Software Engineering I – Case Studies

Wilderness Weather Station

To help monitor climate change and to improve the accuracy of weather forecasts in remote areas, the government of a country with large areas of wilderness decides to deploy several hundred weather stations in remote areas. These weather stations collect data from a set of instruments that measure temperature and pressure, sunshine, rainfall, wind speed and wind direction.
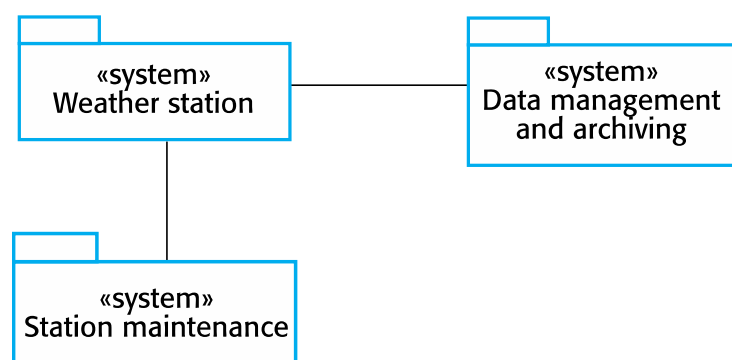

Figure 1. The Weather Station Environment.

Wilderness weather stations are part of a larger system (Figure 1), which is a weather information system that collects data from weather stations and makes it available to other systems for processing. The systems in Figure 1 are:

1. The weather station system. This is responsible for collecting weather data, carrying out some initial data processing and transmitting it to the data management system.

2. The data management and archiving system. This system collects the data from all of the wilderness weather stations, carries out data processing and analysis and archives the data in a form that can be retrieved by other systems, such as weather forecasting systems.

3. The station maintenance system. This system can communicate by satellite with all wilderness weather stations to monitor the health of these systems and provide reports of problems. It can update the embedded software in these systems. In the event of system problems, this system can also be used to remotely control a wilderness weather system.

In Figure 1, a UML package symbol is used to indicate that each system is a collection of components and have identified the separate systems, using the UML stereotype «system». The associations between the packages indicate there is an exchange of information but, at this stage, there is no need to define them in any more detail.

The weather station includes a number of instruments that measure weather parameters such as the wind speed and direction, the ground and air temperatures, the barometric pressure and the rainfall over a 24-hour period. Each of these instruments is controlled by a software system that takes parameter readings periodically and manages the data collected from the instruments.

The weather station system operates by collecting weather observations at frequent intervals – for example, temperatures are measured every minute. However, because the bandwidth to the satellite is relatively narrow, the weather station carries out some local processing and aggregation of the data. It then transmits this aggregated data when requested by the data collection system. If, for whatever reason, it is impossible to make a connection, then the weather station maintains the data locally until communication can be resumed.

Each weather station is battery-powered and must be entirely self-contained – there is no external power or network cables available. All communications are through a relatively slow speed satellite link and the weather station must include some mechanism (solar or wind power) to charge its batteries. As they are deployed in wilderness areas, they are exposed to severe environmental conditions and may be damaged by animals. The station software is therefore not just concerned with data collection. It must also:

1. Monitor the instruments, power and communication hardware and report faults to the management system.

2. Manage the system power, ensuring that batteries are charged whenever the environmental conditions permit but also that generators are shut down in potentially damaging weather conditions, such as high wind.

3. Allow for dynamic reconfiguration where parts of the software are replaced with new versions and where backup instruments are switched into the system in the event of system failure.

Because weather stations have to be self-contained and unattended, this means that the software installed is complex, even although the data collection functionality is fairly simple.