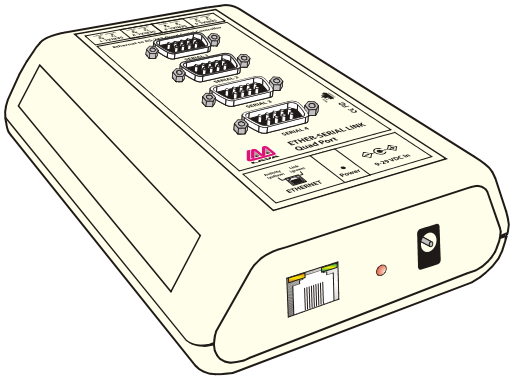
LAVA Ether-Serial Link Applications



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Ethernet-to-Serial Connections: A Wide Range of Applications

Introduction

Serial device servers have become an essential part of connectivity infrastructure, and given their versatility, low cost, reliability, and ease of use that is no surprise. Serial device servers address a number of the limitations of simple serial connections: they make it possible for numerous users to access a particular serial device, they make it possible to control an unlimited number of serial devices from a single computer, and they make it possible to overcome the cable length limitations inherent in standard serial connections.

This white paper outlines a variety of real-world applications of LAVA Ether-Serial Link serial device servers. These uses demonstrate the range of places where Ethernet-to-serial interfaces offer the benefits described above, and in addition at times show other benefits as well.

Serial Device Server Benefits

Backward Compatibility

- older serial devices plug directly into serial device servers
- conventional network hardware is used
- software works without alteration

Ease of Use

- works just as if the serial port were internal in the computer
- once operating, the interface is transparent to the hardware, software, and user

Longer Distances

- serial device servers eliminate the 50 foot cable limitation of RS-232

More Connections

- unlimited numbers of users can now access a serial device
- a computer can now manage an unlimited number of serial devices

Sophisticated Management

- ability to remotely configure port settings
- ability to control users' access to serial ports
- ability to see all serial connections in a coherent interface

Ethernet-to-Serial Background

A little background on what serial device servers are and how they operate will provide a useful context for the applications described in this white paper. Serial device servers are simple in concept: they take data from a serial port, wrap it up for sending over Ethernet ("packetize" it), and transmit it to an Ethernet address. They also receive similarly packaged data from the Ethernet, unwrap it, and send that data out their serial port or ports.

In doing so, a fair bit of behind-the-scenes technology comes into play, as the data needs to be handled in ways that are ultimately transparent to the serial devices and software involved.

The table below summarizes the contents of this white paper, which are really just the tip of the iceberg.

Customer	Application	Benefits
Atlas POS	ECR polling; modem replacement	greater reliability simpler configuration ability to eliminate a dedicated phone line for modem use
Hennepin County Library	ECR polling; modem replacement	centralized control overcoming geographical limitations
Ether-Serial Link 1-422-RJ45	industrial applications	effective noise rejection able to supply power on serial port
Pier1 Imports	door sensor integration with POS system	LAVA-modified firmware to suit customer need
Opal	kiosks and vending machines	SSL security
Industrial control	factory automation	DOS commands piped over Ethernet
Detroit Institute of Arts	climatological monitoring	overcoming geographical limitations remote monitoring
Video systems integration	television remote control	centralized flexible control eliminates expensive signal amplifiers reduces cabling
Dakota Security Systems	ECR to video server	serial data format conversion
Remote monitoring (SCADA)	power meter to LAVA Ethernet-to-POTS	modem replacement to connect to cellular router
I^3 International Inc.	DVR security system	embedded application for high reliability
Innovative Control Systems	car wash control	custom hardware for harsh environment
Tyco/ADT	RFID handset reader	Ethernet-to-TTL custom embedded hardware

A Sneak Peek at LIPS: the LAVA IP Socket

In addition, this white paper looks forward to a product infrastructure currently in development at LAVA — the LIPS system (LAVA IP Socket). This is an offshoot of the LAVA Ether-Serial Link design that presets a generalized IP socket to provide versatile interfacing for custom development. Potential application scenarios are discussed near the end of this paper.

Atlas POS

Atlas POS, a POS integrator specializing in Sharp ECRs, operates throughout Canada from Vancouver to Newfoundland. They have now used LAVA Ether-Serial Links and HQ-ST Plus Links in numerous POS polling applications. They focus on POS installations for cafeterias, and have sold systems to colleges, universities, and hospitals, as well as to companies such as BMW and Rogers. In these applications serial device servers are essentially replacements for dial-up modems, offering greater reliability, simpler configuration, and the ability to eliminate a dedicated phone line for modem use.

