



Open AT® OS

The standard C wireless operating system

The Open AT® Operating System is the heart of the Wavecom family of wireless solutions. It is the brain that *thinks, acts, does* and makes Wavecom products more than simple bit-pipe modems - they are highly sophisticated and powerful computing platforms. What this RTOS does differently is that it not only provides you with core embedded real time programming capability, as you would expect from any embedded processor operating system, but it adds to this, the capability to connect to globally standardized cellular wireless networks. Built-in connectivity to the Internet, without wires, means that your application can now fly.

REAL TIME OPERATING SYSTEM

As the Open AT® Real Time OS natively supports the wireless functionality, it provides guaranteed response time to external and hardware timer interruptions - not only when the GSM stack is off, but whatever state the Wireless CPU® is in (IDLE, Voice Call, GPRS transfer...).

MULTITASKING PREEMPTIVE OS

The Open AT® OS is a pre-emptive multi-task RTOS. It uses semaphores to synchronize tasks, and allows customer tasks to have higher priority than non-critical GSM stack tasks.

PURPOSE BUILT ON C

Open AT® Software suite is the only software platform created specifically to meet the demanding requirements of the M2M industry and has evolved to efficiently serve Automotive and Mobile Professional segment needs too. Open AT® Applications are written in standard C and run natively on top of a real time OS, with a minimum memory footprint and processor resource overhead.

COMPREHENSIVE

Open AT® Software Suite consists of Open AT® OS, Open AT® IDE, Open AT® Plug-Ins and Open AT® Firmware.

BE PART OF THE FAST GROWING OPEN AT® DEVELOPER COMMUNITY

By exchanging application software and experience on the Wavecom Developers Forum (www.wavecom.com/forum), you not only benefit from Wavecom's knowledge, but can also leverage your peers' experience.



wavecom[®]
Make it wireless



Open AT[®] Operating System

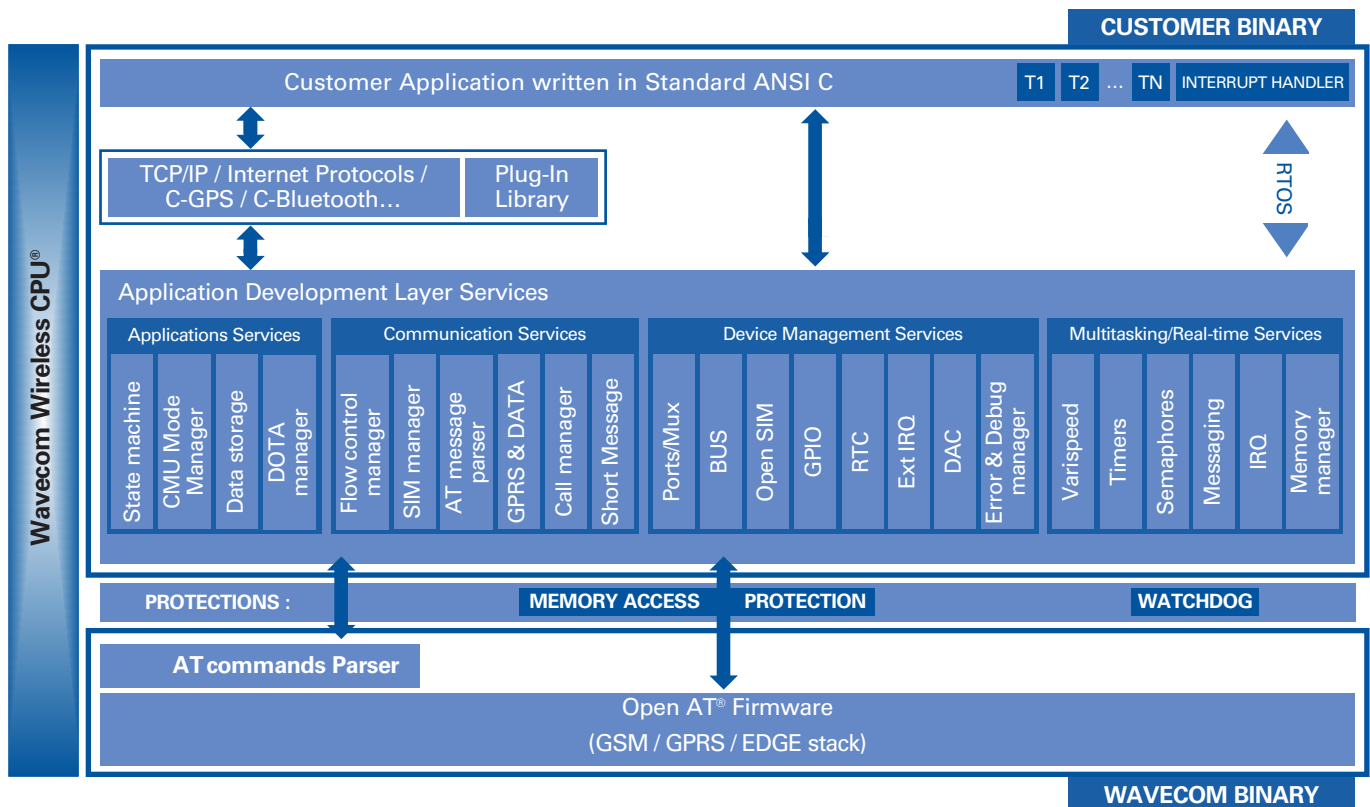
If you take a look at the software embedded in Wavecom's Wireless CPU[®], you will find that two different binaries are embedded and smoothly executed at the same time – each one being protected from the other by the Memory Access Protection feature of Wavecom Open AT[®] OS.

