



SOFTWARE DEVELOPMENT PLATFORMS FOR CAT-IQ

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By Peter Mariager, Technology Manager
pm@rtx.dk

FACTS ABOUT RTX TELECOM

- Founded 1993
- Listed on the Copenhagen Stock Exchange in 2000
- Over 700 wireless development projects completed
- Headquartered in Denmark with offices in Brazil, Hong Kong and USA
- Approximately 165 employees
- Average telecom experience per engineer: >10 years



RTX OFFERINGS & CAPABILITIES

ADVANCED WIRELESS SHORT RANGE SYSTEM DEVELOPMENT

SOLID TECHNOLOGY KNOWLEDGE



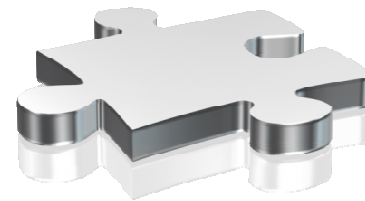
EXPERIENCED WIRELESS ENGINEERING EXPERTS

- RF & Antenna Design
- Embedded SW Development
- Baseband & Electronics
- Acoustic Design
- Test Scripts & Test Systems
- Project Management



- Prototype Manufacturing
- Acoustics Lab
- EMC Lab

IN-HOUSE STATE-OF-THE-ART LABS



Product vision



OEM/ODM product

EXCELLENT PRODUCT REALISATION SKILLS

AGENDA

- Embedded Device Architecture
- Host Based Solutions
 - Integration Options
 - Unified API
 - Operating System Support
 - Tool Chain Considerations
- Stand-Alone Solutions
 - Unified API
 - COLA: CO-Located Application
- Questions



EMBEDDED DEVICE ARCHITECTURE

ARCHITECTURAL CONSIDERATIONS

HOST BASED SOLUTION APP & CAT-IQ ON SEPARATE CPUS

- Higher BOM
- Shorter TTM
 - Physical separation - no side effects
 - Easier implementation & debugging
- Host may already exist
- Larger and complex app possible
 - UI, storage, networking
- No or less CAT-iq certification costs
- Existing or known tool chain

STAND-ALONE SOLUTION APP & CAT-IQ ON SAME CPU

- Optimized BOM – Good for high volume
- Longer TTM
 - Tight integration of app and protocol
 - Learning cycle / tool knowledge
- Less power consumption
- Limited application complexity
 - Good for small applications
- CAT-iq certification
- Dedicated tool chain
- Limited connectivity and I/O

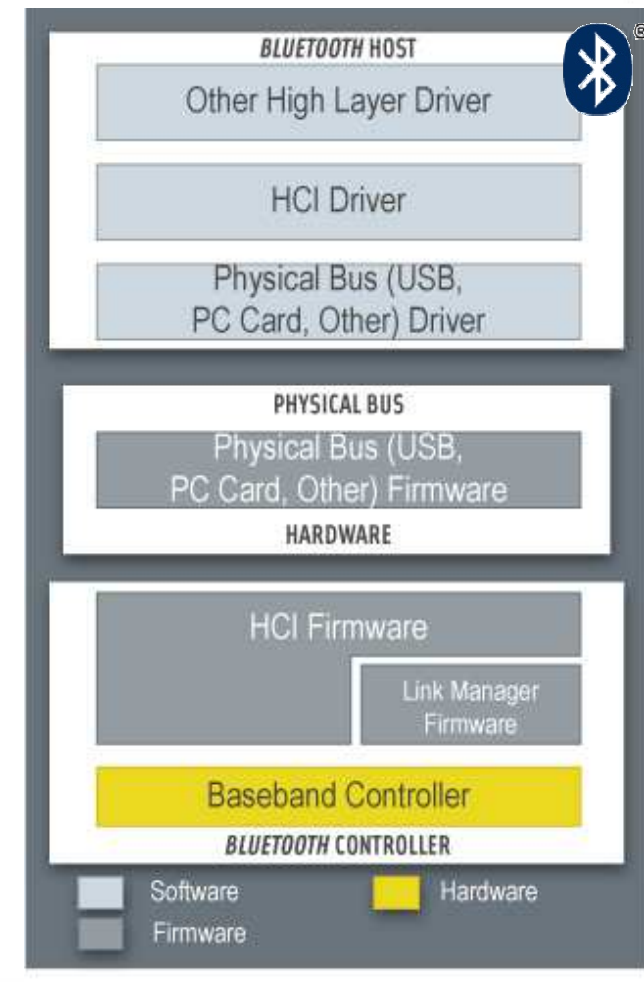
With clean API, host applications can easily be ported to stand-alone architecture

EMBEDDED DEVICE ARCHITECTURE

FINDING THE LOGICAL SPLIT...

