Allegro Software Development Corporation

The Leading Name in Premier Device Management
and
UPnP™ technology for Embedded Applications

Introduction/Summary

It's widely recognized that device networking is a vital new facet of electronic product design. The vision of the pervasive internet encompasses a world of remote access and device management, distributed intelligence, quick and simplified information sharing and network-based upgrade, repair and product maintenance services. As momentum builds towards this vision, the edge of the internet becomes increasingly by populated by devices rather than PCs. The world will see millions, if not billions of intelligent, connected devices. The pervasive Internet presents a new set of design and implementation challenges for electronic equipment vendors in that all of these networked devices will require some sort of configuration and remote management capability, especially if they have no local user control or display features. Beyond these basic features, there is a drive to reduce support requirements and know-how, where possible, through a measure of autonomous configuration and operation.

Since its first products were launched in 1996, Allegro has established itself as a respected industry name for delivery of device management technologies specifically targeted at embedded system implementations. As an active participant in the recent evolution of device management, Allegro has created a series of focused toolkits, consisting of management software technologies that are cost effective and proven in real network implementations. Across all of its products, Allegro toolkits directly address the challenges of extreme cost sensitivity and limited memory resources faced by embedded system development teams. From these solid technical and commercial foundations, Allegro is moving forward to address the newest and most complex challenges of UPnP implementation in the device world. As a contributor to the UPnP initiative and an influence for rational and pragmatic approaches within these new standards, Allegro's team brings a craftsman's eye to meeting the standards of UPnP implementation and interoperability. The company is underscoring this prowess with early design wins in the OEM products that are leading the market for networked media systems.

Device Management Challenge

Over the next 5-10 years, almost every device that has anything to do with information, control or measurement will be connected to the Internet by one method or another. The edge of the network, once the domain of desktop computers, will increasingly be populated by millions, if not billions of intelligent, connected devices. All these devices require some sort of configuration and remote management capability, especially if they have no user control or display features. As the challenge of device connectivity emerged, the embedded development community responded with a range of increasingly sophisticated approaches to meeting this requirement.

The first, and often the lowest level approach to solve this problem for a device has been to provide serial line connectors and communications support for a "dumb" terminal such as a DEC VT100 (or a terminal emulator application on a PC) to attach to the device. Low level commands text commands are used to enter and verify basic device parameters, such as address information, after which the device can join the network and be accessed by higher level application protocols. A variation of this approach uses Telnet protocols to connect a terminal emulation server within the device after basic network parameters are established. This approach minimizes development expense but is arcane for many users and does not support any kind of graphical interface.

A second approach was the development of a hosted management application to communicate to the device using a dedicated, often proprietary low level protocol. This can often provide very efficient management of any specific device with the strongest support for the user, since the vendor has complete control of both ends of the wire. However, the cost of development, quality assurance and ongoing maintenance for multiple host platforms is high and this approach provides no bridge to enable the collective management of devices supplied by a variety of vendors.

The third early approach to device management has been through implementations of the Simple Network Management Protocol (SNMP) as adopted to address the monitoring and control of workstation and router equipment in the IT domain. The SNMP approach can use industry standard Management Information Block (MIB) browsers and management applications to present information to users, but the information and display is highly technical in nature and not often suited for anyone who is not versed in IT network administration.

All of these techniques, individually or in combination, still have important applications today, but the advent of the World Wide Web and the universal availability of the common console application we know as a web browser, has eclipsed all other techniques for device management in popularity and sophistication. It is meeting these challenges that drives the technical creativity of the Allegro team and the commercial success of its products.

Web Technology for Device Management

Universal familiarity with the web browser interface and the implementation of simple, low profile device web server agents has meant a fundamental change in the expectations of management interfaces and the capability of device developers to meet those expectations. Now, device developers are using Web technology to offer excellent graphically oriented interfaces, offering greatly more accessible networked device setup and administration without requiring excessive implementation time or cost. By embedding Web servers into their products, these vendors have given their customers an intuitive, user-friendly way to manage their devices using open protocols. This approach has all the benefits of the older serial terminal approach for minimizing development costs, but provides a consistent graphical user interface, on any host platform, for an enhanced user experience.

Early simple embedded web servers were pressed to deliver on ever more complex requirements and a small, select industry emerged to deliver commercial, robust server components that could support true RFC compliance, security, dynamic data presentation and leverage a common parameter database in presenting Web, CLI and SNMP views of device operation. Allegro's RomPager product range has evolved to address all these more complex run-time demands and added offline tools to assist with data preparation and organization.