Norm Puig at Atlas sees increasing need for machines that require networking, either natively in the machine, or through IP-enabling technology such as the Ether-Serial Links and HQ-ST Links that he installs. His observation is that for installations where the requirement for complex cash registers is high, as when an organization has a large number of inventory items to manage, the ECRs and POS systems are Ethernet ready. By contrast, when the cash register requirements are simpler or stores are smaller, IP-enablers make more sense.

Figure 1: Sharp ER-A520

Typical installations for Norm include Ether-Serial Links for polling Sharp ER-A420 cash registers, polling with Skantalk software, at the Royal Conservatory, Toronto; HQ-ST Links polling Sharp UP600 registers in the Sweet Tooth Candy Emporium chain, and Sharp ER-A520 cash registers being connected with Ether-Serial Links in the Old Forum Inn, Cambridge, ON.

Norm prefers the ease of use he finds in the LAVA products to some of the more difficult to use products on the market.

Gift Shop ECR Polling over IP

Hennepin County Library in Hennepin MN has been recognized as one of the top libraries in the United States. The 41-branch library system had 5.8 million in-person visits and almost 20 million Internet visits to their library in 2010.

Figure 2: LAVA ESL 1-232-DB9

When the library looked to connect their Electronic Cash Registers (ECRs) to a central location they chose a solution offered by local reseller American Metro Cash Register that included LAVA serial device servers. Attached to each in-branch gift shop/book store ECR, the LAVA Ether-Serial Links made it possible to poll each of the stores throughout the library chain. This system allows them to do everything from monitoring end-of-day sales to doing on-the-fly lookups of items and prices.

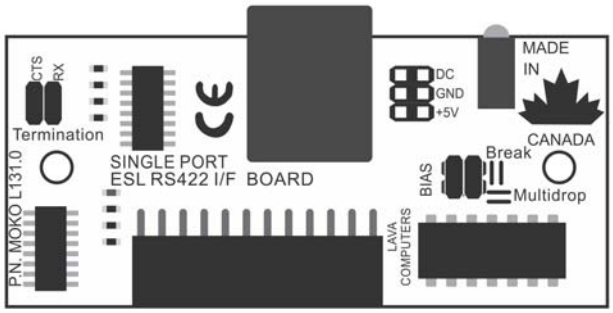
Figure 3: Hennepin County Library

Ether-Serial Link for Industrial: 1-422-RJ45

The new LAVA Ether-Serial Link 1-422-RJ45 provides one RS-422 enabled serial port, accessible over Ethernet. It has configurable RS-422 termination and bias settings, as well as being able to supply 5 VDC or 12 VDC to attached peripherals that are designed to receive power on their serial ports. The diagram below shows the internal module and its jumper settings.

The ESL 1-422-RJ45, like all LAVA Ether-Serial Links, has a wide range of serial port modes, full serial and network configurability, and complete security settings for both the device and individual serial ports.

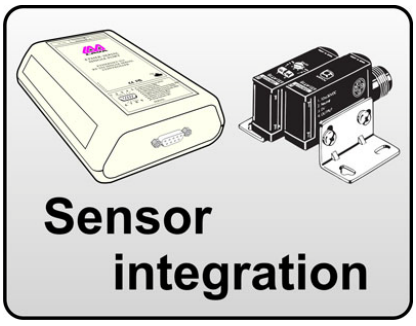
Figure 4: LAVA Ether-Serial Link 1-422-RJ45 interface module



RS422 provides advantages of particular value in industrial and electrically "noisy" environments as it is much less susceptible to electrical interference, and is capable of long cable runs without loss of signal integrity. The fact that the ESL 1-422-RJ45 can provide 12VDC or 5VDC on its serial port means that suitable peripherals can operate without the need for a separate power supply, such as the cumbersome "wall warts" that crowd power bars and wall outlets.

Sensor and POS Integration

In March 2006 Pier 1 imports, a top American home furnishings retailer, sold its England-based business "The Pier" to Lagerinn ehf., an Icelandic group. Lagerinn went on to own, operate, and grow the group to 32 stores and 17 concessions in the UK, sourcing and selling distinctive furniture and household accessories. It had a small IT department: one head of IT and a staff of nine people. Lean was the word!



The British operation used an older but cost-effective POS system and was constantly looking to leverage its existing IT infrastructure. They asked LAVA to design a unit that would work with their existing front-end equipment from Toshiba TEC, but that also would integrate with door sensors and software to detect and count customers entering the stores. As complications, some stores had multiple doors and the data had to be accumulated internally on the devices before being centralized. LAVA modified one of our existing Ethernet-to-serial device servers to work with the dry contact sensors already installed in "The Pier" stores. LAVA first tested the device in our head office, then piloted the system in several UK stores, and finally worked with a local system integrator — Readycrest Ltd. — to roll out the system throughout the chain.

