## XECOM APPLICATION NOTE:

# Selecting a Modem for Smart Appliances?

Smart Appliance designers encounter unique conditions affecting their modem choices. They need to achieve maximum data throughput at minimum cost often while discreetly sharing the residential telephone line.

### Which Modem Protocol to Use?

The designer must consider the time required to establish the modem connection as well as the data transfer rate to determine the most efficient modem protocol for an application. The more complex modulation schemes provide higher data rates but take longer to complete protocol negotiations. Table 1 illustrates how transferring a small file can be faster with a low speed modem because of the reduced training time. The "Typical Training Time" shown refers to the time required to complete protocol negotiations. Of course 2400 BPS modems also possess a significant cost advantage over higher speed modems. Modem vendors are now developing products specifically for these low speed embedded applications, including Xecom's XE2420.

### Error Correction:

Standard error correction protocols such as V.42 add substantial overhead to system communications. Error Correction increases the amount of data and lengthens the time required to establish the connection. Incorporating error correction into low speed modems also takes substantial design resources. Neither Zilog, Conexant or TDK includes V.42 error correction in their 2400 BPS modem chips. As a result, the designer must integrate the error correction protocol into the host system firmware. This taxes engineering resources and adds substantially to processing requirements. A simple checksum will allow verification of data integrity without the added overhead.

### Sharing the Local Telephone Line:

To save operating costs many Smart Appliances count on sharing the residential telephone line. This arrangement requires the modem to operate in the background and never interfere with residential use of the telephone.

**TABLE 1: TOTAL TIME TO TRANSMIT A 2 KBYTE FILE**

| Modulation | Data Rate | Typical Training Typical | Duration of Data Transmission | Total Time to Transmit File |
|---|---|---|---|---|
| V.22bis | 2400 BPS | 6 seconds | 8.5 seconds | 14.5 seconds |
| V.32 | 9600 BPS | 14 seconds | 2.1 seconds | 16.1 seconds |
| V.34bis | 33,600 BPS | 14 seconds | 0.6 seconds | 14.6 seconds |

This sly use of the residential telephone line forces the appliance to verify telephone line availability before initiating a call and to yield the telephone line to all outgoing calls.

Line availability can be determined by monitoring the telephone line's battery voltage. Telephone lines use a battery to supply the local telephone loop current. When the line is idle the battery voltage sits at 48 Volts. The voltage drops to 8 – 12 volts when the telephone line is in use. The value of the battery voltage is a function of the DC load on the telephone line. By monitoring the battery voltage the Smart Appliance can determine if the line is available ($V_{bat}$ > 40 volts) or in use ($V_{bat}$ < 20 volts) before initiating a call.

Detecting when the telephone handset is lifted also requires monitoring of the loop voltage. In this instance the equipment checks for the small changes in loop voltage which occur as the telephone handset is lifted. Lifting the telephone handset increases the DC load. The battery voltage typically drops one to two volts as the load from the telephone handset is added to the loop. Upon recognizing this voltage change the Smart Appliance must immediately disconnect to permit access to the telephone line.

The Line-in-Use Detect and Handset Detect features operate on the telephone line side of the modem circuit, the DAA (Data Access Arrangement). Implementation of these features is critical because the connection to the telephone line is regulated under FCC Part 68 Rules. FCC Part 68 Registration is required of all equipment plugged into the telephone line. It is important that the Line-in-Use and Handset Detect circuits do not violate the FCC rules particularly the minimum on-hook impedance of 5 Meg Ohms. Meeting the FCC requirements is a primary reason designers frequently elect to use a pre-approved modular modem as provide by Xecom and other vendors.