International Rock Excavation Data Exchange Standard

IREDES

Standard documentation

DRAFT
IREDES Machine Status Profile

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Author:	Dipl. Ing. Christoph Müller, PhD

Contents

1 Document Information

1.1 Change history:

Date	*Initials*	*Vers*	*Major Changes made*
30.09.15	CM	1	Initial release

1.2 Document Draft Information

Sections in which the document is regarded incomplete or where specific topics are not complete or missing, related text or resulting questions are written in bold italics embraced by [ ]:

[This topic has to be added...]

1.3 Disclaimer

This is an uncorrected, not reviewed and not formally released draft of a development document still in the progress of being set up.

This document therefore is not a formally binding standard specification nor of any contractual relevance. Until officially released, it may not be used for development of equipment or software claiming IREDES standard compliance.

The document is used to reflect the ongoing status of standard development.

Comments and corrections please send to:

cmueller@iredes.org

2 Introduction

IREDES is a flexible standard architecture for convenient worksite information exchange in the mining industry. It is used for information exchange between mainly mobile equipment and devices on one side and central computer systems on the other side. Also Machine-to-Machine ("M2M") communication is covered to a certain extend. Excluded from the standard is any direct communication related to machine remote control as this is inside the product responsibility of the respective suppliers.

The standard covers definitions of how to exchange information and what kind of content is exchanged.

The standard documentation in the future consists of different parts:

IREDES Part 0:	General definitions and standard architecture
IREDES Part 1:	Generic and equipment type independent parts used in common in all specific parts of the standard: Application Profiles, Commonly Used Objects
IREDES Part 2:	Drill Rigs and Bolters
IREDES Part 3:	Explosives Chargers
IREDES Part 4:	LHD's, Trucks and rubber tire based transportation vehicles
IREDES Part 5:	Tracking, Messaging and Work order handling

These standard parts are being extended basing on the demands of the IREDES members.

This document will be later compiled into the IREDES Part 1 documentation as it deals with machine type independent Machine Status and Maintenance Status information.

All machine type specific extensions have to be reported in the corresponding machine type specific parts.

3 Scope of this document

This extension of the IREDES standard covers the real time reporting of machine status information in order to allow a seamless integration of the machines into a controlled and optimized mining production process.

This document contains newly made specifications for

- Machine Status information
- Machine Maintenance information
- Alarms and Events

The document will be later compiled into the IREDES Part 1 documentation as it deals with machine type independent Machine Status and Maintenance Status information.

All machine type specific extensions have to be reported in the corresponding machine type specific parts.

4 Normative References

Normative references are to be given in ISO standardized format:

ISO #####-#:20##, General title — Part #: Title of part

5 Terms and definitions

5.1 Commonly Used Objects

Definitions in the standard which are used in identical form by different profiles. Explained in detail in Part 1 of the standard

5.2 IREDES

International Rock Excavation Data Exchange Standard.

To be completed

6 Timing of Information Exchange

Exchanging Machine Status Reporting telegrams ideally needs an online communication to the machines or at least a hot spot coverage allowing to update the machine status whenever the machine comes within reach of a communication base station.

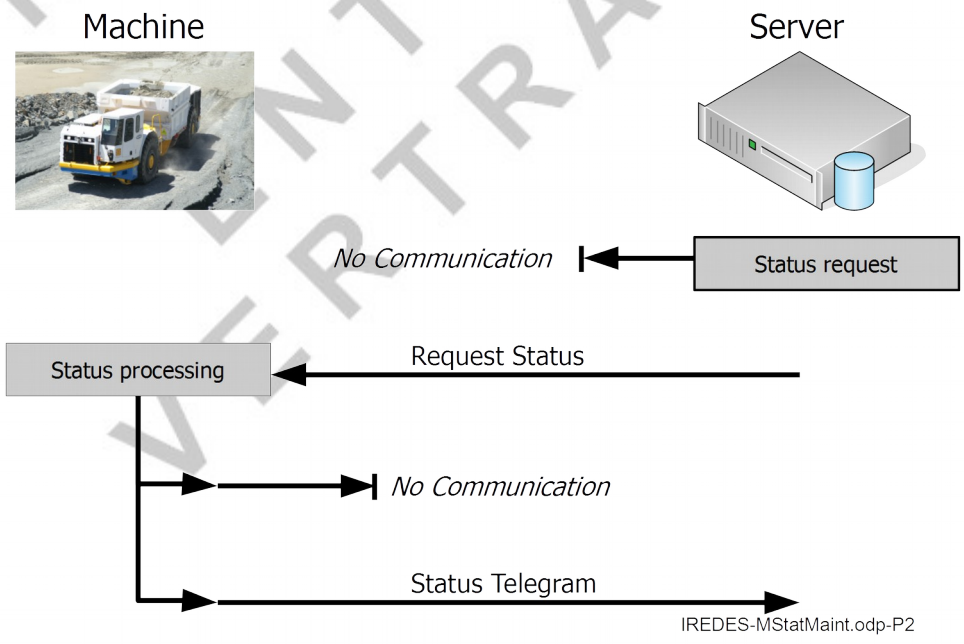
For machines typically working remote without any communication coverage, also mobile vehicles and / or other machines may be used as a proxy forwarding the information from the stationary machine to the network (See 6.5).