In its current form, the RomPager family offers a layered approach to embedded network management that substantially lowers implementation risk and costs for a wide range of device development challenges. The benefits of these robust, integrated toolkits have been applied across many vertical market areas including Automotive, Medical, Industrial, Datacom and Consumer Electronics.

Despite the considerable advances of the web based interface for network devices, there remain many hurdles to adding and using networked devices in the home environment. The gulf between the implementers of a networked product and its users, including the assumptions they make about the environment and terminology familiar to those users can still lead to poor instruction manuals, tricky installations and awkward user interfaces. At best these failings leave lay consumers less than satisfied with their purchase – at worst, fully functional products get returned to the store for replacement or refund. The adoption rate of the newest network capable home devices and the potential benefits they bring will be critically affected by their ease of installation and seamless interoperation with other network components – especially those from different manufacturers. Even tech savvy consumers will not be enthusiastic about devices that require extensive user management or interaction to get them to play nicely with other equipment.

The next level of management technology – launched as Universal Plug and Play and now simply UPnP™ - tries to make devices more autonomous in their operation, particularly when they are added or removed from the network, and to standardize the way that one device can interact with another over the network. The first fruits of these standardization efforts are now coming to market in the form of UPnP enabled home gateways and UPnP compliant Digital Media devices - which enable easy network access to music, images and video stored on a variety of home computer or server systems.

Leveraging the mature foundation technology of its web management products, Allegro has seized on this new opportunity and invested heavily in the integration of support for this new level of management component. Experience in cost effective web and XML technology was critical to making this connection but now, with a respected position in the industry organizations driving forward standardization, operational conventions and interoperability testing, Allegro has brought a new class of sophisticated embedded technology to market. The RomPlug toolkit family is already successfully deployed in many leading OEM products and is recognized as a “gold standard” by many of the leading development teams. Allegro’s commitment to further development and refinement is underscored by its regular participation in “plugfest” gatherings and contribution to the DLNA and other industry bodies. These new networked products represent complex device subsystems that will play a critical role in machine-to-machine transactions and web service revenue streams. Allegro is the leading provider of robust technology suites that have the level of precision engineering necessary to underpin these new business paradigms.

Allegro Value Proposition

Allegro Software Development Corporation has long been at the forefront of developments in device management technologies and techniques. Amongst the pioneers that recognized the power of a Web-based approach to device management, Allegro created the first embedded system specific web server toolkits, giving device manufacturers cost effective building blocks to implement web interfaces within their products.

Today, with Allegro's RomPager as the most widely used embedded Web server toolkit in the marketplace and a growing base of more sophisticated products for industrial, automotive and consumer customers, Allegro is the leading provider in embedded Web management and has developed the momentum to become the leading provider of UPnP and device management technologies for embedded applications.

Because cost effective solutions are necessary to support wide scale adoption of many new types of connected devices, Allegro realized that it is simply not realistic to re-purpose PC applications or even many open source applications that were originally implemented in a run-time environment that assumed the existence of large scale system resources or general purpose support subsystems. Allegro's software toolkits are precision engineered to meet the specific demands of device developers working on cost sensitive systems. The toolkits are highly portable and flexible enough to support rapid integration with the wide range of low profile networking stacks, run-time environments and low cost microprocessors that manufacturers are choosing for implementing these devices. Allegro's toolkits for UPnP implementation are fully compliant with current device specifications and include tools to aid development and compliance checking during integration.

Product Lineup

Allegro toolkits are robust, reliable and proven implementations of sophisticated embedded internet technology. They are engineered for easy integration and combine a rich feature set with rich compile time configuration flexibility, high performance and a low memory footprint.

Allegro responds to differing market needs by delivering toolkit technology in two forms:

- An "à-la-carte" technology menu approach of individual component toolkits, each supporting a specific function, but that are interrelated and interoperable, giving broad flexibility to the system developer in the choice of management features and functions that address the network management requirements of a specific design project. Allegro's RomPager, RomCLI and RomMailer are examples of toolkits families that address this point solution technology requirement, yet support module-to-module integration within an overall design.

- Integrated suites that provide sophisticated functionality in a self-contained form and that meet or exceed current industry interoperability requirements, notably those related to UPnP and DLNA. These more sophisticated toolkits are, of course, optimized assemblies of the more basic component technologies. The structured approach to the products guarantees that the more advanced capabilities are build on proven foundations of fundamental technology that has been maintained and optimized over many generations of designs.

