

Remote Monitoring: Mining and Caterpillar® Equipment

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The mining market is a very attractive market for Monico because of the dominance of Caterpillar in this market. Caterpillar is known to be the largest manufacturer of mining equipment in the world. What makes CAT even more interesting in this market is the fact that they manufacture the entire machine instead of only the engines to drive other equipment. These machines range from “small” machines weighing 100,000 pounds to the largest mine haul truck that weighs 1.4M pounds with a payload of around 880,000 pounds. This largest mine truck is driven by a 4000HP 20-cylinder diesel engine and requires 11 flatbed trucks to transport. Each tire on this haul truck costs about \$75k. The capital cost alone drives the need to see this piece of equipment generating revenue 24/7/365, so remote monitoring is a critical piece of the asset management.

Many mine operators have driver-simulators almost as sophisticated as airliner simulators where drivers can be trained to better operate the equipment. For example, if an operator goes down a hill too fast and overheats the breaks, this mistake can cost tens of thousands of dollars for repair. Engine alarms are monitored constantly, and drivers are required to go through remedial training to prevent reoccurrences when mistakes are made.

Another feature of these machines in the mining market is the sophisticated electronics to run them. Each of these machines has from 2 or 3 ECM's up to about 8 ECM's running on the Cat Data Link (CDL) with later model machines adding an S.A.E. J1939 data link. Since our gateways reside on the native CDL data link, we can gather data from all the ECM's on the equipment and if the equipment has J1939 we can connect to both links to take advantage of varying data sets on each link. In addition, we can connect via J1939 to accessory data links like tire pressure monitors. In addition to sensor data, we provide visibility of all Fault codes from the machine network.

Caterpillar offers a VIMS module on these machines that ranges from \$30k-60k and offers some information to customers. Unfortunately, this module is taking the raw sensor data from the ECM's and aggregating the data down to Minimum, Maximum, Average, and Median values and outputs in a text format once per hour which requires parsing into a database. Since it is not raw data, it is of limited value in performing analytics for Condition-based maintenance. In addition, VIMS is not available for equipment such as the dozers and graders, whereas, Monico gateways can work on all CAT electronic equipment.

Therefore, Monico's ability to provide real-time streaming data directly from the ECM's is an enormous value to our customers who want to perform their own analytics. Since 11 of 11 of the Fortune500 mining companies use the OSI Pi System, the new Pi Connector on mCore®SDR is a tremendous tool to gather data for



analytics. The Monico implementation of OSI Message Format (OMF) includes data containers that are created on mCore with a real-time stamp. The container can be created on a periodic basis or by an exception value. Once created and time-stamped, the container is sent to the buffer that holds it until there is a network connection available. We can buffer up to 2GB of data in the standard version but can buffer more if needed us an onboard microSD card. When these time-stamped containers arrive at the Pi Relay Connector in the Pi System, they are automatically decrypted, decompressed, and put into Asset Frameworks and Archive. This assures 100% data with no packet losses which is so critical for analytics.

If the customer does not have their own remote monitoring or analytics platform, Monico offers our own Pi System in the Microsoft Azure cloud called MonicoLive. MonicoLive uses Monico's subject matter expertise to provide pre-configured visualization, data analytics, and automatic notifications. Monico's new flagship product, mCore®SDR was specifically designed to take data from sensitive critical equipment to the public cloud in a secure manner. mCore opens an outbound socket to the pre-programmed IP address to the MonicoLive server in the Azure cloud. mCore inspect the servers' certificate to authenticate it is the server we intended to contact. An encrypted SSL tunnel is opened, and all communications is both encrypted and compressed. When setting up the connection in MonicoLive, an SAS token is created that is unique to each mCore connection. This token is NEVER passed over the link but is manually installed in the mCore unit. This token serves to authenticate this mCore to the MonicoLive server, thus insuring a bi-directional authentication scheme.