When a machine was subject to a communication loss it has to transmit all status information in cases 6.2. - 6.4 immediately when a communication link becomes available.

A machine supporting this standard has to implement at least the Request and Send upon Change communication types as Web Services to fulfill Basic Standard Compliance. Full Standard compliance requires an implementation of all types of information exchange at least as Web Services. Implementation of OPC/UA is optional as this more or less also is a special type of Web Service.

The methods used by a particular machine may be configured on the machine's information processing device.

6.1 Request



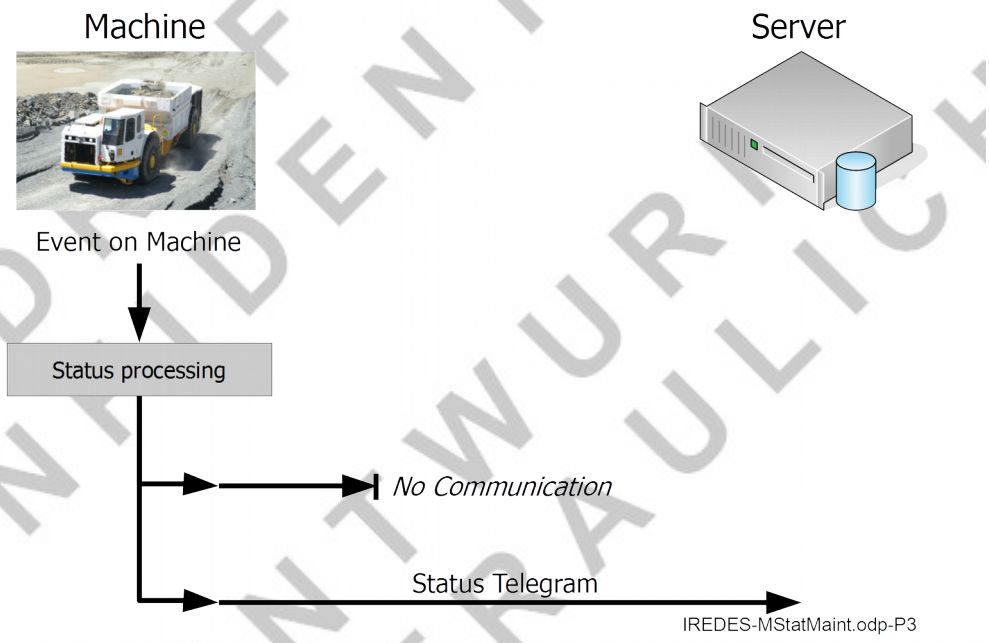
Picture 1: Telegram Exchange Request

Request Status is an explicit request which is answered on demand only. The server sends a Status Request to the machine and the machine answers with the respective Status telegram.

Attention: The use of “Request” requires the machine to be inside network coverage upon time of reception of the Request datagram from the server.

6.2 Send upon Change

This type of communication triggers a send of a new status telegram always when the status telegram content data changes or a relevant event on the machine happens.



Picture 2: Send upon change

In order to prevent from permanent sendings, timing relevant information like operating hours and other timings are transmitted in 10 minute intervals. This parameter may be configurable in the machine device settings.