Figure 5: Pier1 store

IP-Enabling Kiosks and Vending Machines

Opal Manufacturing Ltd. has been designing and manufacturing vending solutions for over 70 years and is a global leader in the delivery of prepaid telecom products, transit ticket dispensing, postal booklet vending, prepaid debit card vending, PIN vending, prepaid IP access, and self service bill pay applications.

Opal's primary focus has been in producing equipment for vending prepaid telecom products, namely cards for long distance calling, cards for mobile top up, PIN printing at the time of sale and real time on-line account top up. When Opal wanted to add TCP/IP functionality to their remote vending machines, especially telecom prepaid kiosks they turned to LAVA. As well, we added another level of security beyond the standard ones already present in the technology to make sure that the financial transactions that were being processed were being done securely.

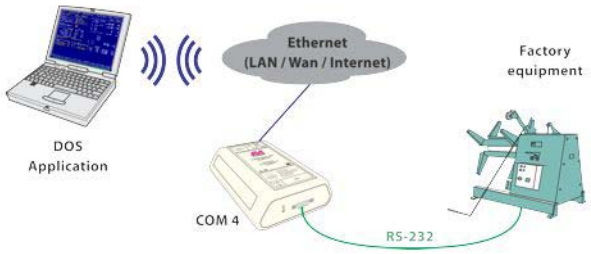
Figure 6: Opal kiosk

Opal chose LAVA because engineering, manufacturing, and technical support are located in Toronto, Canada, close to Opal's operations. Secondly, LAVA developed a product to their exact specification that is delivered to them on a just-in time [JIT] basis. Finally, the LAVA Lifetime Warranty guaranteed that the product would remain very cost-effective and spoke to high reliability — crucial considerations, especially since the final finished product is shipped to many remote locations in the world.

Piping DOS over Ethernet

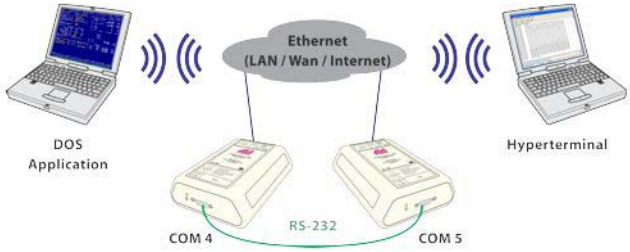
A little-known fact: DOS commands can be sent through LAVA Ether-Serial Links. And it's actually simple to do. With an Ether-Serial Link configured in Windows Driver mode, and with its port activated as usual, all you need to do is pipe DOS data (using the conventional DOS redirection command ">") to the serial port of the device server, which will send it to the target device. The diagram below shows this setup connecting a DOS application to a piece of factory equipment.

Figure 7: LAVA Ether-Serial Link: DOS interface to factory equipment



This concept is easy to test, as the diagram below shows. While a two-device setup is used to demonstrate this concept, only one Ether-Serial Link is needed to actually send data to a peripheral, as we saw above. In the diagram below, the DOS application on the left is sending data to the serial device server on the left, by piping its data to COM 4.

Figure 8: LAVA Ether-Serial Link: DOS commands over IP



That Ether-Serial Link is connected to the serial port of the Ether-Serial Link on the right, which is in turn monitored by Hyperterminal. DOS commands piped to COM 4 are received at COM 5.

Remote Climatological Monitoring

The Detroit Institute of Arts (DIA) is a renowned art museum in the city of Detroit. In 2003, the DIA ranked as the second largest municipally owned museum in the United States, with an art collection valued at more than one billion dollars. It encloses over 100 galleries and now covers 658,000 square feet (61,130 m^2); a major renovation and expansion project completed in 2007 added 58,000 sq. ft. (5,388 m^2).

Figure 9: Detroit Institute of Arts

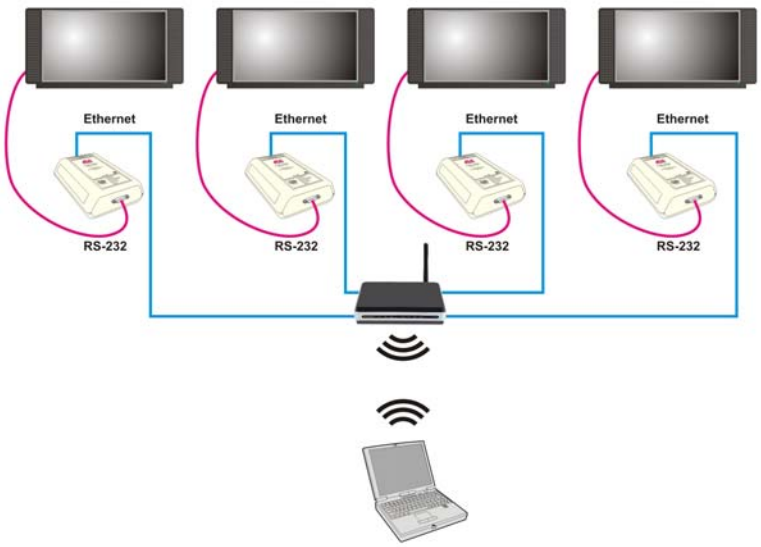
And even with that, not all its collections are currently on display. They are storing other materials off-site. When the DIA Operations people want to check and control the temperature in an off-site location they use a serial device server — the LAVA Ether-Serial Link (ESL) — in Windows Driver mode to access that information.

