Machine-to-machine communications: Internet modem or the traditional modem

By Howard A. Raphael

Embedded modems have become ubiquitous as more products have communications capability built in. Now there are two alternatives for a product with a resident modem: Traditional modems and Internet modems. Traditional modems use the Public Switched Telephone Network (PSTN) and allow a machine at point A to talk to a machine or host at point B over a dial-up connection. Networks of traditional modems have been in use since the 1963 Carter Phone decision allowed for private modem networks. Then followed the evolution from large thousand dollar boxes to embedded modem solutions costing less than $20. With the reduction in size and price has come an enormous increase in usage and applications, which has come to be known as the Machine-to-Machine (M2M) communications era. A parallel evolutionary path has recently emerged that pertains to the development of the Internet. The Internet as a resource has become pervasive and indispensable to all aspects of our professional and personal lives. More and more machines are also using the Internet in much the same way we do for information transfer. Enter the emerging trend of Internet M2M communications. For a machine to use the Internet requires a specialized modem sometimes called an appliance modem or Internet modem. While at the heart of an Internet modem is a traditional modem, that modem is surrounded by a layer of software that performs the Internet access function known as Transmission Control Protocol/Internet Protocol (TCP/IP) and Simple Mail Transfer Protocol (SMTP). Knowing which advantages are specific to traditional modems and Internet modems allows designers to make an informed choice when selecting a modem methodology.

There is a good chance that your current generation of products has a built-in component modem. This modem and its inherent communications capability would be used for product software updates, data collection, remote control functions, and better service or diagnostics of your product to the end user. Your modem uses the PSTN. You have worked out a networking architecture for your field products to communicate with a central host. The cost of your modem is the component cost, the telephone tariff charges, and the maintenance of the private network and host. The alternative to this is the Internet modem. The Internet modem performs the Internet interface activities transparent to the user and is command-driven with macro commands just like a traditional modem's AT commands. The Internet modem must have access to the Internet via an Internet Service Provider (ISP). All units in the field and the central site, if any, access the Internet via an ISP from a regional local telephone number.

Internet enabled modems are also sometimes called *appliance modems* and define any machine that is Internet enabled. They are also called simply iModems. The iModem, like a traditional modem, can be embedded in the OEM product, but they have the additional intelligence to do the Internet connectivity, handshaking, and addressing of e-mail messages or transfers of large blocks of data to a destination e-mail address. E-mail or web hosting becomes the data transfer medium for the communication. The necessary connectivity variables such as passwords, local access numbers, and addresses are stored in the iModem and used transparently. In the case of e-mail, the iModem formats the data and composes an e-mail for subsequent transfer. The SMTP along with the TCP/IP stack perform the block addressing for Internet compatibility. The added capability to perform Internet activity required over traditional modems adds some cost, but offers other advantages that perhaps offset this cost over the product life.

Let's examine the difference between traditional modems and iModems as they relate to design and implementation considerations when selecting a modem for a product.

The network: Private or Internet

A modem network typically comprises units in the field and a central host to which they all communicate (Figure 1). Internet modems use the Internet's infrastructure. Each point of the network is Internet enabled and can communicate with any other point. This arrangement avoids the need for a specialized central host with banks of modems since the ISP manages the network capacity and distributes it around. Any Internet enabled PC may be defined as the network host. This presents the advantage of requiring no specialized central site hardware, network protocols, or dedicated personnel to manage the network. The traditional modem network offers point-to-point security since the network is comprised of dedicated units in the field with the capability to dial out to a dedicated central site that performs the network management and communication concentrating function. Traditional

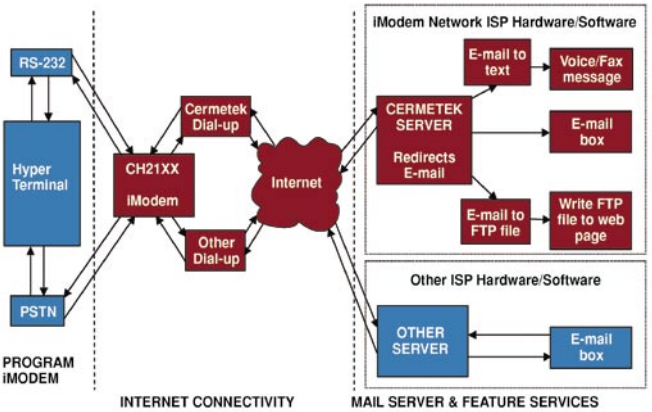

Figure 1

modem networks give the user control of the communications because the user defines the hardware and protocols.