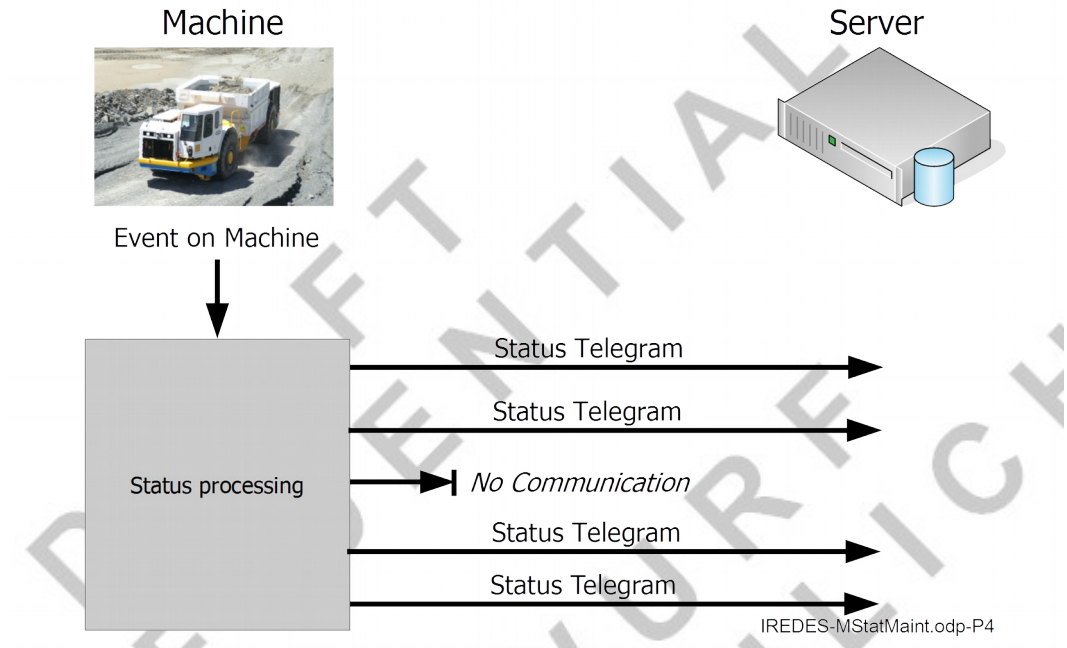
An event of any kind triggers the transmission of the entire telegram.

6.3 Periodic

A periodic information exchange is triggered solely by the machine.

A full telegram will be sent every *n* minutes, whereas *n* shall be configurable on the machine's information processing device.

The configuration on the machine's information processing device may include sending the telegrams to several destinations if this is applicable.



Picture 3: Periodic information exchange

6.4 Subscribe

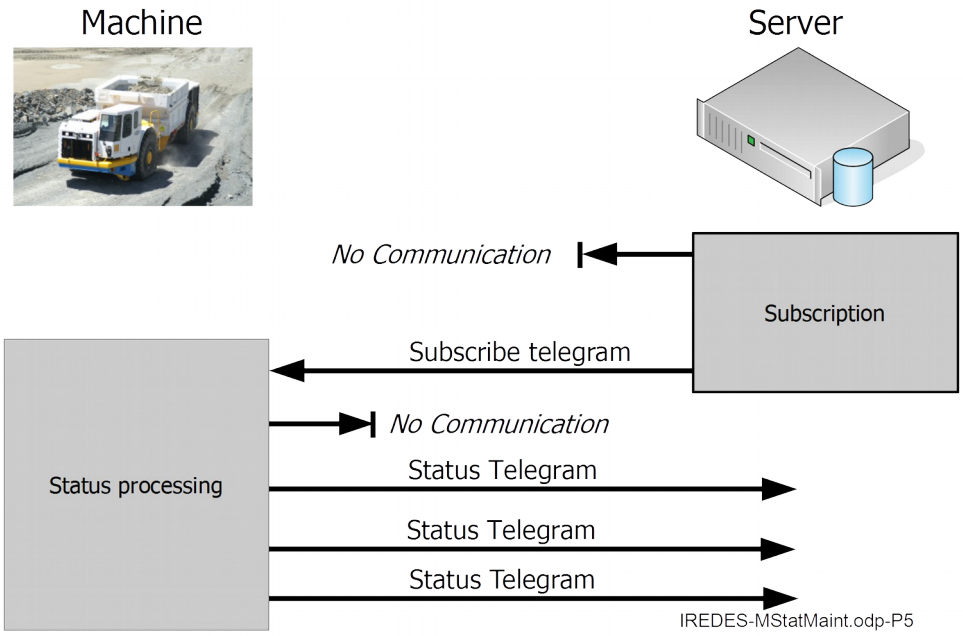
Using the Subscribe type of communication means that a server sends a subscription telegram to the machine explaining which may contain a specific configuration of the timing of data exchange and also which particular telegrams are to be transmitted.

