Using Uncertainty Techniques in Radio Communication Systems

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Abstract. This paper describes the application of uncertainty to a radio communication system. In this particular application, uncertainty information is used to optimise a Reason Maintenance System so that tight deadlines can be met. The advantages of using uncertainty techniques here are the capability of dealing with data which may have been corrupted, and the improved real-time performance. The experiences of using uncertainty techniques in a real application are summarised.

1 Introduction

In this paper the application of uncertainty to radio communication systems is investigated. The term 'radio' in this context refers to the transmission of information using a radio channel. Radio communication systems suffer from many problems that are virtually non-existent in their wired counterparts. Although removing the fixed wires can have many advantages such as mobility and ease of installation, many additional problems arise. These include transmission errors, power supplies, maintaining user subscriptions and so on. The main issue of concern for this paper relates to the error rate of the system. The probability of transmission errors occurring via a radio link is often significantly larger than via a fixed link. If uncorrected, transmission errors are immediately related to the perceived quality of the system and this is therefore an important issue in the competitive communications market.

2 Handover in Communication Systems

In order to counteract some of the effects of transmission errors, many radio communication systems have a facility called handover. This means that during transmission the routing of the connection is changed in such a way that the connection with the highest quality is maintained. Using DECT (Digital Enhanced Cordless Telecommunications) as an example, a system may contain several fixed terminals (base stations) and several portable terminals (portables), for example in the configuration shown in Fig.1. Here, the black squares represent base stations, situated within an area of 60mx60m. Connected portables are shown with a line to the base station they are connected to. When the signal received by a portable decreases in quality (perhaps due to movement or interference
from other, nearby portables), the portable may choose to be connected to a
different base station and thereby improve the quality of its connection. The de-
cision to perform a handover is usually based on several available metrics. These
would typically relate to the received signal strength and the estimated number
of errors in the received data.

![Fig. 1. An example of a DECT configuration](image)

Most handover strategies assume that the metrics used for decision making
are reliable and accurate. However, in practice this is not always the case. Due to
the properties of radio propagation, errors may occur during transmission. The
possibility of errors causes uncertainty in the correctness of both the metrics and
the data. This leads to the requirement for a method to deal with uncertainty.
We can distinguish several types of errors and uncertainty. Firstly, we consider
errors during transmission. The transmitted data is normally protected at dif-
ferent levels by using error correction or error detection coding. This means that
some redundant information is added to the transmitted data. When received,
the redundancy provides information about the number of errors that occurred
during transmission. Signalling data (required to control the connection) has