The first binary, called the firmware, provides the wireless functionality. It is Wavecom-owned property that has been fully developed and tested by us. This core is so stable that some customers have licenced it from Wavecom.

The second binary is your product-specific software and is based on Wavecom's application development layer that brings you an extensive set of high level APIs (Application Programming Interfaces). With it, you can develop and execute your own application in standard ANSI-C. These applications use core features of Wavecom's Open AT[®] OS such as Real Time Operations and seamless access to all hardware resources such as buses, GPIOs or General Purpose Input Outputs, memory, power saving modes, interruptions and hardware timers.

Wavecom uniquely guarantees that whatever GSM state the Wireless CPU[®] is in, it takes no longer than one millisecond to start code execution related to external interruption or hardware-timer interruption.

Finally, with the Open AT[®] Real Time OS, you can benefit from Wavecom's Open AT[®] Plug-Ins provided in the Software Development Kit as Open AT[®] Libraries. These Open AT[®] Plug-Ins are for you an opportunity to use and integrate field proven, advanced features such as IP networking in your code, without having to develop them.



UNIQUE REAL TIME CAPABILITIES

1 ms response time to interruption (External or HW timer) is guaranteed, whatever GSM state the Wireless CPU[®] is in: IDLE mode, voice call, Data GSM, GPRS and EDGE transfer, Network Synchronisation phase...

OPEN AT[®] PLUG-IN LIBRARY

Pre-packaged libraries such as TCP/IP, Internet Protocol (FTP, SMTP, POP3, HTTP...), C-GPS and C-Bluetooth Plug-Ins may be used to increase the set of services provided by the Open AT[®] OS. Many more Plug-Ins will be added in 2007 and 2008.

APPLICATION DEVELOPMENT LAYER LIBRARY

This library provides a set of high level APIs for easy application development. It gives access to all the hardware resources: Buses, GPIOs, Interruptions, Low power modes, Memory (RAM and Flash), Real Time Clock...

OPEN AT[®] FIRMWARE

The firmware has been fully developed and tested by Wavecom, and seamlessly provides the wireless functionality. It is Wavecom's own property, built on the company's experience in wireless technologies since 1993.



