RF TECHNOLOGIES®

Resolving RF interference in the assisted living and long-term care setting: a case study
By Elroy Shelley, RF Interference Specialist

Lakeport Skilled Nursing Center is a 90-bed facility located 115 miles north of San Francisco. It is one of 34 skilled nursing, assisted living and retirement communities in California and Utah owned by privately held Horizon West HealthCare, Inc.

Like most such facilities, Lakeport makes use of multiple electronic systems and devices to assist in providing patient care, security, recreational activities and administrative services. Lakeport uses a mix of hardwired and wireless electronic systems including a computer network, a wandering management exit system, walkie-talkies, a voice paging system, cell phones, public address (PA) system, televisions, electronic organ and assorted other facility and patient-owned electronics.

Symptoms of radio frequency interference

Over a span of time, symptoms of radio frequency interference (RFI) at Lakeport were manifested through a variety of seemingly unrelated issues occurring throughout the Lakeport facility. Unexplained problems with reliability of their computer network resulted in unpredictable losses of data that necessitated retransmission of data packets for resident charting, licensing reports and re-imbursement filings. Slowdowns in network operation were noticeable. Staff conversations over walkie-talkies were often garbled and unintelligible. As a result, the devices were discarded in favor

Understanding RF Interference in the Healthcare Environment

Electronic disturbances that interfere with the successful transmission of other electronic signals are called electromagnetic interference (EMI). A subset of EMI, radio frequency interference (RFI) or RF noise refers to a particular segment of the electromagnetic spectrum that is typically used for broadcasts between 150kHz and 1GHz. RF noise may be audible; more often, it is inaudible and thus it is more difficult to isolate its source.

RFI from a proliferation of wired and wireless equipment is a growing challenge in healthcare settings. Computers-on-wheels (COWs), wireless nurse call and patient security systems, generators, radio frequency identification devices (RFID), notebooks, personal data assistants (PDAs), microwaves, cell phones and pagers place growing demand on a limited electronic frequency spectrum. Furthermore, new energy-saving features of medical equipment and lighting emit less heat but convert energy to a form that pushes out more RFI.

While it would be nice if radio frequencies could all just get along, this is clearly not the case. Not only do the plethora of transmitters interfere with each others' signals, RFI can also interfere with the functioning of critical medical equipment and computer networks. Limited federal RFI standards are not enforced, and inadequate knowledge of most equipment vendors leave healthcare facilities vulnerable to complex RFI problems.

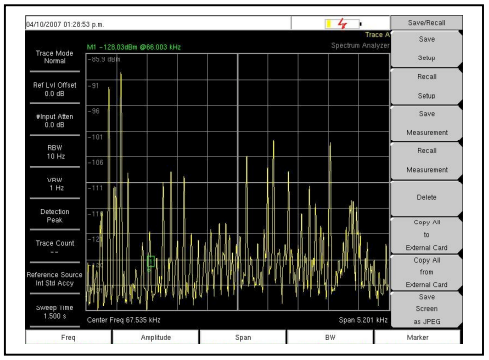
of cell phones. Quality of cellular telephone signals varied at different locations around the facility and at different times of day and night. During religious services and musical programs, the electronic organ had an annoying habit of producing a loud electrical buzz. The voice paging and public address system sometimes emitted a similar buzz. Staff began to see intermittent interference with the wander management exit system.

"Few things were more exasperating than having both front and back door wander-alarms go off when there was no reason for them to do so. All of the emergency measures triggered by these alarms sprang into effect only to discover yet another false alarm, maybe the 13th or 14th that day," says Paul D. Morris, Ph.D. Executive Director, Lakeport Skilled Nursing Center.

The array of electronic problems consumed staff time. Outsourced consultant fees and service call charges ran up expenses and frustration levels. In addition, there were less tangible costs. System failures increased potential liability. The welfare of their residents was paramount. Lakeport staff devoted considerable time and money trying to resolve these problems. It became clear that specific expertise was required.

RFI Detective Unravels Mystery

RF Technologies' Service and Solutions Division was called in based on their expertise in electronic signals complexities. RF Technologies consultants specialize in RF interference mitigation. They often find that in healthcare settings where so



Multidirectional RF travel often mystifies

The ability to identify the source of RFI and resolve its complications lies in understanding how radio frequency interference travels. Radio frequency interference is normally stronger at its source and weaker with increased distance from origin. RFI travels in two ways.

1. Radiated RFI is like a sunburst, spreading out in all directions from its point of origin.
2. Conducted RFI travels along wiring, cables, water and gas pipes, and metal surfaces such as gutters, power lines and fences.

The source of RF noise does not need to be connected to a conductor for interference to travel. Wires or cables near the source may pick up ambient radiated RFI on their surfaces and become conductors. Conducted RFI can travel considerable distances from its source. Along the way, RFI may also be thrown off or radiated from the conductor.

It is no wonder that it can be extremely difficult to identify the source of radio frequency interference. A professional in radio frequency interference Mitigation Specialist will rely on their knowledge of the science of radio frequency transmission. Like a sonar technician on a submarine, they will have a unique intuition for listening to noise patterns. In addition, they will need to have a number of tools to assist them in identifying RFI and patterns. These tools can range from a simple radio and associated combinations of antennae to a more complicated spectrum analyzer that can capture spectrum signatures.

much electronic equipment is present in close proximity, the affects of RFI are widespread and interrelated.