RS-232 Remote Control of Televisions

LAVA was approached by a video systems integrator who was operating a collection of televisions dispersed throughout a convention center. The televisions were controlled on their RS-232 ports. Control codes sent through the serial ports gave him basic operation of the televisions. His original design had serial cables using signal amplifiers, led back to a switchbox, which in turn went to a computer.

He was looking to reproduce his deployment in another location, and wanted a less expensive design. Ether-Serial Links gave him the ability to set up a cheaper and more flexible configuration. He was able to eliminate the signal amplifiers, and in places where the televisions were in a bank, he was able to control them with a multi-port serial device server. Doing so meant he needed fewer Ether-Serial Links, and less network cabling as well.

Figure 10: LAVA Ether-Serial Links as TV remote control interfaces to IP



Many types of consumer electronics, not just televisions, are controllable on their serial ports. LAVA Ether-Serial Links make controlling those devices remotely a snap. Hobbyists have cleared many of the obstacles of out the way. The process of controlling a TV (or monitor, in the case of digital signage) is fairly straightforward, and in some cases people make freely available the code that they use to control their devices, using attractive and intuitive interfaces and full command sets.

Serial control of televisions is discussed at sites such as:

- http://www.remotecentral.com/cgi-bin/mboard/rs232-ip/list.cgi [discussion forum on TV control over RS-232 & IP]

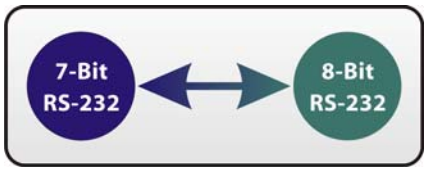
- http://mozkey.blogspot.com/2009/03/c-samsung-tv-remote-with-serial-rs232.html [source code for Samsung TV remote control]
- http://www.veg.nildram.co.uk/remote.htm [Toshiba hobbyist, with infrared interfacing]
- http://support.gateway.com/s/Manuals/Desktops/8508947/8508947.htm [Gateway example control codes]
- http://www.kucher.org/projects/tvcontrol/ [Sony hobbyist]
- http://www.avforums.com/forums/lcd-led-lcd-tvs/607393-rs-232-control-lcd-tv-pc.html [general forum discussion]
- http://mythtvblog.blogspot.com/2009/05/controlling-sharp-aquos-tv-via-serial.html [blog on controlling Sharp Aquos: detailed]
- http://www.rdex.net/projects/lg_tv/ [hobbyist controlling an LG TV]
- http://openlgtv.org.ru/wiki/index.php/Main_Page [a wiki & forum community for modding LG TVs (European firmware)]
- http://rs232codes.com/ [article on using RS232 codes to control consumer electronic equipment]
- http://hackaday.com/2011/07/21/lg-tv-hacking-via-serial-connection-or-ir-codes/ [the hacking community especially likes playing with LG televisions, as they are Linux-based]

Using the Ether-Serial Link as a Serial Data Format Converter

Here's an interesting use for the LAVA Ether-Serial Link: as a generalized serial data format converter.

A quick search on the web shows that people have a variety of needs for converting one RS-232 data format to another, for a variety of reasons, and the solutions are usually cumbersome.

For example, one might want to connect two serial devices that communicate at different, fixed baud rates, or with different parity settings. Without converting the serial data, these devices will not communicate. Some of us remember this problem arising back in the bad old days of dial-up networking, when modems' settings needed to be matched in parity, baud rate, data bits, parity, stop bits, and flow control settings. When they didn't match, the communication either failed, or the data was garbled.

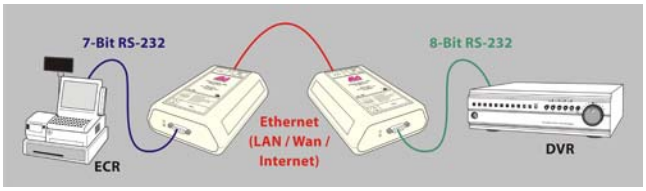


But at least you could set the modems to do what you wanted, if you knew what you wanted, knew how to do it, and had access to the modems (no small set of qualifications).

