

# MICROWARE® OS-9 RTOS

for ARM based systems

**Deterministic - Efficient - Scalable - Fast Booting**

Embedded systems span a myriad of applications, ranging from simple microcontrollers to sophisticated medical imaging systems to complex industrial applications. At the heart of these diverse applications is an operating system (OS) - a software foundation that delivers a common set of services helping software developers deliver their product to market more quickly.

Enter Microware OS-9, the high-performance, high-availability real-time operating system platform from MicroSys. The Microware OS-9 RTOS has been deployed and proven in thousands of products worldwide and represented hundreds of embedded applications, including industrial automation and control and automotive and medical instrumentation.

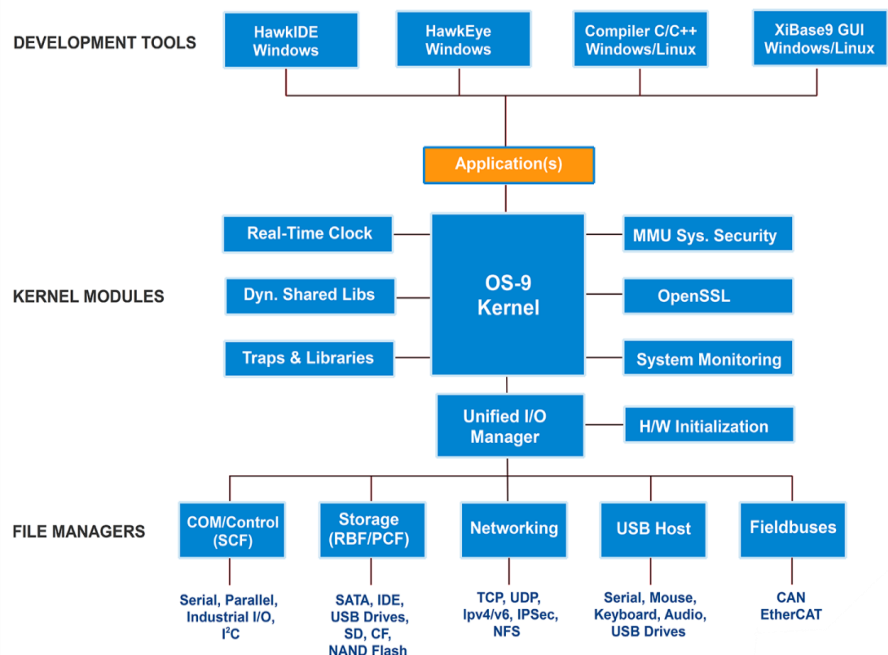
## WHY MICROWARE OS-9

Microware OS-9 compact, high-performance multi-user, multi-tasking real-time kernel is a proven foundation for time-to-revenue success. OS-9 is a full-featured operating system framework, including the OS kernel, kernel services, and industry-standard APIs, middleware, and a complete IDE-based development framework.

## REDUCE RISK

- High reliability - the OS-9 secure process model, real-time operating system (RTOS) provides inherent memory management, resource authorization, and module CRCs, dramatically improving system reliability.
- High performance - OS-9 makes effective use of the CPU by providing integrated I/O and compiler technology tuned for the specific processor instruction sets.

- High availability - OS-9 has the ability to add, remove, and replace individual components in the system while on-line and in-use. This results in a high degree of system availability, even during maintenance. Proven over 30 years in mission critical devices around the world.



- Hard Real-Time Performance - Unlike Windows and Linux-based systems, Microware OS-9 was conceived from the ground up to meet the high-performance and reliability requirements of time-critical embedded applications.

## FAST BOOTING

- Small footprint by modular architecture
- It fits services to application requirement
- No file systems needed

**Offers an 'instant on' experience from reset to a running user interface.**

## PRODUCT OVERVIEW

Microware OS-9® for ARM is a complete solution for real-time applications using ARM architecture based development hardware. MicroSys provides the embedded, real time operating system (RTOS), drivers, development board level solutions, development tools, and middleware, making application development easier and reducing time to market.

