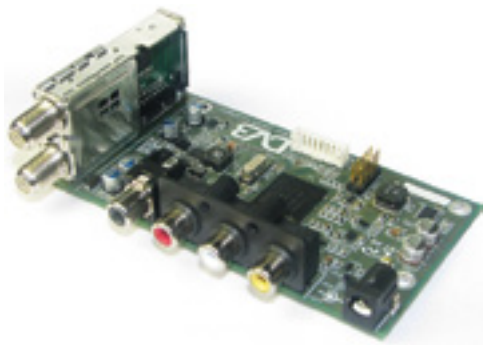*System integration services for a successful product build and placement in consumer electronics and multimedia - for manufacturers, telecom operators, and broadcasters*

DTV System integration

From a platform selection, through platform depended SDK of mayor OTT services, middleware (DVB, ATSC) featuring: DLNA, HbbTV, MHEG, PVR, CI Plus, to HTML and Java application level, RT-RK **offers complete development, customization, and integration services** for connected, content protected, broadcast and broadband digital receivers and gateways on Linux and Android. On the **OS** level we provide kernel adaptations/extensions, porting and integrations of 3rd party devices/drivers as well as real time optimizations. Customization of **Chipset SDK** includes porting of peripherals, porting and integration of 3rd party software components, SDK adaptations to support product specific requirements (second screen, IPTV protocol stacks, etc.), and Media playback improvements (different codec and containers support, synchronization).

support product specific requirements (country specific specifications, broadcast signaling, etc.). On the **Application** level we provide customization of DTV applications in: HTML4/HTML5/CE-HTML, Java UI framework, Maestro UI toolkit, Tara's Embedded Wizard and OSD Builder, and SVG. We also provide services of connection with head-end: configuration, firmware upgrade, and parameter monitoring; precertification, and testing.

SoC	Mstar / NEOTION SMART DTV	BROADCOM / QUALCOMM	ST / MARVELL
RTOS	OS21	eCos / Android	Linux
TEHNOLOGIES	DVB / HbbTV	ATSC / dlna Wireless	CI+ / ip:tv
CAS/DRM	verimatrix / irdeto	NAGRA KUDELSKI GROUP / conax	DRECRYPT / NDS

Middleware encounters: DTV middleware porting on various chipsets/platforms, Native integration of TV middleware in Android operating system, DTV middleware upgrade to be compliant with the latest specifications (ATSC, DVB), porting and integration of 3rd party software components (CI Plus, MHEG-5, DLNA, HbbTV, OTT services, etc.), and TV middleware adaptations to

For the major Swiss telecommunication provider Swisscom, RT-RK performed a system integration on a Marvell platform with iWedia software for a STB on Android.

Product Development

RT-RK specializes in developing **high volume digital consumer products**. We create fully custom products and offer a complete service pack, from concept proofing to after sales support. Our technical skills and successful track record of launching new products guarantee that we can respond to your needs and deliver your vision.

Our customized products include **Set-Top Boxes, digital TV sets, home automation and control systems**, **A/V devices**, and other **embedded electronic devices** based on **SoC/DSP/FPGA expertise**. We are experts both in application/top level and real time software.

RT-RK develops its resources to support all stages of product lifecycle, and tries to act as service integration point, to accumulate knowledge necessary to turn our clients' specific requirements into a project with a fast, efficient route to market. We design products to be industrially manufactured and therefore attach considerable significance to testing and verification, and develop product prototypes and small scale production series with zero functional defects.

Your product design will be supplied with a **complete electronic documentation**, **prototypes**, **bill of materials and elaborated purchasing chain, test reports and testing environment including verifying tests, measurement equipment and custom made hardware and software.** Our project document flow is transparent to the customer at all times.

SMALL SCALE PRODUCTION SERVICES

Within RT-RK they aim to **support prototyping activities and production of special purpose equipment**. It is a universal link in the chain of research and development services, design and in

dustrialization, but it also covers special requests from fragmented markets, such as digital TV.

We offer industrial production practice from early prototype stage all the way to market ready product.