Embedded Software Architecture

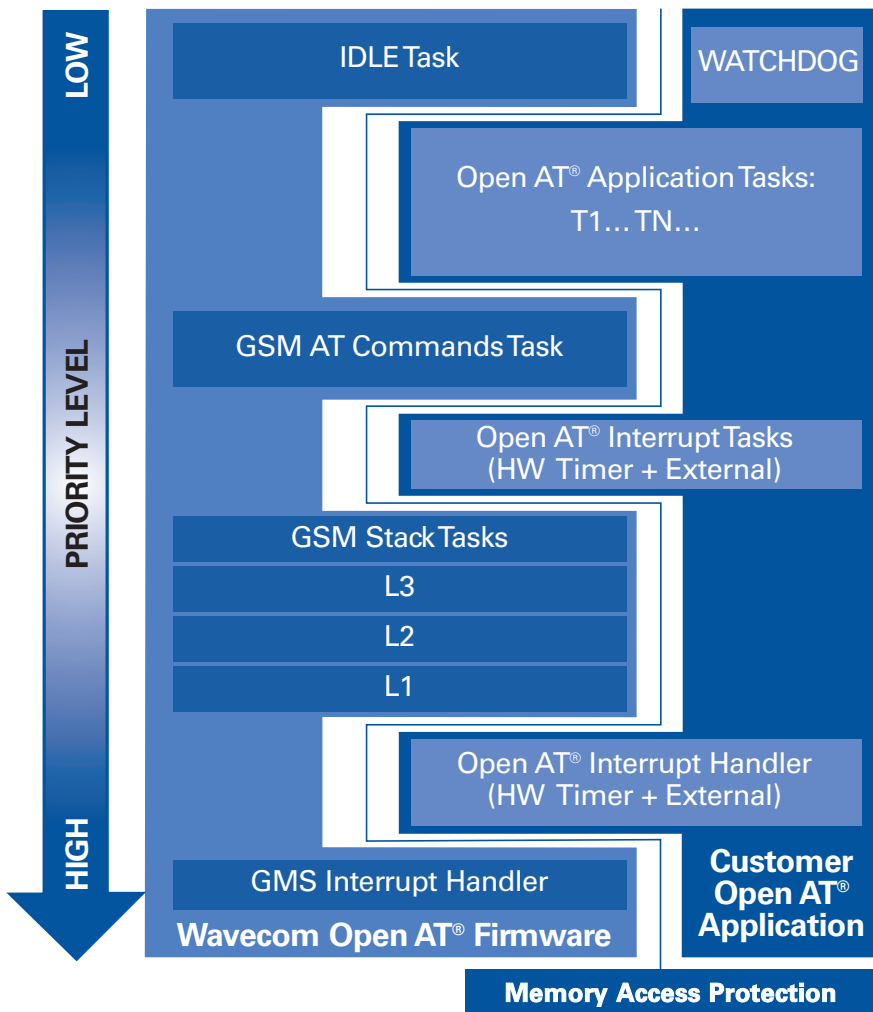
As you may imagine, guaranteeing real time capabilities to any hosted application while simultaneously certifying that any wireless operation will be conducted successfully is not an easy task.

It not only requires complete know how of the GSM protocols, but also full ownership of the code as well as full control over the Wireless CPU® on which this miracle would happen. This is why today the Wireless Real Time Operations of the Open AT® OS are unequalled on the market.

For the Open AT® developer, however, this high complexity does not appear. The Open AT® OS features the same mechanism as any other RTOS to manage time critical and non time-critical processes.

This is a multi tasking environment providing commonly available services such as mail box, messages, semaphores and an Interruption Handler, allowing the processing of time critical operations.

To ensure fixed and guaranteed response time to external interruption or hardware timer interruption, whatever GSM state the Wireless CPU® is in, Wavcom has defined the following software architecture:



OPEN AT® APPLICATION TASKS:

This is the core of the customer application. It is designed to execute high level processes that are not time critical.

OPEN AT® INTERRUPT TASK:

This Interrupt task has been designed to perform "long" or resource demanding operations such as complex calculations or value acquisition report creation and storage in Flash Memory. These operations would to be performed asynchronously and would not be time critical.

