Longwatch™

enabling security, safety, productivity

Video Engine Communications Using Cellular Gateways

Table of Contents

1 INTRODUCTION

The Longwatch Surveillance System is a highly-functional video application providing "at the edge" digital video recording from analog or IP cameras, event detection and integration of live video into the SCADA or HMI system locally. A typical Longwatch system consists of one Video Control Center component locally and 1 or more Video Engines in the field. The Video Engine component of Longwatch processes video directly from cameras as well as I/O from field devices such as motion detectors, door switches or inputs directly from an existing PLC or RTU. This application note is intended as a guide to help system integrators in the process of setting up a cellular gateway device as a means of communication to those Video Engines that reside at places where communication means is non-existent.

Historically, monitoring and control of remote sites have required very little data bandwidth. Since the advent of PLC's and RTU's, most remote operations entities have been upgrading communications to go along with the upgrade to these digital devices. However, even PLC's and RTU's do not require significant data bandwidth to perform as they have been required. Today, operators are asking for more capabilities in their remote operations, such as Video Surveillance and remote Access Control. The Longwatch system can operate on more networks than any other Surveillance and Access Control system in the world, including networks currently being used for the remote monitoring of pipelines, distribution networks, interstate transmission, storage, production and processing of water, natural gas, electricity, and oil, as well as a multitude of other remote monitoring applications such as rail, fleet management, rental equipment, and many others.

While the Longwatch system was designed for low bandwidth, Supervisory Control and Data Acquisition (SCADA) integrated operation, there are still many remote sites that have insufficient infrastructure, obsolete technologies or high levels of proprietary technology for even Longwatch to effectively operate on. These would include DC Telephone circuits, Tone (FSK) communications, proprietary radio networks, extremely slow networks (300 bps), and others. Additionally, networks that have not been designed and constructed with the ability for the remote sites to communicate back to a central facility prove problematic for any video surveillance system.

There is a very short (and expensive) list of upgrade paths that will result in a network that will be sufficient for scalable surveillance applications. However, to implement a successful Longwatch application, there are many additional choices for upgrading these insufficient networks. While all upgrade options will require some level of engineering, the simplest and fastest upgrade is to install a Cellular Gateway.

The term Cellular Gateway refers to a device that acts as an interface between a local computer or LAN and the Internet, through a cellular data connection. They can provide high performance wireless TCP/IP data communications via cellular networks, for connectivity to remote sites and devices. This communication pathway is secure and "always on" allowing for on-demand transfer of data to both Ethernet and/or serial devices.