INSPIRED BY BLUETOOTH™

- Bluetooth SIG identified a need for separation between application and HW
- Introduced the Host Controller Interface
- Unified, “well”-documented API
- Not regulated by certification, but used during
- Allowed a host based application to be developed on any architecture (endian-ness)
- Allowed easy interchange of Bluetooth HW
- HCI Bus independent of transport layer
 - SW or HW (UART, USB etc.)



HOST BASED INTEGRATION

HOST BASED SOLUTIONS

THE GATEWAY MANUFACTURERS PERSPECTIVE

DRIVEN BY CUSTOMER AND SERVICE PROVIDER DEMAND

- Customers asking for wireless and wideband services
 - Current FXS Port on Gateway can not meet CAT-iq requirements
- Service Providers need to differentiate on services and quality
 - Superior voice quality – slow down customer transition to cell service
 - Reduce number of end-user components
 - Require integration path for existing and new customers

INTEGRATION OF CAT-iq IS THE SOLUTION



HOST BASED SOLUTIONS

THE GATEWAY MANUFACTURERS PERSPECTIVE

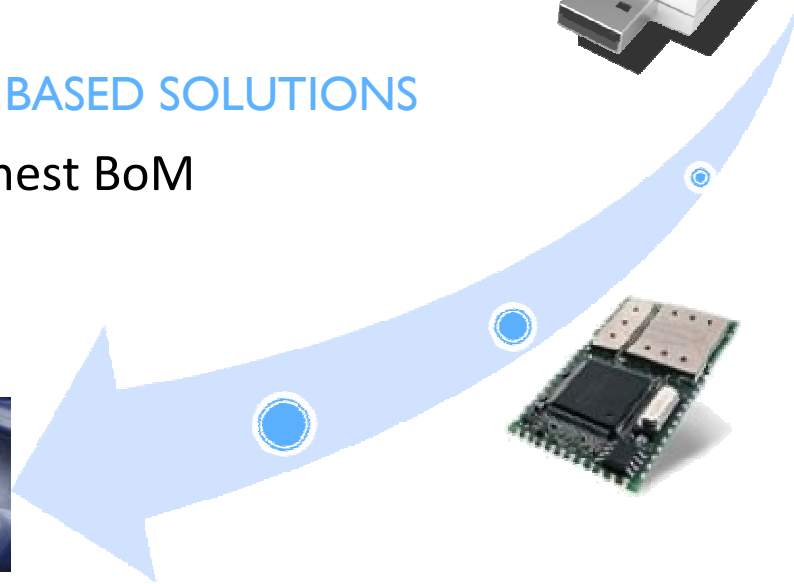
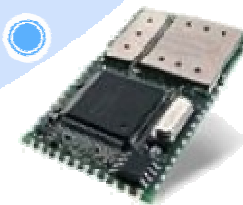
MANY DESIGN CHOICES

- Software: How do I integrate CAT-iq into my middleware / application / DSP layers ?
- Hardware: Re-certification, Interference etc.



INTEGRATION OPTIONS FOR HOST BASED SOLUTIONS

- USB Dongle: Fastest, easiest, highest BoM
- Module
- Flat Design
- Full SoC Integration