Toolkit Packaging

All Allegro products are engineered as an integrated set of ANSI-C compliant source code that has been compiled for a wide variety of CISC and RISC CPU architectures, including IA32, PowerPC, ARM, SPARC and MIPS. The architecture was designed from the ground up to support devices with ROM-based real-time run-time environments, in contrast to much of the available public domain code, which was originally targeted at resource rich, disk-based Unix environments. Using a precision engineered suite of embedded system products provides a number of advantages to networked product development teams:

- The product will be ready for the marketplace sooner with less engineering risk than developing these capabilities from the ground up.
- Allegro products incorporate the results of compatibility testing with all versions of the major browsers to insure a solid, protocol-compliant implementation of Web interface functionality.
- Ongoing support for new browser revisions and the new versions of the evolving HTTP/HTML specifications is provided by Allegro as a part of the support for its product. As the development team moves from version to version within a product family, the development code base can be updated to reflect improvements in performance, functionality and compatibility with minimal re-integration risk.

Product Family

RomPlug: Sophisticated and fully integrated toolkits that enable rapid development of UPnP compliant embedded devices, including Internet gateways and Digital media players/servers/adaptors.

- Complete integrated suites to address discovery, device management and service implementation
- Proven compliance with UPnP specifications
- Proven interoperability with other UPnP-based devices and applications
- Includes offline compilation of UPnP Forum templates
- Compact and efficient

Allegro's range of UPnP toolkits address some of the most complex and comprehensive requirements of device and network self configuration in home and commercial networks. With support for core UPnP device and control protocols, and specific support for UPnP IGD and UPnP AV protocols, the RomPlug toolkits allow device vendors to add proven UPnP/DLNA support to meet these emerging requirements with a minimum of effort. The written standards in these markets are fresh and true industry wide interoperability requires a precise and pragmatic approach to implementation coupled with an active participation in the forums and events that drive the necessary refinements. Allegro's commitment to this process, thorough engineering methodology and solid technical foundations have made it a leading vendor with a solid set of OEM design wins. As a complement to its UPnP device toolkits, and an example of their maturity, Allegro has also released a fully compliant UPnP AV server product which runs in both PC and Mac environments. The Allegro Media Server (AMS), which is built on Allegro's embedded technology, seamlessly joins together the world of Apple iTunes music libraries on home computers with the new world of UPnP AV Digital Media Player products. These DMP products stream digital music into networked entertainment centers and portable music devices around the house.

RomPager: A family of embedded web server toolkits that has become the most widely used Web management software on the market today. The toolkits offer a combination of a rich feature set, high performance and low memory usage.

- Scalable offerings from basic to sophisticated
- Supports current HTTP and HTML standards
- Flexible security models
- Efficient internationalization support
- Offline compiler tool compacts and encodes page contents for minimum footprint
- Long track record of commercial success
- Robust and compact

Addressing the most fundamental embedded web server requirements through the most sophisticated, Allegro's range of RomPager toolkits provide finely tuned, commercial quality technology to support networked device management. The basic web server toolkit can be enhanced to add very flexible dynamic data formatting, SSL secured connections, Java-based real-time graphical display and proxy storage of selected content. Attention to detail is demonstrated by such features as the multi-lingual error and phrase library support, SNMP MIB integration and integrated interfaces to command line management tools. Also included is a comprehensive HTML compiler tool that compresses, tokenizes and optimizes a tree of web file content to support highly efficient memory layout for the run-time engine. And all of these capabilities are proven compliant to the relevant RFCs (including Microsoft and Mozilla extensions) and demonstrated to interoperate with the widest range of browser clients.

RomXML: A small memory footprint XML parser and framer that enables embedded devices to translate internal data structures to and from XML streams.

- Extends XML capability to constrained world of networked devices
- Includes an offline TagBuilder parser preparation tool
- Compact and efficient

The use of XML is a powerful approach to the exchange of information between embedded devices and desktop or server machines, but using ageneral purpose XML parser support can be very expensive in the constrained resources of an embedded device. Allegro's RomXML toolkit addresses the primary need for embedded XML support - to efficiently translate between XML syntax and internal device data structures. This solution provides an efficient translation between pre-defined C-language structures and XML-based representations to move data to and from and embedded device. The included TagBuilder tool is a special purpose offline XML translator tool that uses dedicated schema definitions to produce an object definition file in C-language source to be compiled with the RomXML Parser-Framer code and that drastically reduces the run-time code and data storage requirements for any specific application.