RT-RK is experienced in component purchasing, assembly and bring-up of both unique single devices made by hand, and small series assembled in semi-automatic and automatic processes, all in accordance with IPC procedures.
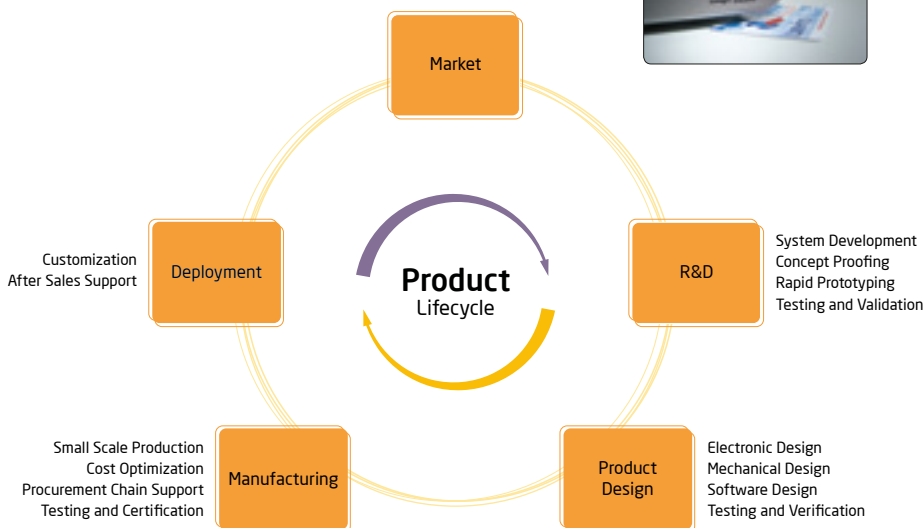
TESTING AND VERIFICATION

RT-RK offers **Zero Functional Defect Program** to our customers. Even for prototyping and small production series manual, semi-automatic and automatic test and verification environments are established, including **documented test plans, measurement equipment, and custom made hardware and software**.

These include:

- Full functional verification
- Long run and stress tests
- Extended temperature range measurements
- Random vibration and shock tests
- Reliability tests
- EMI/EMC measurements
- Environmental Stress Screening test and other

GENERAL SATELLITE

For Russian General Satellite RT-RK developed a STB on a Neotion platform with iWedia software. Product roll out included the entire chain - from development of hardware and software customization, to testing and verification of mass production in GS production facilities.

Product Lifecycle

- Market
- R&D — System Development, Concept Proofing, Rapid Prototyping, Testing and Validation
- Product Design — Electronic Design, Mechanical Design, Software Design, Testing and Verification
- Manufacturing — Small Scale Production, Cost Optimization, Procurement Chain Support, Testing and Certification
- Deployment — Customization, After Sales Support

Embedded software

COMPILERS AND TOOLS

RT-RK has a dedicated group of compiler engineers with a proven experience in this domain. The team can offer complete compiler from scratch development, based either on the RT-RK's proprietary compiler solution or customization of the existing open source alternatives such as **GCC** or **LLVM**.

The team has been contributing some of the work to open source community, thus a few references are already available in the official repositories of the aforementioned compilers. Significant RT-RK contributions (complete ports, backend work, assembler, JIT, other) can be seen in the rapidly growing community of LLVM. This compiler knowledge has been leveraged in different fields to debug and improve other technologies such as **Renderscript** (LLVM/Android) and **Native Client** (LLVM/Chrome), to name a few. The team has skills to cover complete toolchain development or improvements, which includes also support for assemblers, linkers, debuggers, required libraries, emulators as well as integration with different IDEs. On Windows, Linux, and Cygwin platforms we offer: **Eclipse** based, **GCC** customization, with a complete toolchain development (Compiler, Linker, IDE).

We are specialized in u-boot, flashing, and terminal boot tool customization, and experienced in **JTAG debugger scripting and customization** (Lauterbach, EPI MAJIC, Green Hills).

VIRTUAL MACHINES AND JIT COMPILERS

Apart from LLVM, the company has a history of contributions to different virtual machines and binary translators. The competence range goes from Java **Dalvik Virtual Machine** to **JavaScript engines**. RT-RK has been engaged in development of **V8** since its early start (pre-Crankshaft era) up to today, with regular contributions to the official trunk. The team also works on other JavaScript compilers such as **IonMonkey** in Firefox, so the company can offer full support to customers who want to optimize or use different JIT compilers in their systems.

