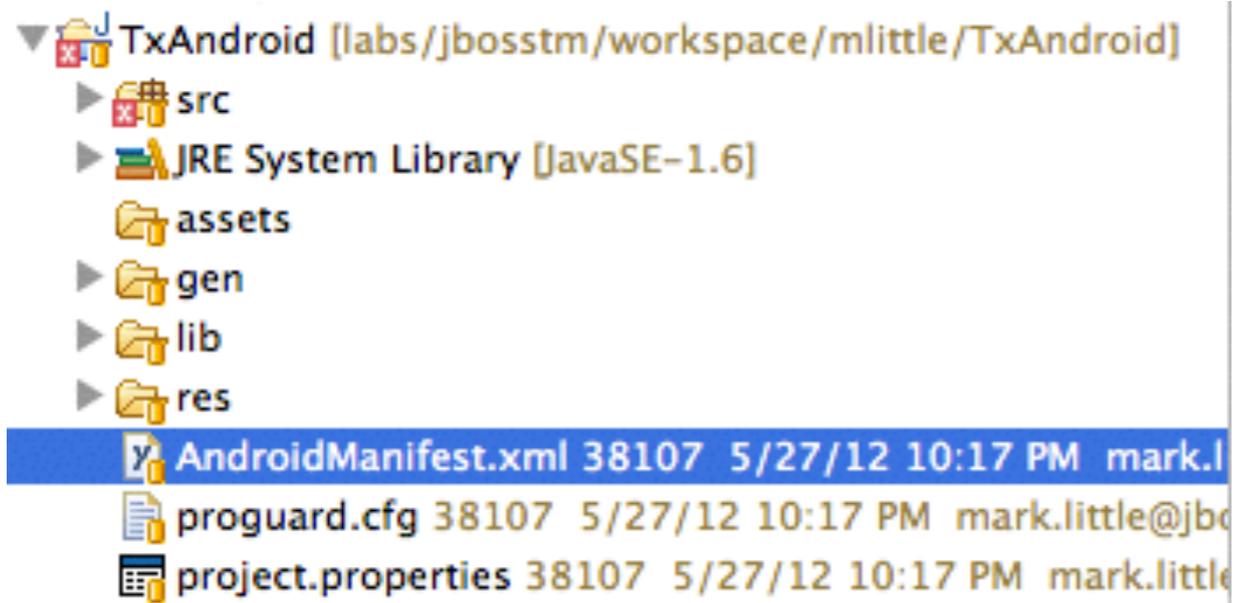
Genre	Artist	Album	Price	
Scrumpy and Western	The Wurzels	I Am A Cider Drinker	\$0.99	Add to Cart
Hip Hop	Vanilla Ice	Ice Ice Baby	\$0.01	Add to Cart
Easy Listening	Ena Baga	The Happy Hammond	\$0.50	Add to Cart
Bird related songs	The Tweets	The Birdy Song	\$1.20	Add to Cart



Examples on Android (transactions)

- <https://svn.jboss.org/repos/labs/labs/jbosstm/workspace/mlittle/android/>
- <https://svn.jboss.org/repos/labs/labs/jbosstm/workspace/mlittle/TxAndroid/>

Emulator example ...



What's in the manifest?

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.helloandroid"
    android:versionCode="1"
    android:versionName="1.0">

    <application android:icon="@drawable/icon" android:label="@string/app_name">
        <activity android:name=".HelloAndroid"
            android:label="@string/app_name">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>