### Supported ARM Architectures

Family	Architecture	Core/Chip
ARM6	ARMv3	ARM6xx
ARM7	ARMv3	ARM70, ARM710, ARM7100
ARM7TDMI	ARMv4T	ARM7TDMI, ARM710T, ARM 720T
StrongARM	ARMv4	SA-110, SA-1110
ARM9E	ARMv5TE	ARM926EJ-S, AT91SAM9261, AT91SAM9G45, i.MX257, i.MX233
XScale	ARMv5TE	PXA255, PXA26x, PXA270, IXC100, IXP425, IXP2800
ARM11	ARMv6, ARMv6T2, ARMv6KZ, ARMv6K	ARM1136J(F)-S, ARM1156T2(F)-S, ARM1176JZ(F)-S, ARM11 MPCore
Cortex A5	ARMv7-A	SAMA5D36, SAMA5D3x
Cortex A7	ARMv7-A	A20, Layerscape LS1021A
Cortex A8	ARMv7-A	i.MX53, AM3358, S5PV210, A10, A13
Cortex A9	ARMv7-A	i.MX6Q, R8A7740, Altera HPS, ZYBO Z-7010, Cyclone V, Zynq-7000

### OS-9 FOR EMBEDDED SYSTEMS

OS-9 for ARM is a licensed product that includes the development environment tools, fast and compact run-time binary software, and driver sources for custom ARM and ARM Cortex A hardware platform development.

### OS-9 BOARD LEVEL SOLUTIONS

The Microware OS-9 Board Level Solutions (BLS) is a complete software foundation to create, debug and deploy embedded applications on ARM based single board computers. The software framework allows developers to boot OS-9 on the target board and start the creation of differentiated applications from day one. The integrated software development suite spans the embedded workflow and includes a highly optimizing C/C++ compiler, a fully customizable development environment, an editor, graphical debugging tools, system profiler, project manager, and middleware libraries and solutions.

### CURRENTLY SUPPORTED HARDWARE PLATFORMS

- MicroSys miriac™ SBC6Q, i.MX6Q
- Atmark Techno Armadillo840, R8A7740

- Atmark Techno Armadillo440, i.MX257
- OLIMEX A20-OLinuXino
- ZYBO, Xilinx Zynq-7000
- Atmel AT91 SAMA5D3X-EK, SAMA5D3x
- WinSystems SBC35-c398Q, i.MX6Q

### BSPs with supported CPUs in work

- Freescale MCIMX53 i.MX53
- Freescale Layerscape LS1021A
- MicroSys miriac™ SBC53, i.MX53
- OLIMEX A10 & A13 (MICRO)
- OLIMEX iMX233-OLinuXino-MAXI, i.MX233
- Atmark Techno Armadillo840, R8A7740
- Beagle Bone Black, AM3358
- Raspberry Pi, BCM2835
- Atmel SAMA5D3-XPLD, SAMA5D36
- Cubieboard: Board (A10) Board 2 (A20) & Truck (A20)
- FriendlyARM MINI210, S5PV210
- FriendlyARM MINI6410, S3C6410
- Mpression Helio, Cyclone V

### OS-9 EVALUATION PACKAGE

Request your FREE evaluation copy of OS-9 for ARM by a note to [info@microsys.de](mailto:info@microsys.de). This is a full-featured OS-9 BLS complete with all development tools, device drivers, and network connectivity options. This allows you to experiment with the strengths and options of OS-9. Tools will time-out 60 days after installation.

Microware OS-9 for ARM is designed to complement the unique features of the processor by providing a complete software baseline with source code and binary objects for advanced wide or local area network, connectivity, graphics, multimedia I/O, and sophisticated power management. (*The ARM Thumb instruction set is not supported yet*).