The machine then transmits these telegrams according to the configuration without the need for specific Requests.

A subscription is terminated when a related message is received.

Subscriptions and their configurations need to be persistently stored on the machine in order to be re-established after a machine shutdown or power loss.

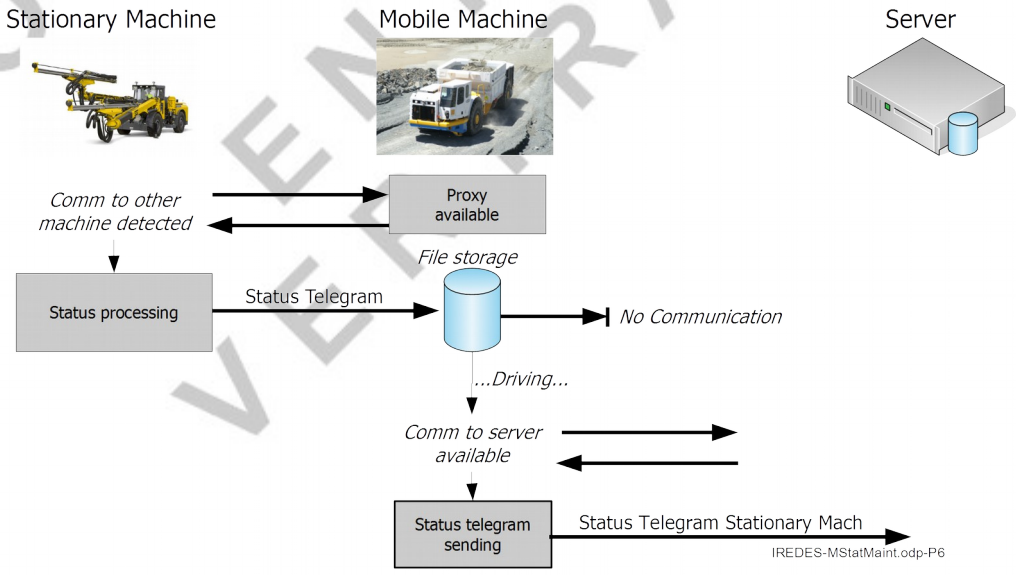
All subscriptions are automatically re-triggered for sending when the machine enters into an area covered by the communication system.



Picture 4: Subscription

6.5 Machine Proxy

Using the Proxy communication method is applicable to machine in remote workings where an online communication is not or not yet available.



Picture 5: Mobile Machine or vehicle as Proxy for remote stationary equipment

This type of communication needs mobile equipment (machines or vehicles)

equipped with related proxy functionality. This may be provided either by the mobile machine's own communication device or by dedicated hardware units mounted on these vehicles or machines.

To prevent from confusions, the Proxy function needs to be enabled on the stationary remote machine in order to allow sending telegrams to a proxy vehicle. Otherwise it has to be fully transparent to the stationary machine meaning that no other special configuration should be required.

6.6 Methods of Information exchange

The following methods are supported:

Web Services (Details /(Examples tbd)

OPC/UA (Details /(Examples tbd)

Any of the methods used has to take into account that communication are volatile: **A communication loss is a regular operating condition.**

Communication loss or unavailability therefore may not lead to software stopping to work, slowing down or waiting (“hang”) several minutes before resuming processing.

Implementors have to take care of these facts of underground and wireless communication.

7 Machine Status reporting

Machine Status reporting is defined as reporting the operational status of a machine in real time. Machine Status information is mainly relevant for production follow up, ongoing production planning and machine dispatch.

In addition to the generic IREDES Header information, the Machine Status report covers the following main information explained in the following sub chapters. For detail information please refer to the spread sheet as working document.

All values described below are valid at the time of reporting!

This generic Machine Status reporting Profile is implemented as Complex Type in the IREDES Application Profile. By this principle, it can be derived by extension from within every Equipment Profile using it thereby assuring that all generic information is compatible throughout different machine types.

Add spreadsheet information to sub chapters when discussion finished and first release is being documented

7.1 Operational Status

The Operational Status of the machine states whether the reporting equipment is working normally or with active failures or warnings.

Embedded into the operational status also is the information whether communication to the machine is available or not. This , to be exchanged via network upon request or sent continuously / upon network availability

7.2 Operation Mode

The operation mode states whether the machine is operated manually (“MANUAL”), in a semi-automatic (“SEMIAUTO”) mode (like e.g. drilling a single hole automatically for a Drill Rig) or fully automatic (“AUTO”). Automatic in this sense means fully automatic with an operator on board or also autonomous (operator less).

