

Overview

The TCM[®] System consists of the M-System mounted in the wind turbine nacelle (top housing) and the back-bone TCM[®] Server at the control room e.g. at the TCM[®] Data Center. The TCM[®] server must be able to contact the M-System to collect data and system information to do the permanent Turbine Condition Monitoring tasks and the M-System must in certain configurations be able to contact a time (ntp) an/or email server (smtp). All communication is based on the TCP/IP transport protocol i.e. the protocol used on the Internet. This connection is in the following referred to as the infrastructure. The infrastructure can be implemented in many ways, depending on existing infrastructure and the location of the wind turbines.

Table 1 - Infrastructure Components

Abbreviations	Description
AP	Wireless Access Point
ISDN ROUTER	A router capable to connect TCP/IP networks over an ISDN connection
CAP	Wireless Client connecting to an AP
LAN	Local Area Network 100 Mbit implemented as Ethernet STP CAT5 cables
FB	Fibre cable connecting two LAN's through media converters, typical top to bottom in the tower
GSM MODEM	GSM modem for GPRS connections, i.e. a radio based telephone connection
MC	Media converter between FB and LAN medium
ADSL/CABLE ROUTER	Broadband Internet connection

The M-System can be connected to the TCM[®] Server in various ways:

- Directly by a GSM MODEM
- Through wireless (CAP) to an AP connected through ADSL or ISDN ROUTER
- To a LAN in the Site of either FB or copper cables or a combination, connected through ADSL or ISDN router

A mix of the connections named above is of course also possible. The TCM[®] Server has as needed an ISDN, GSM or Internet connection.

Possible Infrastructure

Various topologies can be implemented with the items listed in table 1. A typical wireless configuration is shown below in figure 1.

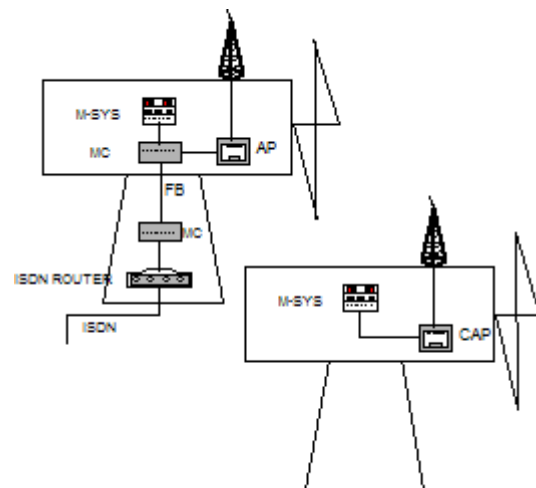


Figure 1 Typical wireless topology

Cost of Infrastructure

The most optimal infrastructure from a technical point of view is a 10/100 Mbit LAN connection in the nacelle connected to the TCM[®] Server through the Internet with a bandwidth of 2 Mbit or more. To minimise cost other solutions may be more attractive and still satisfying. The most optimal solution depends of the existing infrastructure at the site and on the distance between turbines. If the infrastructure goes from bottom to top in the tower we recommend using an optical fibre connection although a copper cable could do. If no usable infrastructure between the turbines exist it might be more feasible to use radio-based communication as wireless or GSM, compared to digging fibre cables into the ground. A typical scenario connecting an existing site with a number of wind turbines using wireless, AP, ISDN or ADSL will cost approximately 200-300 € per turbine @ 5 turbines in direct equipment costs. A GSM/GPRS solution will cost app. 400-500 € per turbine. On top of this you have to add ISDN, ADSL or GSM subscription fees if these not exist already.