The product provides a pre-integrated development environment with compiler technology tuned for the ARM and instruction sets. Microware OS-9 for ARM also provides native C/C++, HTML, and Java™ application environments, drastically reducing development time and effort and providing an immediate run-time foundation for third-party applications.

### INTEGRATED DEVELOPMENT ENVIRONMENT

The IDE (referred as HAWK) is designed to increase the efficiency of OS-9 development. The tightly integrated tool set simplifies and automates the tasks of creating, debugging,

analyzing, and managing complex real-time software projects.

The development environment includes the development environment includes the Borland® CodeWright® code editor, compiler, linker, object loader, application and system level debuggers, a system profiler and over 100 on-line technical manuals in a PDF format.

Additionally Eclipse (JUNO) incl. Eclipse project management and the Ultra C compiler are part of the IDE.

#### **HawkEye® OS-9 PROFILING**

HawkEye is a GUI-based visualization tool for the OS-9 operating system. It captures and analyzes logs of various system events, such as process forks and exits, context switches, system calls, and interrupts. It graphically displays processes interactions in an easy to understand format, which can save developers an enormous amount of time when debugging or optimizing an applications.

#### **OS-9 CONFIGURATION WIZARD**

The OS-9 Configuration Wizard provides a GUI based configuration manger that simplifies configuration and the building of system images. Simply point and click for networking, TCP/IP configuration, graphics, and debugging. The wizard automatically creates a software image for your target system.

#### **SoftStax® INTEGRATED COMMUNICATIONS FRAMEWORK**

OS-9 contains a pre-integrated driver based communications framework called SoftStax® that enables individual protocols and networks to be "snapped-in-and-out" without disturbing application software. Driver-based architectures increase network throughput by up to 30% over task based architectures. In addition, the SoftStax framework allows applications to utilize several protocol stacks during a single communications sessions, and switch protocols depending on the network requirements. The product includes a modular, dual IPv6/IPv4 network stack based on NetBSD, with a sockets-based API and TCP/UDP/IP functionality.

SoftStax supports the checksum off load capability provided by several Ethernet controllers.

#### **OpenSSL - SECURE COMMUNICATION**

Support of secure sockets layer & transport layer security, offers additionally a general purpose cryptographic library.

#### **OpenSSH - OPEN BSD SECURE SHELL**

Allows encrypted network communication sessions based on the SSH protocol.

#### **XiBase9 - THE PERFECT FIT EMBEDDED GRAPHIC SYSTEM**

XiBase9 is a complete embedded graphic system and allows the design of innovative human interfaces and interactive display systems for embedded applications. It is based on an object oriented graphic server, with the focus on fast program execution and low demand on system resources.

So it fits perfectly the graphic system requirement of highly integrated and cost effective embedded system designs, supporting all common CPU families.

For more than 20 years XBase9 and OS-9 have a proven deployment track record in numerous automation applications globally.

It can be selected from a rich library of available graphical objects, which has grown for years. The access to this huge basis of objects offers a developer, just by a few simple modifications, the fast generation of new graphic concepts or prototype system designs.

The XiBase9 server communicates via a defined interface with the applications and the system platform (operating system and if available the graphic subsystem). This guarantees portability and platform independence.

Changes of the graphic elements do not require application code changes. This improves programming efficiency; offers clear code structures and results in easier to maintain projects and systems.

XiBase9 is very well suited for embedded real time systems with a high demand on graphics quality, reliability, small footprint and resource demand. Common windows like or individual graphical user interfaces can be easily generated by the support of the included development tools.

## **CUSTOMIZABLE EXCEPTION HANDLING FRAMEWORK**

The OS-9 exception handling mechanism isolates, contains, and cleans up after offending software.

Developers can also customize exception handling to more extensively log, report, or perform automated recovery of individual exception conditions as desired.

In today's increasingly complex communications environment, this capability is central to maintaining 99.999% availability.