2 CELLULAR GATEWAY IMPLEMENTATION CHECKLIST

A. Determine which sites will require a Cellular Gateway device.

B. Determine which cellular providers are available in your area.

- Use http://www.wirelessadvisor.com

C. Find cellular towers located in your area to estimate operability.

- Use http://www.antennasearch.com/

D. Perform preliminary Site Surveys at your target sites.

E. Select the Cellular Service Provider.

F. Procure Equipment, including Cellular Gateway, Antenna, Lighting Suppression, Cabling, and mounting hardware.

G. Activate the hardware with the Service Provider you have chosen.

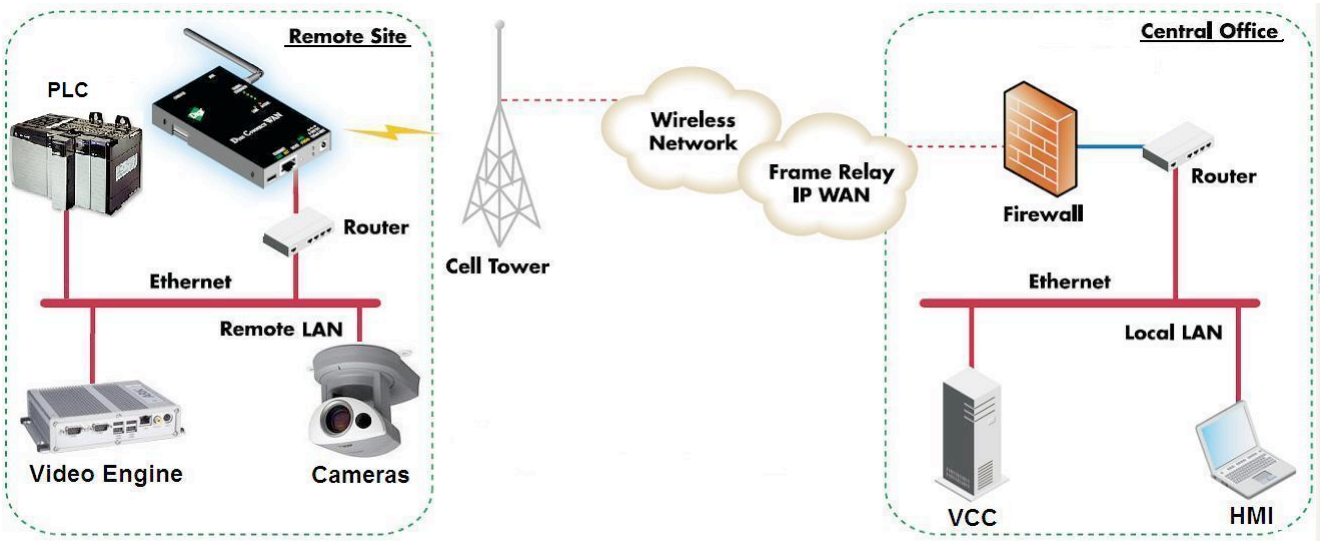
H. Install/Provision the gateway and test communications.

I. Test and tune communication from the Video Control Center location.

J. Configure the Longwatch Video Control Center for proper communication.

3 NETWORK LAYOUT

The cellular gateway device will reside at the same location as the Video Engine. Once the cellular gateway is configured, it will be assigned a unique, static IP address that is publicly accessible. With built in port forwarding capabilities, the gateway is able to act as a portal into remote network of the Video Engine. This allows the Video Control Center to access the remote network as well as the Video Engine to send data back to the VCC.



Network Security

Security is a consideration for virtually everyone deploying in remote environments today. Fortunately, there are advantages built into cellular networks that make the data communications inherently more secure than many other types of wireless networks. However, when considering a remote wireless deployment, one should be concerned not only with securing the data, but also with securing the management of the remote devices. You have the ability to address each of these issues with the following available features:

• Cellular data networks inherently provide Over-The-Air (OTA) encryption to protect the wireless data path.

• Cellular gateways can be configured using Access Control Lists for IP filtering to allow only certain incoming traffic. NAT support is also provided to hide private Ethernet connected IP addresses.

• Pass-through capabilities via TCP/UPD port forwarding are also incorporated in most cellular gateway devices.

• Secure management of the cellular gateway device can be provided via passwords, by blocking certain services such as telnet and by using HTTPS and SSH to manage the device. Optionally, the data traffic to cellular gateway management interface can be secured using SSL.

• Additional end-to-end security can be implemented between the remote site and the subscriber's central office by using IPsec. IPsec is fully supported and integrated in the Longwatch family of products.

4 CELLULAR SERVICE

Cellular service carriers can be divided into one of two categories: GSM or CDMA.

CDMA (Code Division Multiple Access) is a wireless technology delivered in the U.S by carriers such as Sprint® PCS and Verizon Wireless™. Coverage maps for CDMA carriers are available at http://www.cdg.org.

GSM (Global System for Mobile Communications) is the dominant global standard for wireless communications. Wireless carriers such as T-Mobile® and AT&T Wireless® deliver GSM in North America. A listing of international carriers can be obtained on the GSM World website at http://www.gsmworld.com.