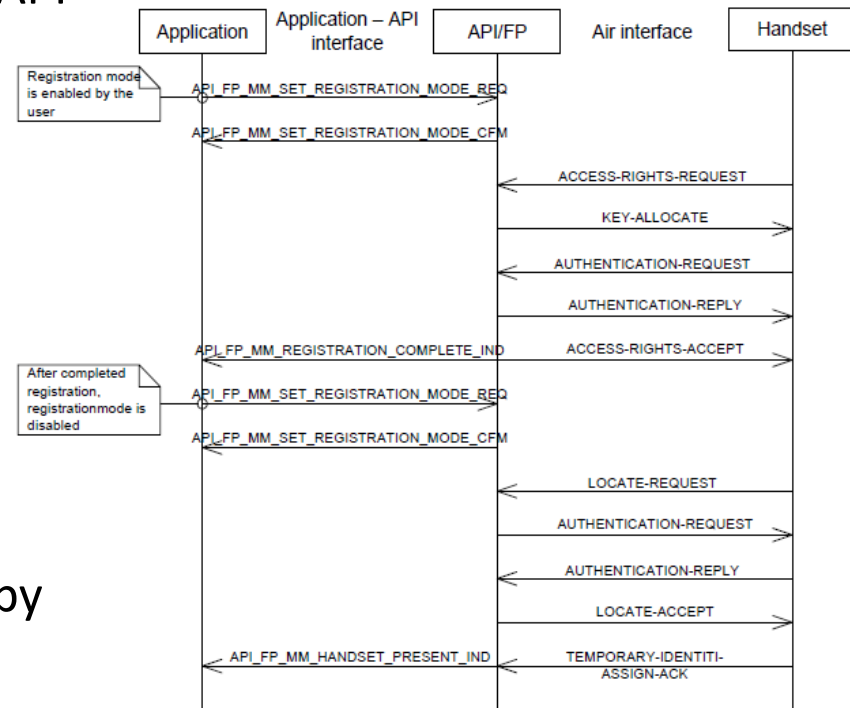


HOST BASED SOLUTIONS

THE GATEWAY MANUFACTURERS PERSPECTIVE

UNIFIED API MAKES DECISION EASIER

- Today there is no standardised CAT-iq API
- RTX has unified, common API for all product types
 - Relatively high abstraction layer
 - Transport layer independent (UART, USB, SW Pipe etc.)
 - Also includes new ULE features
- Eases Host based integration decision by supporting roadmap to lower BoM



Future: Standardized USB Interface for IADs / eMTAs

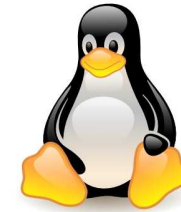


**HOST
ARCHITECTURES**

MeeGo

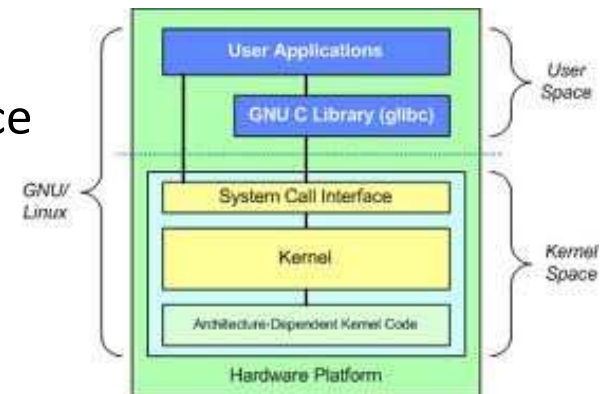
HOST BASED SOLUTIONS

EMBEDDED LINUX ARCHITECTURE



HOW DOES RTX PUT CAT-iq INTO LINUX ?

- Encapsulate CAT-iq functionality into Kernel Space
- Expose character device driver /dev/dect
- Reasons:
 - Protocol can run under same OS thread model regardless of which integration option is used
 - Easier app debugging, harder for protocol developer ☺



CONSIDERATIONS FOR INTEGRATOR

- Audio integration into DSP architecture is often more difficult than control messages
- MIPS requirements

```
[c011cab0] __mod_timer+0xe6/0x13d
[c02661c1] schedule_timeout+0x7e/0x9c
[c011d33b] process_timeout+0x0/0x9
[c0157212] do_poll+0x93/0xb1
[c0157369] sys_poll+0x139/0x1e0
[c01197ea] sys_gettimeofday+0x22/0x55
[c015600f] __pollwait+0x0/0x2a
[c0102fa1] sysenter_past_esp+0x52/0x75
Warning: kfree_skb on hard IRQ 008623f8
scheduling while atomic: gem_server/0xffffffff/8215
[c0265982] schedule+0x4c/0x455
[c0113a0a] sys_sched_yield+0x47/0x50
[c0150a3d] coredump_wait+0x2f/0x74
[c0150b1b] do_coredump+0x99/0x17a
[c015ab1b] d_alloc+0x1b/0x174
[c011def5] __dequeue_signal+0x16e/0x179
[c011d14e] dequeue_signal+0x1e/0x62
[c011f6bb] get_signal_to_deliver+0x27e/0x2ac
[c0102e13] do_signal+0x57/0xd0
[c013daa3] do_brk+0x19a/0x244
[c0111a24] do_page_fault+0x0/0x4e7
[c0102eb3] do_notify_resume+0x27/0x38
[c0103042] work_notifysig+0x13/0x15
Kernel panic - not syncing: Alee, killing interrupt handler!
```