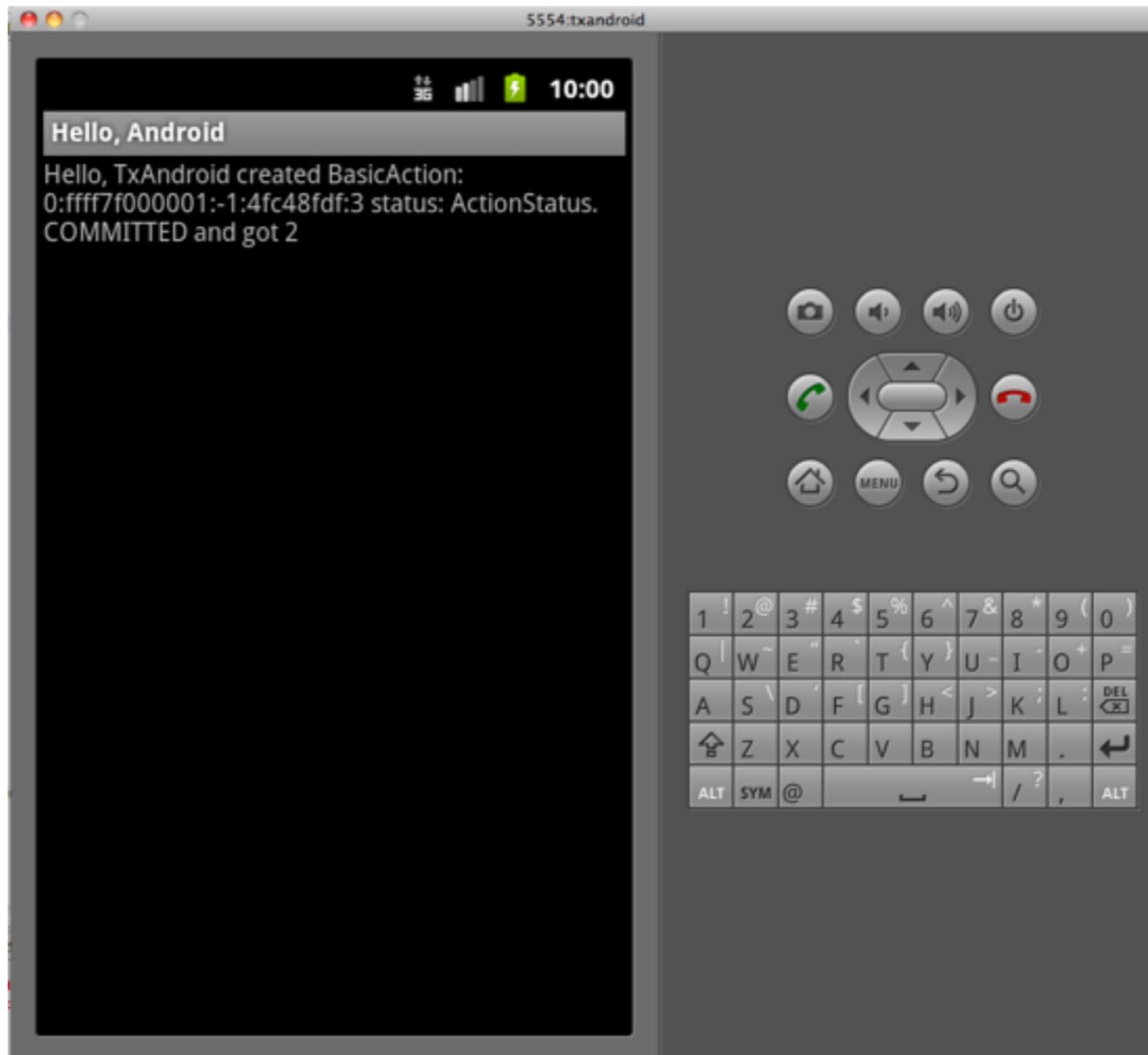
    <uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE" />
    <uses-permission android:name="android.permission.INTERNET"></uses-permission>
</manifest>
```

The code

```
public class HelloAndroid extends Activity {  
    /** Called when the activity is first created. */  
    @Override  
    public void onCreate(Bundle savedInstanceState) {  
  
        super.onCreate(savedInstanceState);  
        TextView tv = new TextView(this);  
  
        AtomicAction A = new AtomicAction();  
        AtomicObject foo = new AtomicObject();  
  
        A.begin();  
  
        foo.set(2);  
  
        A.commit();  
  
        tv.setText("Hello, TxAndroid created "+A.toString()+" and got "+foo.get());  
  
        setContentView(tv);  
    }  
}
```

Results

```
[2012-05-29 09:59:05 - TxAndroid] Uploading TxAndroid.apk onto device 'emulator-5554'  
[2012-05-29 09:59:05 - TxAndroid] Installing TxAndroid.apk...  
[2012-05-29 09:59:09 - TxAndroid] Success!  
[2012-05-29 09:59:09 - TxAndroid] Starting activity com.example.helloandroid.HelloAndroid on device emulator-5554  
[2012-05-29 09:59:10 - TxAndroid] ActivityManager: Starting: Intent { act=android.intent.action.MAIN cat=[android.intent.category.LAUNCHER] cmp=com.example.helloandroid/.HelloAndroid }
```