7.3 Operator Location

This entry states the location of the operator. Valid entries are “LOCAL” for local operation from the machine's cabin, “RRC” for Radio Remote Control when the operator is in line-of-sight contact to the machine but not on the machine or “REMOTE” when operation is performed from a remote control room, control cabin or operation center.

7.4 Working Location

Working Location is the location of the machine in the mine. This information is provided as IREDES coordinate system entry.

If not provided by the machine, this tag can also be added by an intelligent communication infrastructure (e.g. a reporting accesspoint) or through the database by recombination of the location via the communication system.

7.5 Communication Status

This field states the current communication status to the machine. It is optional and can be added by the server system in order to provide a comprehensive status overview to be forwarded by the Server to other IT systems like visualizations etc.

This field cannot be filled in by the reporting machine!

7.6 Last Comm

Date/Time the machine was last online in the communication network (last Status Data Exchange). This field is optional and can be added by the server system in order to provide a comprehensive status overview to be forwarded by the Server to other IT systems like visualizations etc. It states at what date / time the last Status data exchange to the machine took place.

This field cannot be filled in by the reporting machine!

7.7 Operating Hours

A number of fields is used for reporting the operating hours of the machine. The most important one is the field OPHRSTOT reporting the total operating hours as they traditionally can be found on the counter of the machine.

Sub-Entries report on the operating hours of specific subsystems or single aggregates on the machine. These are defined within the equipment profiles and which also may contain supplier specific.

8 Machine Maintenance Information

Machine maintenance information is used to track machine health and for organization of preventive and predictive maintenance.

In addition to the generic IREDES Header information, the Machine Maintenance report covers the following main information explained in the following sub chapters. For detail information please refer to the spread sheet as working document.

All values described below are valid at the time of reporting!

This generic Machine Status reporting Profile is implemented as Complex Type in the IREDES Application Profile. By this principle, it can be derived by extension from within every Equipment Profile using it thereby assuring that all generic information is compatible throughout different machine types.

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8.1 Estimated Time To next Service (ETTS)

Estimated time to next service is the only mandatory tag in the MAINTSTAT type. Defines the number of machine operation hours until the next service of whatever kind is due. May be optionally supplemented with detail data from 8.2. The general ETTS is the minimum out of all reported detail ETTS values (8.2).

8.2 ETTS Detail Information

This is a list of all detail ETTS information for subcomponents or single aggregates (e.g. hydraulic pump, Rock Drill, …)

In the Application profile, only the data type is provided for this entry. The Equipment Profile has to fill it with machine type specific information.

9 Alarms and Events

Any machine able to support alarms shall be able to communicate these alarms or error messages to central IT systems.

The IREDES Alarm lists contain the following information for each alarm entry:

9.1 Time Stamp

9.2 Unique ID

Unique Alarm Identification (ID) assigned by the machine to be able to create a link between a coming or going alarm and the operator acknowledgement.

9.3 Alarm number

This is the alarm or message number identifying the event.

9.4 Alarm Classification:

The following classifications are introduced:

INFO	for information only,
WARNING1	Warning level 1: Regular Warning, the machine is able and allowed to continue operation
WARNING2	Warning level 2: Warning2 is issued when the machine was operated overriding manufacturer defined procedures or maintenance schedules
ALARM	Stop of the machine for technical reasons, which however are not specified in detail. Such analysis can be done on server systems by analyzing the Alarm Numbers and their occurrences / durations of presence.

9.5 Alarm Status

The Alarm Status states whether in which status the alarm is:

Active	Active alarm, pending
ACK	Acknowledged by operator (Optional)
Cleared	Alarm cleared meaning that the technical reason for the alarm is not present any longer.

In the Application profile, only the data type is provided for this entry. The Equipment Profile has to fill it with machine type specific information.

9.6 Black Box Reference

When an alarm is logged, the machine may have created a Black Box recording data for some time prior to and potentially past the event. In this case, the entry contains the file name of the Black Box as a Reference.

Due to the individuality of the machines and their automation systems, a Black Box may be evaluated only be the machine manufacturer using proprietary equipment and analysis tools.

As a Black Box is not of relevance for integration of the machine into the operational process, this is not of standardization relevance.

List of pictures

Pictures

References

[1]

[2]

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