But at other times, the hardware you want to connect cannot be changed: the serial port settings are locked. In these situations, resolving the connectivity problem has usually meant either coding software to do the specific job needed, or hunting down a piece of hardware to do the conversion (again, just for that specific task).

A case in point: Pete Eirikson, a Commercial Project Manager for Dakota Security Systems, Inc. contacted LAVA for a solution to an existing customer problem. They needed to get a cash register (in 7-bit mode) to communicate with a video server (in 8-bit mode) over serial, where both devices are fixed and not able to change their respective data bit sizes. The solution was to install a Lava Ether-Serial device server on each serial connection and then use our devices to convert the 7-bit data from the cash register to 8-bit data for the Dakota video server.

Figure 11: LAVA Ether-Serial Link as serial data formatter



The Ether-Serial Links are each set in Data Connect mode, with each "pointed" at the other's IP address and TCP port number. Because the serial ports of the two devices do not need to be set to the same port settings (they can differ on any combination of port settings in fact), the Ether-Serial Links must — and do — manage the translation between ends of the connection.

What this means is that the Ether-Serial Links can provide a transparent means of interconnecting devices with disparate serial port settings. This of course is particularly useful when the devices in question cannot have their serial port settings altered, or not altered to match each other.

A fringe benefit of this method of connecting devices in Data Connect mode is that the devices in question now also can be situated at any distance from each other, from near placement to any distance over the Internet.

In the case of converting 7-bit serial to 8-bit serial for Dakota Security Systems: problem solved.

Wireless Connection to Power Meter

While not strictly an Ethernet-to-serial implementation, this Ethernet-to-phone design is the equivalent, in that it is effectively a modem replacement. In this case however, the modem is internal in a power meter, and that modem needs to see the Ethernet as a phone jack. The ultimate intention is to avoid a wired connection altogether, without replacing the power meter. A customer writes:

"So I want to connect up a power meter wirelessly over IP. It (the power meter) used to connect to a phone line, picked up a phone call, and sent data back. Here's what I'm doing:

- power meter connects to LAVA POTS-to-Ethernet box
- LAVA POTS-to-Ethernet box connects to a cellular router
- I connect to the cellular router, which connects to the LAVA box, which "phones" the power meter
- then the power meter sends its data to me over IP

The setup looks like this:

Figure 12: Ether-Serial Link bridging power meter and cellular router

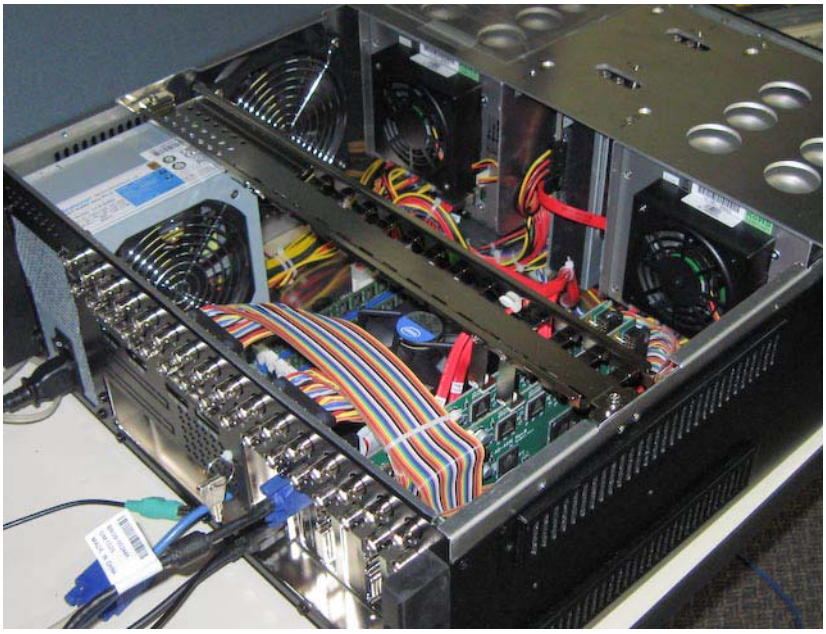
The power meter thinks it's doing what it always did: connecting to a wall phone jack."

Ether-Serial Links: Win 7 Embedded

LAVA now has a functioning Windows 7 Embedded install (driver and Ether-Link Manager) for Ether-Serial Links, at present in an Engineering Release only. Customers looking to use the Ether-Serial Link in a Windows 7 Embedded context will find this of interest.

This release was developed for a customer who wanted to install the Ether-Serial Link driver on a digital video recorder that uses Windows 7 64-bit Embedded. A sample system was provided to us for testing. The specific model was an I3DVR w S1200BTL motherboard.