4.1 Data Offerings

Both GSM and CDMA have evolved with technology improvements in what is called “Generations”, or “G” (i.e., 1G, 2G, and 3G), with fractional Generations recognized for the second Generation (i.e., 2.5G, 2.75G). With each technology improvement comes higher data rates and network enhancements. Table 1 shows the evolution path for GSM and CDMA. Please note that 1xEV-DV deployment is currently stalled and has, for the most part, been superseded by 1xEV-DO.

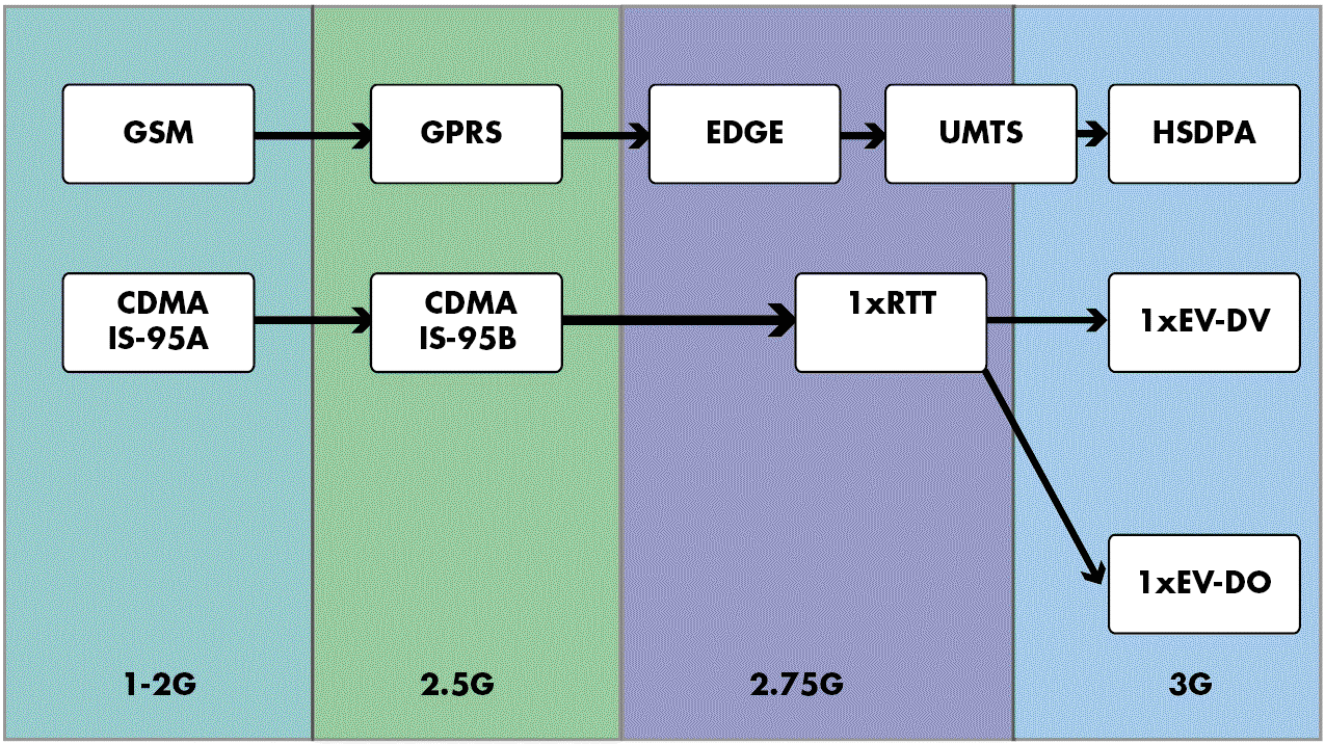


Table 1: Cellular Data Technology Progression

4.2 Data Transmission Rates

Both GSM and CDMA support different data transfer technologies. These technologies offer different data transfer throughput and speed capability. The cellular gateway device will have the ability to support one or more of these data transfer standards depending on the cellular carrier you chose. See

Table 2 for examples on data transfer rates. Please note that the "Typical Throughput" column accounts for real-world scenarios where wireless throughput is further reduced due to network congestion, fading, weather conditions and noisy environments.