OPEN AT® INTERRUPT HANDLER:

This Interrupt handler is the second highest priority process on the platform. It is designed to perform asynchronous time critical operations. Its code will start being executed within less than 1 millisecond upon interruption (HW timer or external) detection. It is designed to perform very short operations such as value acquisition and storage in RAM (for instance in a circular buffer).

OPEN AT® WATCHDOG:

To ensure that the code is properly executed on Wavcom's Wireless CPU®, Wavcom provides watchdogs to independently monitor any application executed on a Wavcom Wireless CPU®.

OPEN AT® PRE-EMPTIVE OS FEATURES

Open AT® OS	Execute embedded applications, making use of up to 70 MIPS even during GPRS full speed transfer
RTOS	Benefit from guaranteed response time to interruption (hardware and timer), whatever GSM state the Wireless CPU® is in
Multitasking	Define as many tasks as necessary for your program
Access to Hardware Timer	Benefit from the possibility to use one Hardware Timer and to place 4 comparable values
Memory Access Protection	Use the Memory Protection Unit of the Wireless CPU® to prevent rogue memory access
VariSpeed	Control the clock speed of the Wireless CPU® from 26 MHz to 104 MHz to dynamically (on-the-fly) tune the available processing power to the needs of your program (no reset needed)
VariPower	Further tune the performance with a set of low current consumption modes, even disabling the network connection to reach as low as 16µA
DOTA Type III	Download only the parts that have changed of either your Open AT® Application, or the entire Wavecom Open AT® Software
APIs	450 APIs, 320 AT Commands and ability to create customs
Custom Commands	Develop custom AT commands thanks to the programmable interface
Open SIM Access	Benefit from the ability to support interaction with multiple SIM cards for GSM reliability or operating expenses reduction
Cellular	Voice/Fax/SMS/CSD/GRPS/EDGE/CDMA1xRTT

RTOS EXAMPLE: SQUARE SIGNAL GENERATION ON A GPIO

Hardware timer set to 20ms and one comparable value set at 10ms Compared value expires: 10ms HardwareTimer expires at 20ms

Interruption generated by the HardwareTimer

Generated Signal on the GPIO:

Period: 20ms High State: 10ms

<1ms; inaccuracy

1 Code executed in the interruption handler

```

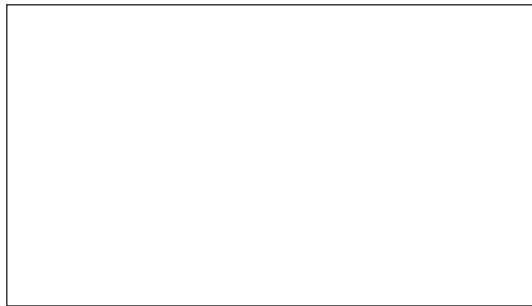
static bool MyIrqHandler ( adl_irqID_e Source, adl_irqNotificationLevel_e NotificationLevel, adl_irqEventData_t * Data )
{
    // low level execution context
    TRACE (( 2, "SCTU interruption handler (SourceMask: %2X)", ( ( adl_sctuInfo_t * ) Data->SourceData )->SourceMask ));

    // Check interruption source
    if ( ( ( adl_sctuInfo_t * ) Data->SourceData )->SourceMask & ADL_SCTU_IT_SRC_COMP_CHANNEL_0 )
    {
        // Comparator channel interruption: set output to 0
        adl_ioWriteSingle ( MyGpioHandle, signal_OutputIoInnerID, ADL_IO_LOW );
    }
    else
    {
        // Overflow interruption: set output to 1
        adl_ioWriteSingle ( MyGpioHandle, signal_OutputIoInnerID, ADL_IO_HIGH );
    }
    return FALSE;
}
    
```

2 Catching the interruption and detecting what generated it (Compared value or timer expired)

3 If the comparable value did then the GPIO level is set down to "0"

4 If the HW timer expired the signal is set to "1"



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