BROWSERS

The key application on majority of the platforms is a web browser. With the complexity of Internet and new standards, internals of browsers have become the most important code sections in a system. Thus, RT-RK has spent time and effort to get experience with different browsers on Linux (**Chromium, QtTestBrowser**) and Android (**Chromium, ContentShell, built-in browser**), among others.

OPERATING SYSTEMS AND SYSTEM SOFTWARE DEVELOPMENT

RT-RK has been fast to get hands-on knowledge on number of operating systems for embedded devices. Some of our effort has been tracked in news, such as the early port of **Android** for BigEndian MIPS systems in 2010. Since that milestone, RT-RK has been a close follower and contributor to **AOSP**. The company was a big supporter of the new platform, but kept up-to-date with other proven embedded systems, mostly **Linux** based.

Today, one of the services we provide to customers is a full image of Linux based distribution customized for the architecture and hardware of choice. Android platform and Debian distributions are two common choices of our customers.

We offer system software concept, architecture and development for different embedded platforms: **MIPS, ARM, Texas Instruments, Intel,** and **ST MicroElectronics**, and development of **proprietary OS for embedded systems**. On Linux kernel we provide: porting/adaptation/support, kernel software development (drivers, devices), and real time adaptations/extensions. On RTOS we offer services of: customization of 3rd party solutions (Nucleus, ThreadX), proprietary RTOS kernel solution, and real-time software design and development. We are also specialized in **legacy file systems** (FAT, JFFS, CRAM), and proprietary dedicated solutions (StreamingFS, FlashFS, JournalFS).

DSP

RT-RK has abundant expertise in digital signal processing and more than 15 years of hands-on experience with designs that comprehend a full development cycle of DSP based systems.

ALGORITHM DEVELOPMENT

RT-RK is specialized in development of complete algorithms according to customer requirements, modification of existing algorithms (improvement, real time restrictions, platform requirements), and algorithm evaluation (performance evaluation, feasibility study – estimation of needed resources, platform/architecture proposal).

ALGORITHM PORTING

However powerful and brilliant DSP algorithm is at the end of the day it should not on run on the last generation PC yet on a fancy device limited in resources (memory, CPU capabilities and also with limited battery life). RT-RK provides a full port of in-house developed and customer provided algorithms on a range of embedded systems (DSP, CPU, FPGA) from various manufactures (TI, Intel, MIPS, ARM, Cirrus Logic).

OPTIMIZATION

It is often the case that customer has application properly working on a target environment but with inadequate performance. In these cases RT-RK specialists perform algorithm analysis, evaluate performance of the target SW/HW system, perform algorithm modification, code size and speed optimization in assembler and/or HLL language.

VERIFICATION AND CERTIFICATION

Simplification of certification procedure tends to decrease inevitable human errors and to speed up the certifica tion process.

RT-RK offers the following services:
• Fully automatized pre-certification testing for 3rd party audio solutions
• Certification package, error-less installation of a complete testing environment for a certification house site: SDK, firmware, test cases, testing tools, board configuration, measuring devices and the like
• Support during certification process

TOOLS DEVELOPMENT

In the past years we have created a complete tool chain for the several DSP platforms: assemblers, macro-assemblers and high-level assemblers, dynamic and static linkers, generic C compiler, high-speed instruction level compiled simulators, and Integrated Development Environment (IDE) based on the Eclipse framework.

BUILDING OF COMPLETE DSP SYSTEMS

In complete DSP solutions we provide:
• HW design and prototyping (choice of an appropriate DSP architecture, design of a real time system based on the selected DSP architecture, prototyping of the DSP system
• SW design and implementation (algorithm development, porting, optimization)
• Verification (verification of the requirements, verification of the algorithm implementation, verification of the final DSP system)

For the American manufacturer of multimedia equipment RED, RT-RK ported HD AAC multichannel decoder on Texas Instuments and Cirrus Logic platforms. The project included development of an accompanying automatic test environment.