Figure 13: I3DVR with embedded LAVA Ether-Serial Link

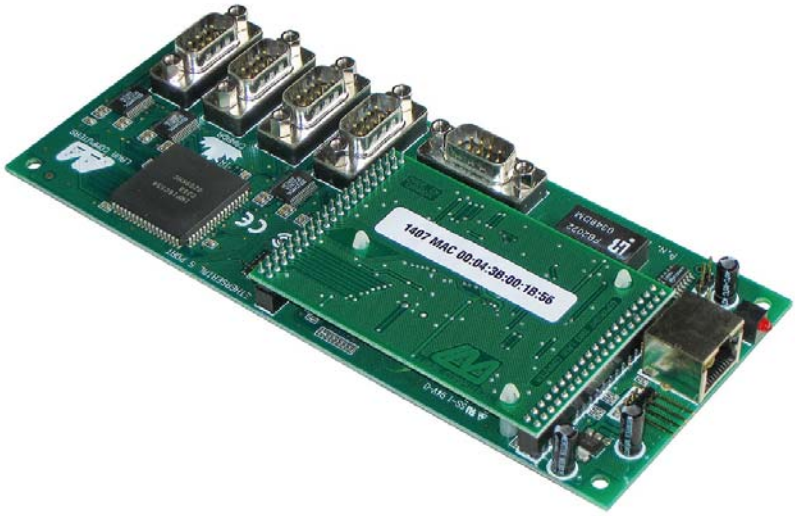


The final version means that the LAVA Ether-Serial Link driver and Manager can be fully integrated in I3's high-reliability DVR security system.

Car Wash 5 Port Embedded Serial Device Server

Innovative Control Systems had a requirement for serial port control of a number of systems in a chain of automated car washes. In this setting, moisture and heat were unavoidable, and the device had to be fitted into an existing climate-proof enclosure. LAVA developed a spin of hardware to meet this need, producing a five-port Ether-Serial Link with a form factor suitable to the customer's needs. On the firmware level, this product is virtually the same as our four-port serial device servers.

Figure 14: LAVA Ether-Serial Link 5-232-DB9 EMB



Because LAVA engineers and manufactures its products in-house, we can meet specialized customer requirements cost effectively and quickly.

Tyco/ADT RFID Embedded RFID Reader

ADT Business Solutions, a division of Tyco, includes in its retail security products RFID security and inventory systems. They needed serial-to-Ethernet interfacing for one of their portable RFID reader systems. Their specifications were for a compact embedded Ethernet-to-TTL serial module that could be integrated into RFID base stations. These base stations would in turn seat the portable RFID readers, allowing charging and

downloading information collected throughout the stores of a large retail chain. Once downloaded, the data was passed over Ethernet to the store's network.

Figure 15: LAVA Ether-Serial Link 1-TTL-EMB

Again, LAVA was able to engineer and manufacture to meet a customer's needs.

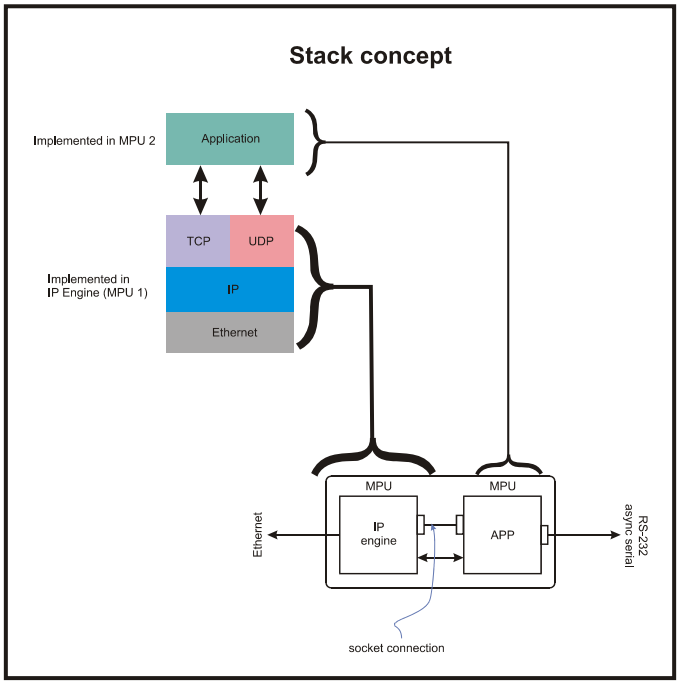
LIPS: The LAVA IP Socket

We thought we'd devote a bit of space at the end of this white paper to the next major development in LAVA engineering, the LIPS System. It takes a bit to get your head around the simplicity of LIPS, but here we go: in its essence, the LIPs decouples two aspects of the LAVA Ether-Serial Link serial device servers — the serial and the Ethernet — and focuses on the Ethernet side. The goal here is to isolate the IP socket's functionality in as generalized a manner as possible, and to make it with as flexible an interface as possible.