Real-time messaging and packet messaging

Typically with an iModem, message routing is done through the Internet and messages are sent in packets unidirectional. This offers a multipoint option so that one message can be sent to multiple recipients. The e-mail message that is sent or the web pages that are updated do not occur in real time, but do occur transparently to the user. In the case of the e-mail the information is packetized and stored in the appropriate ISP for a receive mail transfer at a later time. To send or receive an e-mail or update a web page the iModem must connect to the local ISP, an attempt that can fail. The iModem has the intelligence to retry automatically and even perform an alternative channel routing around the local ISP to absolutely ensure that data is delivered. While information eventually gets to its intended recipient this does not occur in real time. Traditional dial-up modems establish a connection to a remote party in real time, and bidirectional information transfer can occur. Real-time transfer may be essential over the delays associated with a block data transfer routed through the Internet. As it turns out, a real-time connection can be established between two Internet modems by creating a *socket-to-socket* connection and has been implemented in Voice over IP (VoIP). When this occurs, both iModems are connected in the same way as traditional modems and at that point there is equivalency. However, the time it takes to establish the real-time link is longer with the iModem as compared to the traditional modem.

Monthly and capital cost of iModem networks versus traditional modem networks

The variable monthly communications cost of maintaining a product in the field can be measured, whether it is an iModem or a standard modem. A traditional modem incurs telephone access charges, which may be local or long distance charges between the products in the field and the central site. Long distance charges vary with the traffic. Also, as a traditional modem network grows, expansion capital costs occur as racks of modems and telephone line trunks increase.

When a product has a resident traditional modem and is sold to a customer, the customer takes responsibility for the telephone access and charges. These may be passed on to the ultimate end user. With an iModem network there is the single monthly ISP charge for each element on the network. This can be near zero for users who have their own ISP or as low as $2 per month with a third-party ISP. This fixes the communication costs per network element, but the ISP capability required for this must be available and provided. Because machine access to the Internet is new, there is no tradition of who provides the ISP service: component supplier, manufacturer, or end user. This becomes a new consideration in marketing Internet-based products. Expansion of the Internet network requires only the addition of more network elements and the inherent ISP cost per element.

The Internet approach offers a fixed monthly cost for communications almost independent of the traffic volume but dependent on the number of elements deployed. Traditional modems only incur cost as a function of traffic volume. Long distance service has become very competitive, so the user must estimate traditional modem usage traffic and compare that cost to the sum of the fixed ISP cost per element.

Point-to-point versus multipoint

Standard modems are point-to-point communication elements. A source element contacts one destination element and communication ensues until a termination occurs. This provides for maximum security and real-time data transfer. With traditional networks that have a central host, the central host can concentrate and distribute the data where appropriate. With the exception of the socket-to-socket transfer mentioned earlier, iModem transfer can be multipoint. With the iModem each message can be sent to multiple web pages or multiple recipients via their unique e-mail addresses in one transaction. E-mail distributes its own messages through the multiple recipients addressing structure to other e-mail enabled machines or standard Internet enabled PCs. Each iModem can host its own web page or can route information to multiple web pages.

With the advent of ISPs dedicated to machine-to-machine communications, it is possible to send an ASCII e-mail message and have it converted by the ISP to fax or a natural sounding voice message. The central host performs this role in traditional networks.

Message storage requirements

Traditional modems perform data transactions without storage in the modem or a record of a given transaction. All messages are sent transparently. If message storage or cataloging is required it must be accommodated by the network requirements. For example, all field messages must be sent to the dedicated central site host and stored in real time. This requires that a central site take in and file the data traffic. With iModems the Internet stores all ISP messages until requested by the user. In addition, each message is time stamped as to when it was sent and received. All ISPs have redundancy of storage locations, and the ISPs reside in computer-friendly sites that have emergency backup and professional real-time maintenance.