RomWebClient: Enables embedded devices to independently retrieve configuration and other data files from a web server anywhere on the Internet.

- Leverages HTTP to offer virtual file access to embedded devices
- Compact and efficient

The RomWebClient toolkits, offered in Standard, Advanced and Secure editions, are a range of embedded HTTP 1.0/1.1 client implementations that provide devices the ability to send and retrieve objects from any Web server using the HTTP protocol. The toolkits enable networked devices to download configuration files, retrieve software updates, retrieve "print-by-reference" documents or send status notifications. RomWebClient also enables devices to initiate XML-based request/response protocols such as the Simple Object Access Protocol (SOAP), a vendor-independent initiative supported by many computer manufacturers. The RomWebClient toolkits can send and receive HTTP objects in any format. These text, HTML, graphics and XML objects can be sent to and from internal memory buffers or, optionally any internal file system. Advance RomWebClient options include support for caching, pipelining and cookie exchange.

RomCLI: Speeds the implementation of Cisco IOS-style command line interfaces for embedded device management via serial ports or remote login.

- Local or remote command line access for device control
- Optional SSH server for secure remote connections
- Includes offline tool for parser tree preparation
- Compact and efficient

While many embedded devices are managed through RomPager web interfaces, there is still a demand for command line based interfaces to be offered as an alternative or in parallel with web interfaces. The Cisco IOS style of command line dialog is a de-facto standard for networked equipment and the RomCLI range of toolkits offer a cost effective way to construct robust custom management interfaces employing a variety of security options. At the heart of the toolkit is a command line handler and parser system that offers standard line editing and error dialogs compatible with standard terminals or Telnet clients. Access to the command dialog can be via a local serial connection, a Telnet server or a secure SSH server. An offline CliBuilder tool is used to prepare custom parser tree structures and hooks for variable access. Interfaces with variable access structures are unified with those supported by RomPager products so that parallel web and command line interfaces operate symmetrically.

RomMailer: Enables embedded devices to send status or alerts by email to any SMTP server embedded devices and/or to receive email formatted data from any POP3 server.

- Lightweight file transfer using POP and SMTP protocols
- Compact and efficient

The RomMailer group of toolkits enables the embedded device developer to leverage the standard Internet email infrastructure to transfer data to and from external servers. Available in Basic through Advanced editions, RomMailer supports SMTP transfers of text or MIME encoded data through a simple, yet powerful API and integrates well with the RomPager products to support embedded graphics transfer. These features enable devices to issue mail based status updates, alerts and routine data logs. The RomPOP group of toolkits provides equivalent support for file retrieval from standard POP3 servers, enabling configuration file updates and related device control requirements to be met through simple email transfer.

All toolkits are in ANSI C source code form, have proven highly portable to various hardware platforms, OS and TCP/IP stacks and include the appropriate interface files for all the leading embedded environments.

AMS Digital Media Server

As a complement to its expanding group of UPnP device toolkits, and an example of their maturity, Allegro has released a fully compliant UPnP AV server product which runs in both PC and Mac environments. The Allegro Media Server seamlessly joins together the world of iTunes music libraries on home computers with the new networked UPnP AV Digital Media Player products which stream those tunes into entertainment centers and portable music devices around the house.

As an active contributor to the community, principally through the UPnP Forum and the Digital Living Network Alliance (DLNA), and as a long term supplier of UPnP technology, Allegro has gained the respect of the UPnP community and a growing list of world-class OEM customers who are adopting Allegro technology to accelerate their development of UPnP compliant devices for home and office markets.

PR Boilerplate

Allegro is the leading provider of premier device management and UPnP technologies specifically targeted at embedded applications. Since 1996 Allegro has been a force in the evolution of device management technology with its RomPager embedded web server and other toolkit products, which have been successfully deployed in millions of devices worldwide. Now also an active contributor to XML and UPnP initiatives, Allegro has added a range of market leading UPnP toolkits that offer portability, easy system integration and proven device interoperability. Allegro is headquartered in Boxborough, MA. For more information, visit www.allegrosoft.com

Team and History

Bob Van Andel is the founder and CEO of Allegro. Bob has been designing and building embedded systems and communications protocols for more than 20 years. Prior to founding Allegro, Bob was Vice President of Engineering at Avatar Technologies and held a variety of technical positions at Data General building specialist systems for automation and control applications. Like Bob, his team consists of a seasoned group of engineers and business leaders whose broad background gives them the depth of experience that underpins the singular attention to quality and problem solving at the heart of Allegro's culture. Allegro also strives to be an active member of the technology development community that it serves, by participation in industry and trade organizations and running an active partnership program.