It is important to pay particular attention to the "what, where and when" of RF noise activity when investigating the kinds of problems Lakeport was experiencing. The combination of the instrumentation, field experience and data interpretation skills that the consultant brings to the situation is what allows the RFI expert to identify the source of complex and interrelated problems. To understand the complexity of identifying the source of RFI, it helps to trace the process of discovery employed by the RF Technologies consultant for Lakeport.

On his first day on the scene, the RFI consultant used an RF noise "Sniffer" that detects and locates RF signals like a Geiger counter. Midafternoon testing found widespread presence of RFI. The noise disappeared at 5:00 p.m.

The RF consultant returned early the following morning. At 7:30 a.m., the facility was still clear of RFI. A few minutes past 8:00, RF interference was again present. By midday, the Sniffer registered severe RF noise.

The consultant was able to determine the level of severity of the RFI at its operating frequency, using radio detection equipment. It was found that RF noise flooded the entire facility. Interference was also detected on electrical lines and AC outlets, appliances and electrically grounded items, including water pipes, metal doorframes, building framework, computer network cables, the voice paging system, telephone cabling and TV system coaxial cable. This RF interference was

detected as far as two city blocks from the facility in all directions. In all likelihood, neighbors were experiencing similar difficulties.

Using detection equipment, the consultant moved systematically around and throughout the building to isolate the source of the interference. It became clear that the RFI was emanating from within the building, not from an outside power line or exterior source.

The signal became stronger as the consultant traced cable TV wiring through the ceiling and followed the cable split down a hallway to residents' rooms, most of which had televisions connected to the cable. The consultant turned off all televisions in the facility. Radio frequency interference ceased. One by one, each television was turned on and then off again. When the television in one resident's room was turned on and off, it became apparent that this 1980s vintage television was the source of the troublesome RFI. There was no way that a casual observer could have known the problems that this old TV was causing.

RFI detective work solves multiple problems

The television was replaced and RF noise was no longer a problem. The buzzing sounds on the voice paging and PA systems vanished. Walkie-talkie and cell phone clarity improved. Computer network problems disappeared. The organ played beautifully. Radio frequency interference generated by an unsuspected television had been the culprit, and the cable TV wiring had conducted the RFI throughout the facility. The

source of RFI noise was eliminated. All systems were functioning properly again.

“We scoured all of the experts within a hundred miles to help us find the problem, but not until RFT Technologies came to the rescue did we finally resolve it. I find it absolutely baffling that RFT found the trouble to be one of our resident's television sets triggering the alarms. We replaced it and the problem vanished,” Morris says.

RF interference in healthcare settings requires specialized expertise

Long-term care facilities and hospitals will continue to add new technologies and modify existing electronic systems. Facility managers, administrators, security directors, architects and builders increasingly recognize the need for experts in radio frequency interference as valuable partners in facility design, systems planning, troubleshooting and resolution of electronic systems problems.

Implementation of new medical equipment introduces new sources of electromagnetic radiation into the environment. Portable ultrasound machines, dispensers for pharmaceutical distribution, electronic IV pumps, wireless medical telemetry systems, nurse call and telephone systems, and computers for electronic health records all have the capacity to create new RF interference problems. The proliferation of professional and personal wireless devices adds another possible complication.

RFI can also emanate from facility infrastructure. Elevator controls, energy-saving fluorescent light fixtures, and variable

speed drives used in HVAC applications also contribute to RF noise. In addition, failure to install, ground and maintain electrical and electronic equipment properly can greatly increase radiated electromagnetic interference.

Any addition or change in electrical devices may affect operation of critical equipment or systems due to radio frequency interference. However, technological problems tend to be perceived initially as equipment failures. Costs rise and efficiencies decrease while equipment and system vendors attempt to resolve problems that may not lie with their hardware. Many vendors and service representatives lack technical understanding of how radio frequency noise may interfere with the performance of their equipment. Furthermore, they may not have an appreciation for how the RF noise from their own systems may be impacting other systems throughout the facility.

Lack of RF standards precludes assurances of commonality and compatibility across equipment and systems. The result can be unpredicted complications resulting from RF interference. Whether designing a new facility or upgrading systems and equipment in an existing facility, potential ramifications of radio frequency interference in healthcare environments demand thorough and expert consideration.

For more information about radio frequency interference, please contact RF Technologies Services & Solutions at 800-669-9946. www rft.com

About RF Technologies, Inc. *RF Technologies specializes in state-of-the-art radio frequency identification (RFID) monitoring systems for long-term care facilities and hospitals, with an installed base of more than 10,000 systems worldwide. RF Technologies' Service and Solutions Division was first in the industry to offer RF Consulting and 24/7 service support.*

RF Technologies integrated systems include Safe Place® ED and Infant Security, Code Alert® Wandering Management and Wireless Call, Sensatec® Fall Management, PinPoint® Asset Tracking and Seeker® Mobile Locating Solutions.