More intelligence or less

Traditional modems cost less than iModems because they are simpler and have less intelligence. Traditional modems are groomed to do the very basic modem function. This simplicity of operation is an inherent feature. With iModems, resident intelligence is required to do the stack and interface to the Internet. This resident intelligence may be used to enhance the functionality of the iModem in a user environment. The iModem's internal processor may also host user software and become the intelligence element of the user product, or in other words, its processor. It can have additional features such as unattended operation and the sending of prestored messages independent of the host intelligence and control. Each iModem is self-contained and imbued with ability to both send and receive e-mails and their associated Internet protocols with little or no external control. The resident intelligence of the iModem facilitates this. (See Figure 2.) It allows for:

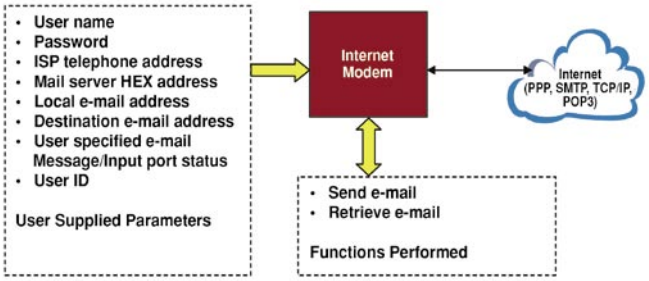

Figure 2

- Nonvolatile storage of a precomposed message
- The required local telephone numbers
- Resident destination e-mail address
- Password and other characteristics

A prestored message can be sent on a contact closure or by a simple software command. The prestored message can also be dynamically changed and recomposed. The message can be of unlimited length and sent in increments. The iModem operation occurs independent of the host microprocessor.

Traffic management

If each element of a large traditional modem network must report in daily at about the same time, this can cause a large demand for central site resident bandwidth in the form of large hardware capacity, including modems and telephone lines. The possibility of traffic jams and coincidence collisions may still exist. The solution is to have the elements report in at staggered times, which works well if the data can be gathered over a longer period of time. With the Internet-based messaging, all field products can send their daily e-mails at about the same time, and they will be delivered as website updates or as e-mail to one or more e-mail mailbox locations within a reasonable period of the desired time of day. The iModems benefit from the distributed local access numbers and local modem capacity, as well as from the Internet's large bandwidth.

Polling large numbers of field-installed products

Users often must poll a large number of field devices for the purpose of updating software or retrieving accumulated data. Traditional modems have an advantage over iModems because they can be programmed to answer an incoming call. iModems may only call out to send or retrieve information. This makes it difficult to initiate an update from a location remote to the device to be polled. With the traditional modem, the unit just needs to be called to gain access. With iModems it may be done in two ways:

- Use the web page hosting ability
- Send an e-mail to each device

When using the web hosting ability, each field modem has a resident web page that is updated or interrogated by the product's resident microprocessor on a regular basis. The interrogation of data is done by accessing the web page and procuring the updated data when present. With software updates the field device is told to interrogate its web page when an FTP flag is set at the web host.

With an e-mail transfer, the e-mail previously sent with a new software update waits to be interrogated. Each field device makes the local call to retrieve its e-mail based on an FTP flag or time of day algorithm, or some local event. The information is downloaded and then acted upon.

Remote downloads of field upgradeable parameters

When products are deployed in the field there is often a need to change the setup parameters. Traditional modems require very little in the way of setup, and they are generally not field upgradeable. An iModem requires many more parameters to be programmed to provide its Internet personality, such as passwords, local access numbers, and e-mail addresses. Occasionally these parameters have to be changed after field installation. The iModem has the ability to remotely change these parameters under protected administrative control, thus avoiding the need for field service calls or return to the factory modifications. Parameters that often need to be changed are passwords and local access numbers to the ISP.

Data transfer speed

High-speed traditional modems on long distance lines often connect at lower speeds than expected due to the characteristic of the telephone line, particularly when long distance is involved. Also long distance connections can cause error correcting communication software to kick in, in turn causing the transfer of data to run more slowly since the modem may have to retransmit blocks of data. The iModem offers advantages since all access is via local access numbers and local telephone calls. The Internet data at the local ISP host site is multiplexed and concentrated on to higher speed T1 or greater conditioned or optical lines. This plus the local nature of the access call ensures that the communication link will run at a higher speed with the iModem.

Conclusion

The advantages of the traditional modem are:

- Low hardware cost
- Simplicity of use
- Variable communications costs based on usage
- The ability to easily poll remote field units

This must be metered against the advantages of the Internet modem, which offers:

- Fixed predictable communications cost
- No central host hardware or maintenance cost
- Higher data rate
- Universal, well-understood networks with data retention

There is an alternative to the traditional embedded modem, namely the Internet modem. Both have advantages in some applications, but in the long run the Internet accessibility will win out.

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