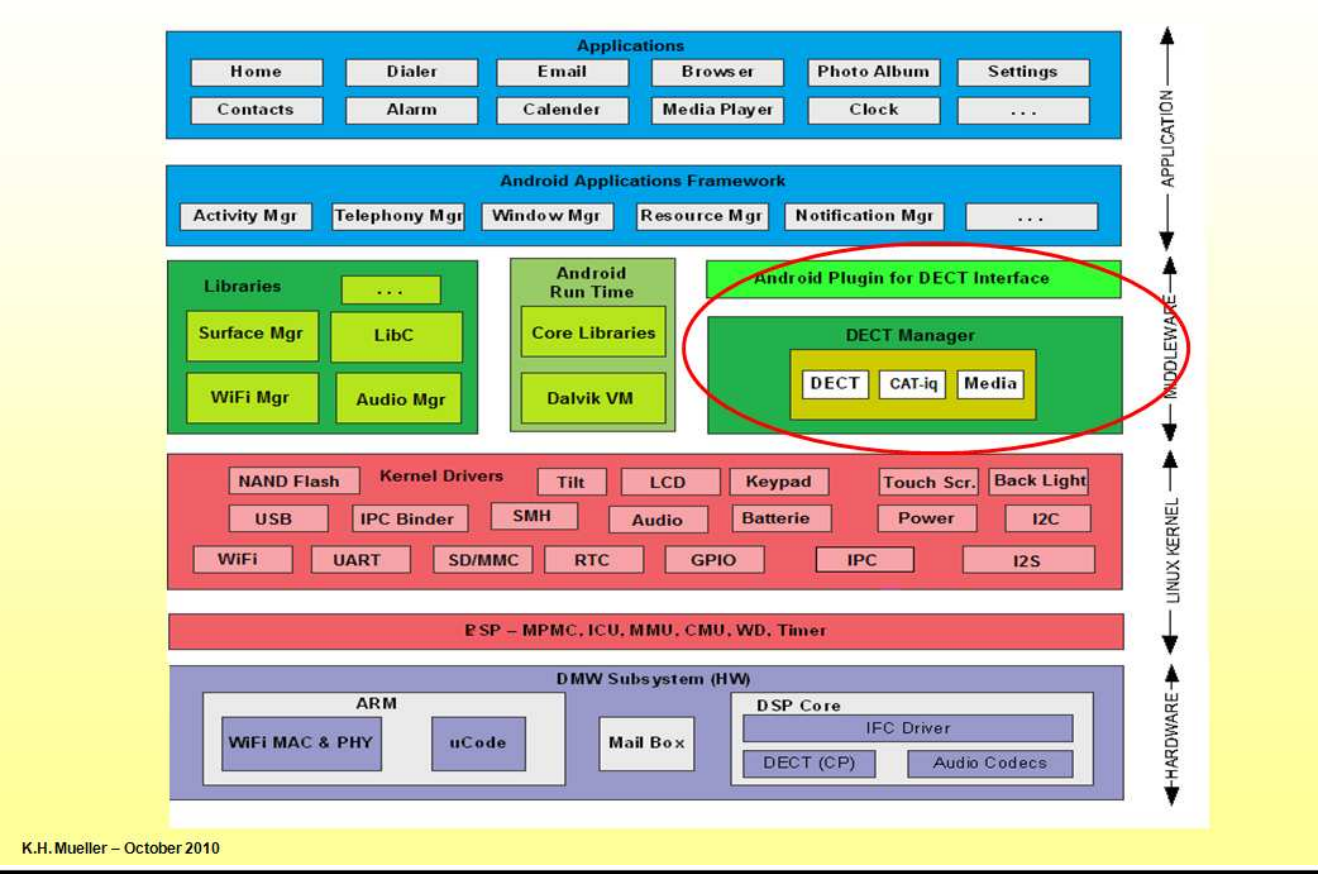
HOST BASED SOLUTIONS

ANDROID ARCHITECTURE



CCT'S ANDROID: **CCT** TECH

Android with DECT/CAT-iq



Courtesy of Karl Heinz Müller, CCT





HOST BASED SOLUTIONS

MEEGO ARCHITECTURE

MeeGo

WHAT IS MEEGO ?