```
JBOSS_HOME: /home/jboss/jboss-as-7.1.0.CR1b
JAVA: java
JAVA_OPTS: -server -Xms64m -Xmx512m -XX:MaxPermSize=256m -Djava.net.preferIPv4Stack=true -Dorg.jboss.resolver.warning=true -Dsun.rmi.dgc.client.gcInterval=3600000 -Dsun.rmi.dgc.server.gcInterval=3600000 -Djboss.modules.system.pkgs=org.jboss.byteman -Djava.awt.headless=true
=====
10:45:31,254 INFO [org.jboss.modules] JBoss Modules version 1.1.0.CR6
10:45:33,065 INFO [org.jboss.msc] JBoss MSC version 1.0.1.GA
10:45:33,567 INFO [org.jboss.as] JBoss AS 7.1.0.CR1b "Flux Capacitor" starting
10:45:40,621 INFO [org.jboss.as] Creating http management service using socket-binding (management-http)
10:45:40,632 INFO [org.xnio] XNIO Version 3.0.0.CR7
10:45:40,709 INFO [org.xnio.nio] XNIO NIO Implementation Version 3.0.0.CR7
10:45:40,753 INFO [org.jboss.remoting] JBoss Remoting version 3.2.0.CR8
10:45:41,460 INFO [org.jboss.as.logging] JBAS011502: Removing bootstrap log handlers
10:45:41,703 INFO [org.jboss.as.naming] (ServerService Thread Pool -- 38) JBAS011800: Activating Naming Subsystem
10:45:41,739 INFO [org.jboss.as.clustering] (ServerService Thread Pool -- 30) JBAS010300: Activating Infinispan subsystem.
10:45:41,753 INFO [org.jboss.as.security] (ServerService Thread Pool -- 44) Activating Security Subsystem
10:45:41,912 INFO [org.jboss.as.osgi] (ServerService Thread Pool -- 39) JBAS011910: Activating OSGi Subsystem
10:45:41,942 INFO [org.jboss.as.security] (MSC service thread 1-1) Picketbox version=4.0.6.Beta2
10:45:41,967 INFO [org.jboss.as.webservices] (ServerService Thread Pool -- 48) JBAS015537: Activating WebServices Extension
10:45:42,236 INFO [org.jboss.as.connector] (MSC service thread 1-4) JBAS010408: Starting JCA Subsystem (JBoss IronJacamar 1.0.6.Final)
10:45:42,759 INFO [org.jboss.as.naming] (MSC service thread 1-4) JBAS011802: Starting Naming Service
10:45:42,865 INFO [org.jboss.as.jaxr] (MSC service thread 1-4) Binding JAXR ConnectionFactory: java:jboss/jaxr/ConnectionFactory
10:45:43,066 INFO [org.jboss.as.mail.extension] (MSC service thread 1-2) JBAS015400: Bound mail session [java:jboss/mail/Default]
10:45:44,035 INFO [org.jboss.as.connector.subsystems.datasources] (ServerService Thread Pool -- 26) JBAS010403: Deploying JDBC-compliant driver class org.h2.Driver (version 1.3)
10:45:44,116 INFO [org.jboss.as.remoting] (MSC service thread 1-1) Listening on /127.0.0.1:4447
10:45:44,378 INFO [org.apache.catalina.core.AprLifecycleListener] (MSC service thread 1-3) The Apache Tomcat Native library which allows optimal performance in production environments was not found on the java.library.path: /usr/lib/jvm/java-6-openjdk/jre/lib/arm/server:/usr/lib/jvm/java-6-openjdk/jre/lib/arm:/usr/lib/jvm/java-6-openjdk/jre/..../lib/arm:/usr/java/packages/lib/arm:/usr/lib/jni:/lib:/usr/lib
10:45:45,549 INFO [org.apache.coyote.http11.Http11Protocol] (MSC service thread 1-1) Starting Coyote HTTP/1.1 on http--127.0.0.1-8080
10:45:47,228 INFO [org.jboss.ws.common.management.AbstractServerConfig] (MSC service thread 1-2) JBoss Web Services - Stack CXF Server 4.0.0.GA
10:45:48,434 INFO [org.jboss.as.connector.subsystems.datasources] (MSC service thread 1-1) JBAS010400: Bound data source [java:jboss/datasources/ExampleDS]
10:45:49,275 INFO [org.jboss.as.remoting] (MSC service thread 1-2) Listening on /127.0.0.1:9999
10:45:49,359 INFO [org.jboss.as.server.deployment.scanner] (MSC service thread 1-1) JBAS015012: Started FileSystemDeploymentService for directory /home/jboss/jboss-as-7.1.0.CR1b/standalone/deployments
10:45:49,955 INFO [org.jboss.as] (Controller Boot Thread) JBoss AS 7.1.0.CR1b "Flux Capacitor" started in 20090ms - Started 130 of 200 services (68 services are passive or on-demand)
```



Code changes

- For Raspberry Pi?
 - It's standard Java
 - No code changes
 - Just add a little more patience
- For Android?
 - No StAX by default
 - Classloading is **very** different
 - No loading of byte code at runtime
 - Remember to use `—core-library` to get javax
 - Some pre-JDK 1.6 compilation issues ...

[INFO] warning: Ignoring InnerClasses attribute for an anonymous inner class
[INFO] (javassist.ClassPool\$1) that doesn't come with an
[INFO] associated EnclosingMethod attribute. This class was probably produced by a
[INFO] compiler that did not target the modern .class file format. The recommended
[INFO] solution is to recompile the class from source, using an up-to-date compiler
[INFO] and without specifying any "-target" type options. The consequence of ignoring
[INFO] this warning is that reflective operations on this class will incorrectly
[INFO] indicate that it is **not** an inner class.

The jar which caused the immediate problems were:

Package	Release Version	Java Version
org.dom4j	1.6.1	1.4.2_02
antlr	2.7.7	1.4.2_09
javassist	3.6.0	1.2

Conclusions

- Typical IoT applications need some capabilities normally associated with enterprises
 - Next generation IoT applications will need more
- Trillions of sensors
- Billions of phones
- Cloud needs intelligent participants
 - Data on the inside vs data on the outside
- Dalvik can be a PITA for Java developers
 - Java but not as we know it