### **SNMP for OS-9**

Net-SNMP 5.4.2.1 is supported currently

### **USB HOST SDK FOR OS-9**

USB Host SDK for OS-9 provides a USB turnkey solution for embedded applications. With this complete library of USB APIs, OS-9 applications do not require additional development to understand the complexity of communication for a USB device.

### **SERIAL/PARALLEL I/O**

The Sequential Character File Manager (SCF) I/O subsystem handles basic character oriented I/O devices, such as serial ports, parallel ports, and modems. It also functions as the input path for a variety of devices such as keypads, mice, and touchscreens.

### **STORAGE I/O**

The Random Block File Manager (RBF) I/O subsystem implements a hierarchical UNIX-like file system for data storage, including a RAM disk device driver for devices that require temporary storage during operation. OS-9 also provides a PC file system (PCF) for PC compatibility. Supported are FAT16/FAT32 file systems.

As NAND Flash file system the YAFFS2 is implemented under OS-9. It is a long structured file system, which is robust and holds data integrity as a main design purpose.

### **PCI I/O**

The product supports a variety of popular PCI devices such as modems, ATA Flash and hard disks, 16550 compatible serial devices and Ethernet connectivity devices.

## **PRODUCT CONTENT**

Microware OS-9 for ARM Architecture contains the following software integrated on a single ISO Image:

- OS-9 RTOS
- SoftStax communications framework
- Modular, dual IPv6/IPv4 network stack, based on NetBSD v4.0
- API with TCP/UDP/IP functionality
- Ethernet and PPP Client support
- Sample device drivers (OEM Product Distribution only) and application source code
- Finished ported boot image for reference platform(s)
- Device driver binaries
- MAUI Multimedia I/O System
- OS-9 Configuration Wizard
- Microware Hawk IDE for OS-9 including
- Borland Codewright code editor
- Source code browser
- Project manager
- Power Management for ARM Architecture power modes
- Ultra C/C++ Compiler
- System and user state debugger
- System Profiler
- Resident tool set
- Product and technical manuals (PDF Format)
- TECH-CHECK Diagnostic Program

### **ADD ONS**

Password protected add-on products on CD include or FTP download:

- SNMP for OS-9
- HawkEye profiling and analysing tool
- USB Host Software Development Kit
- CAN Software Development Kit
- Journaling File System (YAFFS)

## **SYSTEM REQUIREMENTS**

### **Host Development System**

- Microsoft® Windows XP, Windows 7, Windows 8.1 (in Windows 7 mode)
- Intel x86 Architecture or compatible
- about 350 MB Free Disk Space
- CD-ROM Drive



#### **Target System RAM/ROM (minimum data)**

- Base OS-9 Configuration (Baseline) 512K/512K
- Baseline OS-9 with TCP/IP connectivity 2MB/2MB
- Networked OS-9 with Graphics 2MB/2MB

#### **HARDWARE SUPPORT**

##### **Networking**

- common 10/100/1000 Mbit Ethernet controller
- CRC Checksum Offload for supporting Ethernet controller

##### **LCD and VGA Support**

- Typical display devices for embedded solutions, with or without touch functionality are supported.

##### **User Input Device Support**

- keyboard & mouse
- serial and USB devices

##### **Mass Storage**

- NAND Flash controller
- SD & µSD Cards
- ATA and SATA drives
- USB memory devices

#### **FIELDBUS SUPPORT**

##### **EtherCAT MASTER FOR OS-9**

The EtherCAT Master Stack for OS-9 is based on the Beckhoff Master Sample Code and optimized to meet the requirements of hard real-time operation under the RTOS OS-9 in automation applications. The real time communication protocol according the IEC61158 standard is supported.

The master stack is available as optional product.

##### **CANbus SDK FOR OS-9**

The OS-9 CANbus Development Kit has been designed to abstract the CAN bus hardware from the software. The application needs to open a path to the desired CAN device for read or write.