- Technology merger between  and  of two open-source, linux based mobile platforms
- MeeGo takes the best from Moblin and Maemo

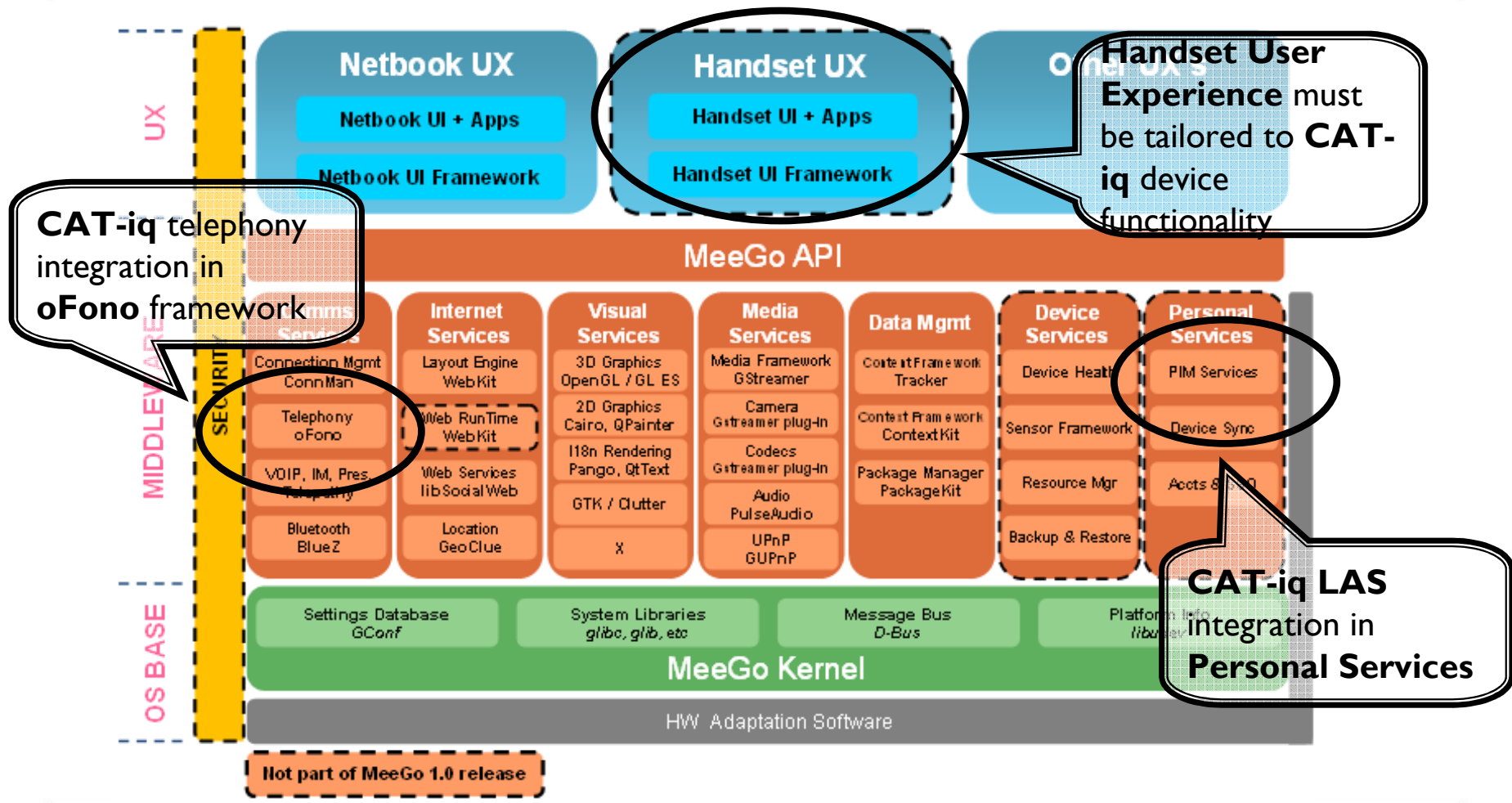


MeeGo currently targets platforms such as netbooks/entry-level desktops, handheld computing and communications devices, in-vehicle infotainment devices, connected TVs, and media phones. All of these platforms have common user requirements in communications, application, and internet services in a portable or small form factor