Table 2: Estimated Data Transfer Rates

Technology	Generation	Connection Type	Theoretical Max Kbps	Carrier Max Kbps	Typical Throughput Kbps
GSM	1G	Circuit	—	9.6	—
CDMA	2G	Circuit	—	14.4	—
GSM GPRS Class 6	2.5G	Packet	64.4	40.6	15-30
GSM GPRS Class 10	2.5G	Packet	86.2	54.2	20-40
GSM GPRS Class 12**	2.5G	Packet	86.2	54.2	20-40
CDMA 1xRTT	2.75G	Packet	307	153	60-80
GSM Edge Class 2	2.75G	Packet	118	118	40-80
GSM Edge Class 10	2.75G	Packet	237	237	80-160
GSM Edge Class 12**	2.75G	Packet	237	237	80-160
UMTS (W-CDMA)	3G	Packet	384	384	200 – 300
1xEVDO (CDMA2000)	3G	Packet	> 2000	>2000	400 – 700
HSDPA	3G	Packet	> 2000	>2000	400 – 700

5 CELLULAR SERVICE PLANS

5.1 Cost

Cost is an important factor when deciding whether to deploy a cellular gateway solution. Fortunately, cellular data plan costs have fallen significantly, creating a more compelling reason to switch to cellular data networks for remote device communications. In addition, cellular gateways have the advantage of maintaining an "always-on" connection without paying for the airtime; therefore,

customers only pay for the data they actually send over the wireless connection. Wireless carriers typically charge customers by the number of Megabytes (Mb) or Kilobytes (Kb) transmitted per month. These rate plans vary from carrier to carrier but typically involve several rate plan options structured in the following format.

$X per month for up to Y Mb data + $Z per Kb over Y

Other rate plan options are available depending on the specific carrier and application usage profile. These plans may include provisions for unlimited usage, data pooling (usage spread across a number of devices), or time-of-day discounts. Monthly charges of $7.99 for 1MB to $69.99 for unlimited data access are typical rates, but can be more or less expensive depending on data usage plans.

5.2 IP Addressing

A typical Longwatch network is comprised of one Video Control Center (VCC) component and 1 or more Video Engines. The VCC initiates communication to each Video Engine which in turn replies with the requested data. Therefore, the Video Engine portion of the Longwatch network requires a routable or "reachable" fixed IP address. In order to accomplish this, the service plan must provide a public IP Address that is also static in nature.

Public vs. Private IP Addresses

Public IP addresses are generally reachable by anyone on the internet. They tend to be expensive because wireless carriers have a limited number of IP addresses they can issue. Because of this, most IP addresses associated with wireless data plans actually hand out private IP addresses that are not reachable by others around the Internet. Therefore you must request a public IP Address prior to initiating the cellular service plan.

Static vs. Dynamic IP Addresses

Most cellular carriers will issue a dynamic IP address as default for cellular service plans. With dynamic IP addressing each device is given an IP address for a limited period of time (usually no more than a few hours), and then the IP address is changed. Static IP addresses however, are assigned initially to the device and never change or renew.

Before committing to your cellular service plan, you must request a static IP address from the vendor. The Longwatch Video Control Center utilizes static IP addressing to communicate to each of its configured Video Engines. **Longwatch is NOT compatible with cellular gateways which are assigned a dynamic IP address.