Why would we do this, and what will it offer to customers?

The idea is to simplify to its most basic the invariant portion on the Ethernet side of the Ether-Serial Link, and at the same time to have it present a configurable open interface, which at present is a dedicated internal interface to serial only. Doing so will both reduce the cost of this portion of an IP link, and make it suitable for many more applications.

Figure 16: LIPS System Design Concept



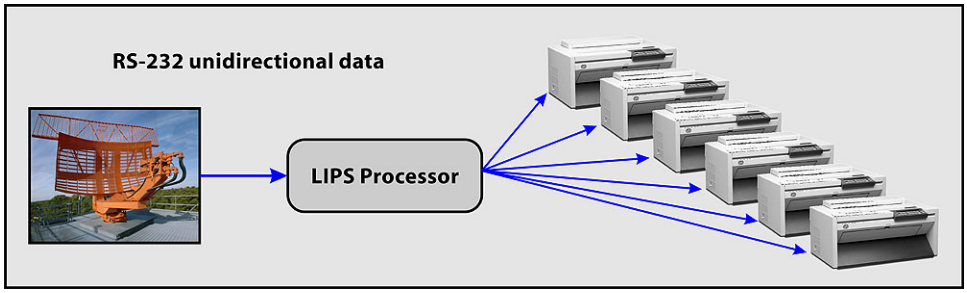
Where in the past when customers have come to us with specific requirements not in our standard product we have answered, "Yes, we CAN do that but . . . ." we will now much more often be able to respond, "Yes, when would you like it?"

Moreover, the interface will not be limited to serial alone as it has been with LAVA Ether-Serial Links. Those products have been RS-232, RS-422, and TTL pretty much exclusively. The LIPS design will bring the same benefits to interfaces to parallel, I^2C, SPI, Modbus, and others. A couple of scenarios will help to make clear the flexibility of the LIP System.

RS-232 Splitting over TCP/IP

In one scenario, an airport has a radar system that outputs flight information on RS-232 to a set of twelve printers, on a modem-based system of phone lines. The airport wants to now configure those connections to send the data over IP. While this sounds simple enough, implementing it without a computer handling the data splitting before it is sent over IP is not easy. To do so with conventional serial device servers is not possible without modifying their firmware to do the required splitting task. However, with the LIPS System it's relatively simple. Looking at the diagram above, the part that would be modified is the green rectangle marked "Application."

Figure 17: RS-232 Split over IP



RS-485 over UDP

A second application is in the area of lighting and multimedia control. The current technology for professional lighting control — DMX512A — is essentially a form of RS-485 serial with connnector and cabling specifications intended for the multimedia industry. While this standard has served the industry well, as time has passed the range and number of interconnections and variables has increased: it's no longer just a question of turning lights on and off and controlling dimmers, but of controlling complex devices such as multimedia servers.

Figure 18: DMX 512 Lighting Control

To meet this need, a new IP-based multimedia communications protocol has been created: ACN (The ESTA Architecture for Control Networks). This is a UDP/IP communication system, yet at the same time many of the devices in an ACN system will be DMX512/DMX512A based. So the need arises for a DMX512-to-ACN interface. Again, this is LIPS territory: it's quite simple to interface UDP to RS-485 with this technology. Again, the part of the diagram above that would be modified is the green rectangle marked "Application."