Allegro Software Development Corporation was founded at the beginning of 1996 with the intent of leveraging standard Internet applications technologies in the management of networked devices. The initial RomPager offerings, designed specifically for embedded applications, set the standard in the emerging web management market with features such as compression for pages and images, support for the latest HTML and HTTP standards, flexible security models and flexible file system support. Customers were quick to realize that such tools supported the quick development of sophisticated management applications and an ability to rapidly deliver consistent cross-platform solutions. By leveraging a standard browser as the device application interface, the requirement for developing, distributing and maintaining custom device management client software was largely eliminated, leading to a sea change in the design and packaging of this type of system.

From 1997 to 1999, Allegro delivered several extensions to its product line including version and option updates to RomPager and the new RomMailer and RomPOP email agents for email based status/alert reports or delivery of new software revisions by email. RomWebClient was added as a general purpose HTTP object retrieval toolkit for embedded devices and RomDNS provided the ability to perform a variety of name-based and address-based queries to Domain Name Servers. These specific technologies addressed unmet needs in the marketplace and expanded the range of capabilities that Allegro's customers could provide in their designs. To extend this range of management options, Allegro also added RomCLI, providing a command line capability, and a compact implementation of protocols necessary to enable TLS, SSL and SSH secured management transactions for embedded devices.

As an early response to the growing interest in more Machine to Machine web services, in September 1999, Allegro launched RomXML, the first XML Framer/Parser specifically designed for the embedded marketplace. With a memory footprint of around 10Kb, Allegro made it practical to harness the power and sophistication of XML based web transactions within a system of embedded devices. Building on this technological base, in September 2000, Allegro announced the RomPlug family of toolkits, which are small memory footprint implementations of the UPnP core technologies. This growing use of more involved multi-protocol transactions at the device-to-device level is reflected in the recent marketing of UPnP based media extender devices. To underscore its committment to this space and to help expand the use of these standard technologies, Allegro is now also marketing the Allegro Media Server - a software application to link personal computers that use the Apple iTunes software with the world of networked UPnP digital media players.

Today, Allegro is an active member of the UPnP Forum - an industry initiative designed to enable simple and robust connectivity among stand-alone devices and PCs from many different vendors. As a group, the UPnP Forum is leading the way to an interconnected lifestyle.

Allegro is also a participant in the activities of the Digital Living Network Alliance (DNLA). DNLA companies are working to turn the vision of a networked home into a reality for consumers around the world. This vision integrates the Internet, mobile and broadcast products through a seamless interoperable network.

Media and Analyst Interest in Device Management

Recent editorial coverage of the world of networked Internet devices and various aspects of device management includes publications like: EE Times, PC Week, and Network Computing. Even mainstream media such as the New York Times and Wall Street Journal are covering aspects of this challenge from a consumer perspective. There are also a number of highly specialized analyst firms and industry trade groups being formed to cover developed and applications in the business of the pervasive internet. Examples of key contributors in this market are:

- Harbor Research: http://www.harborresearch.com/
- Parks Associates: http://www.parksassociates.com/
- Yankee group http://www.yankeegroup.com/

Pedigree and Market Success

Many companies have discovered the advantages of connecting devices to the Internet. Allegro customers include many of the leading developers of computer systems and networking equipment such as 3Com, Agilent, American Power Conversion, Andover Controls, Casio, Cisco, Hewlett-Packard, Honeywell, Motorola, Nortel, QMS, Sony, and Xerox. These customers, and others have found that the RomPager family is well suited for embedding in devices like printers, routers, fax servers, RAID disk arrays, UPS systems, automated building control systems, and remote access servers. Over 5,000,000 embedded devices have been shipped with the RomPager family of products. In December 2003, Philips and Allegro announced a partnership to make the Allegro RomPlug UPnP technology available for the Philips Nexperia semiconductor family and in the last half of 2004 a number of key Consumer Electronics manufacturers such as Philips and Roku have introduced UPnP media devices that feature Allegro technology.

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If you would like one of our sales representatives to contact you, please send email to: sales@allegrosoft.com. To learn more about our embedded web server, our embedded web client or our other embedded Internet products, or to subscribe to our newsletter, send email to us at: rompager@allegrosoft.com

References and Links

www.dlna.org

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