6 SERVICE TESTING (SITE SURVEY)

Completing a full site survey prior to integration is a necessary step in ensuring the successful implementation of the cellular gateway device. A site survey consists of measuring the Radio Frequency (RF) signal strength of the cellular provider's network you have chosen. This series of tests must be performed on the site of final installation using one of the following devices:

- **Cellular Gateway *(Recommended)***

- **Cellular Phone**
  How to use a cell phone for a basic site survey:
  http://www.wpsantennas.info/pdf/testmode/FieldTestModes.pdf
- **Cellular AirCard**

NOTE: It is recommended to obtain a cellular gateway device similar to the model which will be used permanently prior to surveying the site. This will ensure the most accurate site survey possible and will give you the ability to become familiar with the device prior to integation.

The best throughput comes from placing the device in an area with the greatest Received Signal Strength Indicator (RSSI). RSSI is a measurement of the Radio Frequency (RF) signal strength between the base station and the mobile device expressed in dBm. The better the signal strength, the less data retransmission and, therefore, better throughput.

6.1 Testing with a Cellular Gateway

RSSI information is available from several sources on the cellular gateway device:

1. The LEDs on the device give a general indication (1-4 "bars").
2. Via the Digi device's local user interface:
   - http (Digi web interface > Information > System Info > Mobile)
   - CLI command "display mobile" via telnet, SSH or local serial port connection (via HyperTerminal, TeraTerm or other emulation package) to the Digi cellular router.
3. Digi Connectware® Manager (Server Platform) can also display the value in dBm via System Information screen.

LED Signal Strength

-101 dbm or less (0-1 LED) = Unacceptable coverage

-100 dbm to –91 dbm (1-2 LEDs) = Weak Coverage

-90 dbm to –81 dbm (2-3 LEDs) = Moderate coverage

-80 dbm or greater (4 LEDs) = Good Coverage

7 CELLULAR SOLUTION COMPONENTS

Establishing a connection to a remote Video Engine and allowing access to that device and others on a remote network involves two important pieces.

• Hardware: A cellular gateway product such as the Digi Connect WAN or Airlink Raven-E.

• Cellular Service Plan: Acquiring a monthly service plan from a wireless carrier.

7.1 Hardware and Distribution

Some hardware distributors sell devices but do not offer activation services, while others bundle activation with the hardware purchase. Buying a pre-activated wireless product requires the customer to contact a wireless carrier to identify a proper rate plan and acquire a public and static IP connection.

Solution providers that offer both hardware and wireless service activation can help simplify this process for customers. Longwatch has had success with the following distributors:

1. Industrial Network Solutions

16415 Addison Road
Suite 550
Addison, TX 75001
Phone: 1 972 248-7466
Fax: 1 972 248-9533

http://www.industrialnetworking.com/

2. Express Systems & Peripherals

640 Herman Road
Suite 5
Jackson, NJ 08529
Phone: 1 800 222-0172

http://www.express-inc.com/

3. Ingram Micro U.S.

1600 E. St. Andrew Pl
Santa Ana, CA 92799-5125
Phone: 1 800 456-8000

http://www.express-inc.com/

4. Source Inc.

10975 Benson
Suite 350
Overland Park KS 66210
United States
Phone: 1 913 638-4243
Fax: 1 913 322-3683

http://www.sourceincusa.com/

5. USAT Corp.

P.O. Box 9334
Chapel Hill NC 27515-9334
United States
Phone: 1 888 550-8728
Fax: 1 913 322-3683

http://www.usatcorp.com/products/

7.2 Wireless Carriers

Wireless carriers offer cellular services in either GSM or CDMA format. Below you will find some of the more prevalent U.S. cellular carriers. For more information about vendors in your area, please visit: http://www.wirelessadvisor.com

- AT&T Wireless (GSM) - U.S.
- Broadpoint (GSM) – U.S.
- Sprint (CDMA) - U.S.
- Verizon Wireless (CDMA) U.S., Puerto Rico
- Rogers Wireless (GSM) - Canada
- Midwest Wireless (CDMA) - U.S.
- Alltel Wireless (CDMA) - U.S.
- T-Mobile (GSM) - U.S.
- Cellular One (GSM) - U.S.
- Bell Mobility (CDMA) - Canada