HOST BASED SOLUTIONS

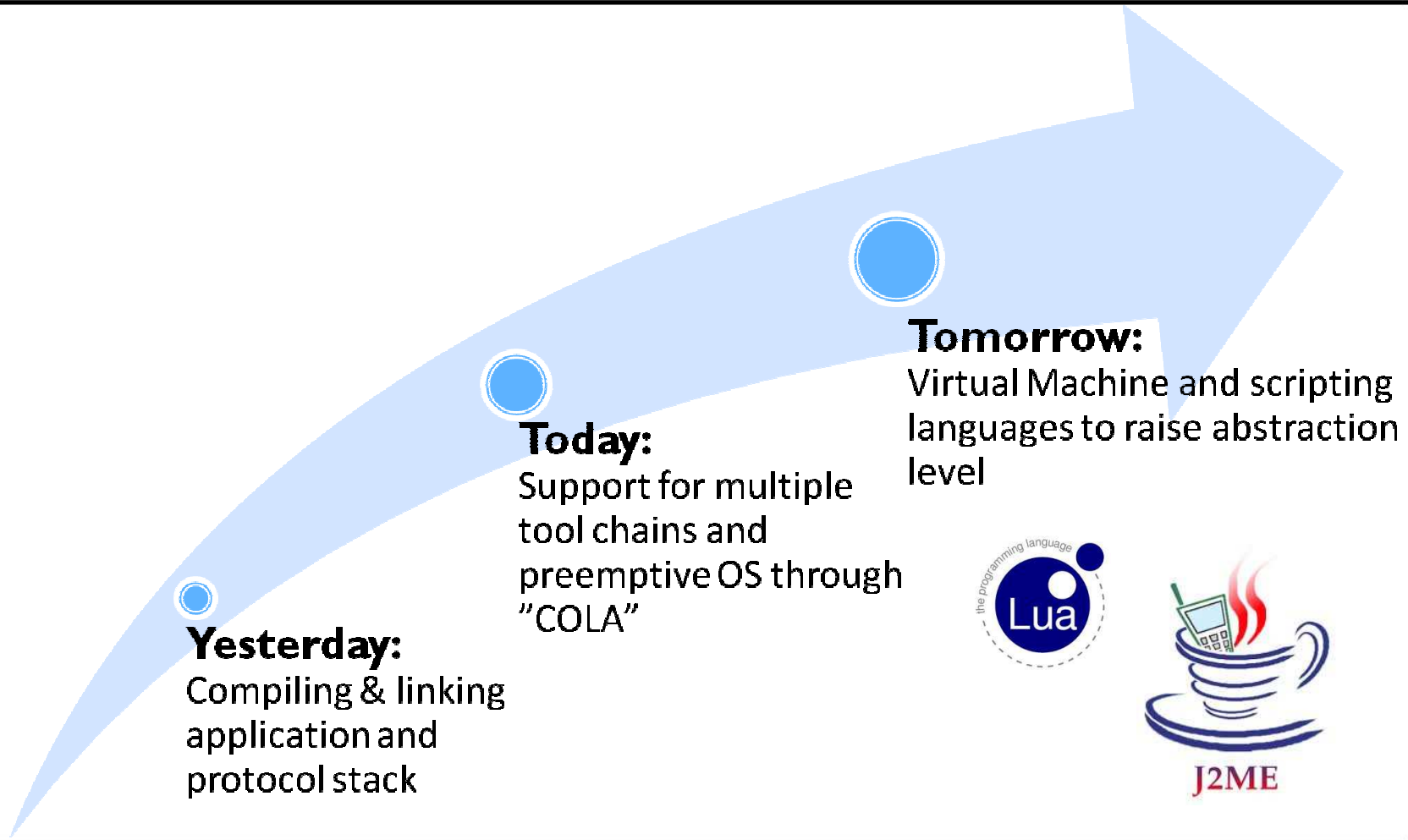
MEEGO ARCHITECTURE



STAND-ALONE ARCHITECTURES

STAND-ALONE SOLUTIONS

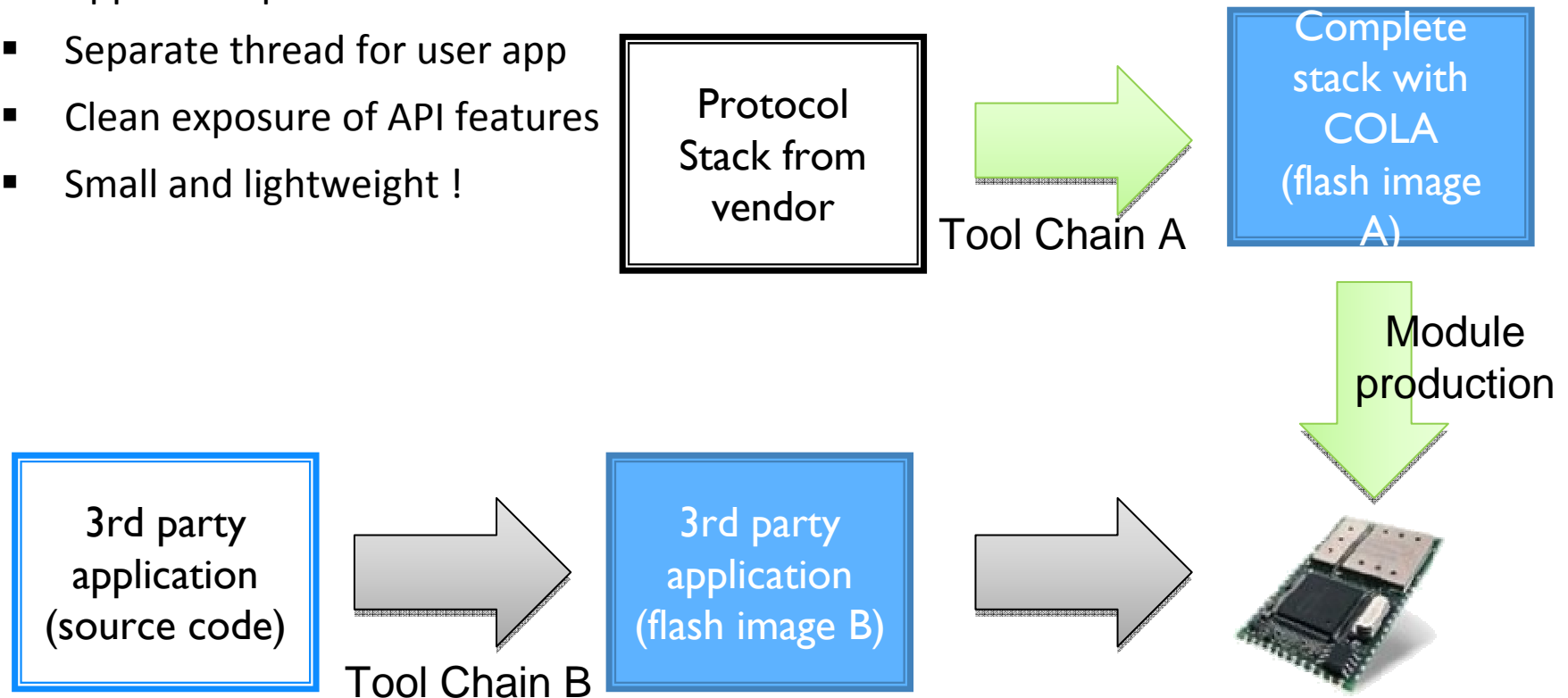
THE EMBEDDED DEVELOPMENT TREND



STAND-ALONE SOLUTIONS

INTRODUCING COLA

- Mechanism to execute user code as separate flash image
- App developer can use free GNU tool chain !
- Separate thread for user app
- Clean exposure of API features
- Small and lightweight !



CONCLUSION

UNIFIED API ACROSS ALL CAT-IQ PLATFORMS

- A unified API has many benefits
 - Easy to move down the BOM “ladder” as host SW remain unchanged
 - App developers can work on several platforms
 - Operators can choose from several dongle vendors
 - Device driver porting across all open source platforms

RTX will continue to ensure unified API across all platforms, as well as strive to maintain backwards compatibility when introducing new CAT-iq and ULE features

RTX TELECOM A/S



THANK YOU...

CONTACT INFORMATION:

Phone: +45 96 32 23 00
www.rtx.dk

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