Data encapsulation and data decapsulation is done by the stack and CAN hardware drivers. Packet queueing (receive and transmit) is handled by the stacked protocol file manager (SPF). It reduces the application effort for handling. CAN devices to a minimum of open, read, write, and close calls by still having the freedom to access all necessary data.

The CANBus SDK for OS-9 is available as an optional product.

##### **OTHERS FIELDBUS SOLUTIONS**

Profibus, Profinet, Modbus or others can be provided on request.

#### **DESCRIPTION**

Microware OS-9 for ARM Version 6.0

#### **PROCESSOR ARCHITECTURES UNDER OS-9**

OS-9 supports most popular 32-bit and 64-bit (in 32-bit mode) processors, including the QorIQ Layerscape (ARM) & Power Architecture PowerPCs, ARM CPUs, Intel x86 Architecture, SuperH (SH-3, SH-4, SH-4a), the 68K family and Coldfire.

#### **MULTI CORE SUPPORT**

On multi core CPUs OS-9 operates in the AMP mode (Asynchronous Multiprocessing). Hereby one instance of OS-9 is running per CPU core. Key functions of typical reliable and high performing real time applications are supported on dedicated CPU resources.

For example, a reliable interrupt driven real time process relies on one CPU core without any interference by other system activities. Another core might support networking or high speed fieldbus (e.g. EtherCAT or CAN) traffic improving substantially the overall performance and capabilities on a very small system footprint.

## **MICROWARE OS-9, A SUCCESS STORY FOR MORE THAN 30 YEARS!**

### **BACKGROUND**

A hard real-time system is one that must meet definite deadlines – it absolutely, positively, has to be ready on time. Examples are antilock brakes, elevators in a high-rise, disk drive controllers, industrial robotics or motion-control equipment, and even network infrastructure – all systems where a slight delay or miscue means failure. Being late is not okay, and “same day service” doesn’t come close.

With more than 30 years of actual use behind it, OS-9 has proven itself in countless hard real-time systems. Systems running OS-9 can respond in under a microsecond – barely a few cycles for most microprocessors. Its task management and priority-based scheduling mean that it’s always ahead of the game, swapping software tasks in and out as required.

### **MAIN KEYS TO SUCCESS**

#### **Resource-Efficient by Design and Ease of Use**

OS-9 delivers excellent performance in even the most constrained environments by its structured and modular architecture.

OS-9 is small and manageable. Applications are written as self-contained modules and not linked in as part of a single monolithic code base with the kernel. OS-9 includes a full interactive shell and many system utilities to directly monitor things like processes, memory usage, devices, system events, interrupts and more, all with built-in help.

#### **Scalable Modular Architecture**

The OS-9 modular architecture enables dynamic configuration changes and enhancements in order to meet changing system requirements without rebooting. OS-9 applications are written as self-contained modules and are not linked in as a single monolithic code base with the kernel. Virtually any OS-9 component may be added, removed, or

updated either at system startup or while the system is running. This means features and new functionality can be added easily, in real-time, and even after deployment to the field.

#### **Reliability, Safety and Security**

OS-9 was designed with reliability, safety and security in mind. Unlike monolithic architectures, the OS-9 advanced modular architecture offers an enhanced level of security, making it a preferred foundation for today's networked environment.

#### **Extensive Services and Middleware**

The OS-9 extensive I/O architecture supports a wide range of devices and networking options. The broad range of services, file managers and device drivers available from a single supplier speeds integration and application development, leaving customers with more time to innovate and differentiate their product.

### **WHO IS STANDING BEHIND OS-9?**

Since February 2013 Microware OS-9 is owned by a partnership of three companies, Freestation (Japan), MicroSys (Europe) and RTSI (USA).

Microware LP actively continues development on OS-9. Recent developments already provide support for ARM Cortex A8 and A9 cores with Freescale’s latest i.MX5x and i.MX6 CPUs.

Microware OS-9 is available through:

- [Freestation](#) in Asia
- [MicroSys](#) in Europe
- [RTSI](#) in the United States