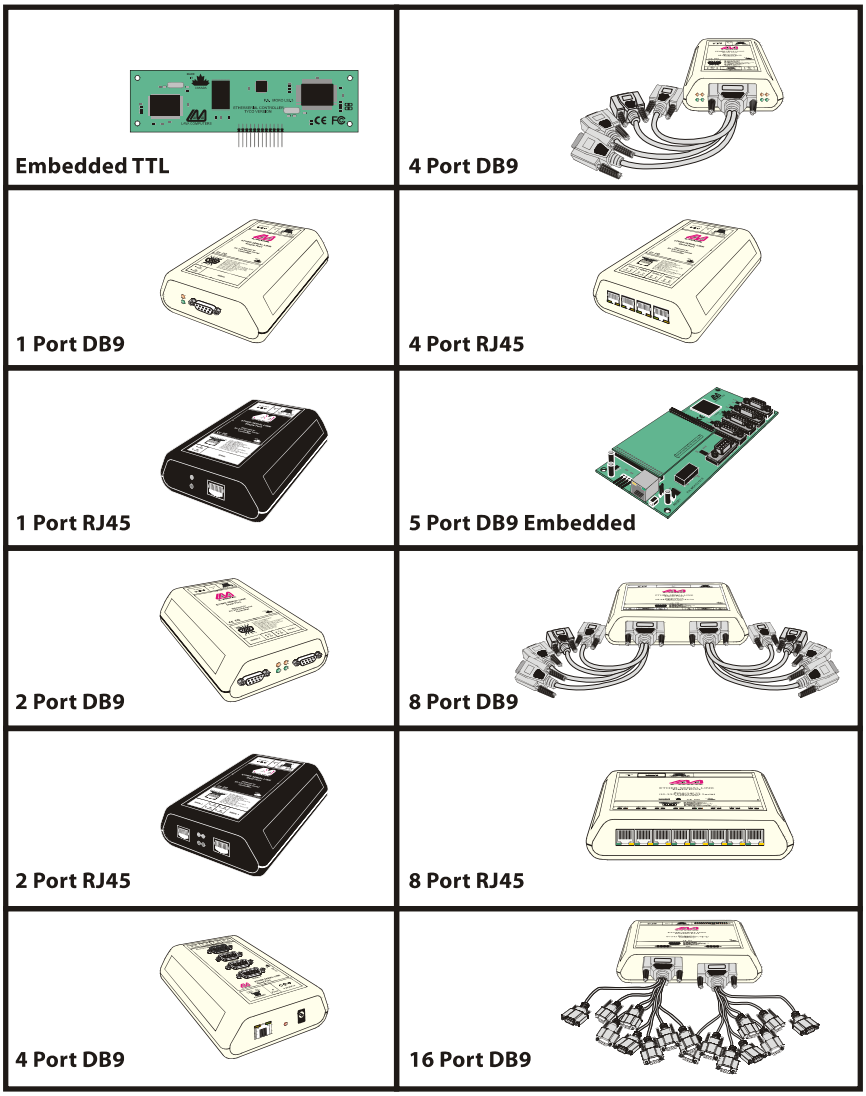
Summary

The LAVA Ether-Serial Link fits readily into many contexts, from POS to industrial to security to AV, and many others. In virtually all cases the primary use of a serial device server is simply to pass serial to Ethernet and vice versa, but as can be seen there are numerous spin-off benefits as well: the ability to support more connections per computer, to allow access to more computers, to manage security and access better, to translate between incompatible serial port settings, and many others.

Extending this already flexible concept is the LIPS System, which will make the potential of the LAVA IP Socket applicable beyond simply serial, and will also make the speedy development of customized products much faster and easier.

LAVA Ether-Serial Links

Figure 19: LAVA Ether-Serial Link Form Factors



Product	Ports; Interface
ESL 1-232-DB9	Ether-Serial Link single RS-232 IP-enabled 9-pin serial port
ESL 1-232-RJ45	Ether-Serial Link single RS-232 IP-enabled 10-pin RJ-45 serial port, power on pin 10
ESL 2-232-DB9	Ether-Serial Link dual RS-232 IP-enabled 9-pin serial ports
ESL 2-232-RJ45	Ether-Serial Link dual RS-232 IP-enabled 10-pin RJ-45 serial ports, power on pin 10
ESL 4-232-DB9	Ether-Serial Link quad RS-232 IP-enabled 9-pin serial ports
ESL 4-232-RJ45	Ether-Serial Link quad RS-232 IP-enabled 10-pin RJ-45 serial ports, power on pin 10
ESL 4-232-DB9 Cabled	Ether-Serial Link quad RS-232 IP-enabled 9-pin serial ports, fan-out cable
ESL 5-232-DB9 Embedded	Ether-Serial Link five RS-232 IP-enabled 9-pin serial ports, for embedded applications
ESL 8-232-DB9 Cabled	Ether-Serial Link eight RS-232 IP-enabled 9-pin serial ports, fan-out cables
ESL 8-232-RJ45	Ether-Serial Link eight RS-232 IP-enabled 10-pin RJ-45 serial ports, power on pin 10
ESL 16-232-DB9 Cabled	Ether-Serial Link sixteen RS-232 IP-enabled 9-pin serial ports, fan-out cables

About LAVA

LAVA designs and manufactures hardware that provides system integrators and end users with simple serial-to-PC, serial-to-Ethernet, and USB-to-serial connectivity. The LAVA product line includes multi-port serial and parallel boards, Ethernet-to-serial device servers, links for legacy payment terminals, and headquarters-to-store links for cash register polling.

We serve customers around the globe in a wide array of industries, including Point of Sale, Telecommunications, Light Industrial Automation, Payment Processing, Building Automation, Gaming, and Restaurant & Hospitality. Our connectivity hardware suits any design needing more COM ports or remote monitoring and control of serial equipment over IP (Internet Protocol).

All LAVA hardware is covered by the LAVA Lifetime Warranty: any LAVA product that fails in its intended purpose will be replaced or repaired.

LAVA Computer MFG Inc.

2 Vulcan Street, Toronto, ON, Canada M9W 1L2

Tel.: 416-674-5942 • www.lavalink.com • Fax: 416-674-8262