THE REMOTE MONITORING OF LIFTS AND OTHER BUILDING SERVICES

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ABSTRACT

Owners of large numbers of residential and other types of properties, particularly local housing authorities, are faced with the management of huge amounts of plant of increasing complexity installed over a wide geographical area. These building services include not only lifts but also heating systems, pumps, lighting, door entry systems and fire detection systems. As techniques for remote management of these services start to come of age it is important for these owners to consider their options for the remote monitoring and management of these building services.

This paper reviews some of the benefits of carrying out the remote monitoring and management of services and develops the authors own operational requirements for such an all-encompassing management system which is now a viable option.

1. INTRODUCTION

There are at the present time a number of third party manufacturers who are offering equipment capable of monitoring all types of building services. As an alternative to them there are lift controller manufacturers who are presently branching out into the monitoring of heating systems and by the same token there are heating and energy management specialists attempting to include lifts and other services on to their existing systems.

At this point in time therefore it is feasible to consider one system being able to handle all these different services. Perhaps only a few years ago such a concept would not have been a realistic option. At the same time the technology has now moved on to something of a plateau and the pace of change over the next ten years is not expected to be as rapid as the past ten.

Outstations can now be intelligent microprocessor based devices

which include low cost modems or communicators for the transmission of data. The same outstations can be programmed to serve completely different functions as varying as simple contact sensing of particular circuits to running three term heating control functions. The centralised management systems can now be multi-tasking, multi-user computers capable of dealing with a huge amount of data and yet able to log and record all events and produce essential management information on all the services being monitored.

2. THE BENEFITS OF REMOTE MONITORING/MANAGEMENT OF SERVICES

These large amounts of plant which include unattended lifts are distributed over a wide geographical area and therefore present a difficult management problem. The public and tenants expect that all this plant will be kept operational at all times and that prompt remedial action will be taken if and when a failure occurs. Even a daily inspection of all this plant becomes impossibly time consuming and therefore expensive. Remote monitoring of lifts and other plant is therefore highly desirable from the viewpoint of customer service. Without it hours or days can sometimes pass before the appropriate department is made aware of the fault and can arrange for service personnel to attend.

More importantly large amounts of money can be saved in relatively short periods of time by the use of energy management systems. Outstations running multi loop control programmes can be addressed and updated over the public telephone network ensuring that time schedules, holiday schedules etc. are always kept up to date with respect to the building users requirements. Optimisation programmes ensure that plant is started up at the latest possible time and shut down at the earliest possible time. Direct digital control of heating controls enables P.I.D. control loops to be established to ensure that preset temperature and humidity levels are precisely maintained.

Remote monitoring can also bring many other advantages. From the viewpoint of lifts alone these can be summarised as follows;

2.1 The Monitoring of New Lifts during their Defects Liability Period

If a remote monitoring system is installed each new or newly refurbished lift can be connected via the public telephone network to a central remote monitoring system. The performance of such new or newly refurbished lifts can then be monitored remotely from day one of the new lift going into service. This enables the owners own personnel to ensure that a fast response to breakdowns is provided by the contractor concerned. By minimising the 'out of service' time that can sometimes plague a new lift going into

service, there is the prospect that the goodwill that generally accompanies a new lift going into service will be maintained and as a result the number of tenants or users suffering inconvenience will be reduced.

Our own experience in this area shows that tenants reasonably expect reliable operation of their new lift from day one, however this is an over-optimistic view as there are often cases where teething troubles have not been adequately dealt with due to poor communication and these breakdowns in turn often accumulate many hundreds of hours 'out of service' which understandably causes annoyance to users and general loss of goodwill.

The improved communication offered by a lift monitoring system will highlight situations where 'out of service' time is beginning to build up and appropriate action can then be taken by informing the contractor responsible. Contract conditions could also be tailored around performance and reliability criteria, which data is gathered by a central remote monitoring system during the Defects Liability Period.

2.2 Dealing with Call-Backs and Breakdowns

With such a centralised remote monitoring system in place responding to lift breakdowns no longer requires the services of a caretaker to communicate the lift breakdown to the owner with all the delays and frustrations that can occur. The communication protocol, being fully automatic, alerts the owner who can see instantly on the remote monitoring system which lifts are out of service and furthermore the response time for the contractor to attend the site as there can be provision on each outstation for signalling back to the lift management system that someone is in attendance.

2.3 Improving the Reliability of Lifts

A remote monitoring system is a very effective tool for constantly monitoring lifts connected to it and since it stores and logs all the information for each lift it can be used to determine how reliable any individual lift is or alternatively what the average level of reliability is for any number of lifts connected to it. The feedback of this statistical information could prove most useful in bringing about improvements in the design of the lifts to increase reliability and even determining an MTBF (Mean Time Between Failures) figure for new lifts. The information derived from the system in this way coupled to intensive follow-up work on any lifts proving unreliable could offer a path forward for general improvements in reliability on all the owners' lifts.

2.4 Housekeeping and Cost Control

A centralised remote monitoring system enables the owner to tie down the performance that any maintenance contractor will have to achieve in terms of response time etc. in order to fulfill their contractual commitments. Furthermore, by allocating the costs of call-backs, repairs, repairs due to vandalism etc. to each site the owner will be able to identify clearly the problem sites where excessive breakdowns occur or where above average expenditure on maintenance etc. is being made, thereby homing in more clearly on the sites that require detailed investigation of unreliability etc. due to age or specific design defects which, when tackled, will enable long term savings to be made on revenue expenditure etc.

3. SERVICES MONITORING

The primary purpose of each outstation or remote monitoring device is to determine that the plant or service it is monitoring is operational and 'in service', in the case of lifts this means that they are able to transport passengers from floor to floor.

So, "When is a lift in service?". Basically, a lift can only be considered 'in service' if it is able to transport passengers from one floor to another, i.e. if it is able to open and close its doors (to let passengers in and out) and travel from one floor to another.

This lift moving (LM), doors opening (DO) sequence is fundamental to establishing that a lift is 'in service'. On most new microprocessor lift controllers this test sequence is carried out regularly by the controller itself introducing landing calls and monitoring the response of the lift. However, with existing controllers it will be necessary for either the outstation itself or some additional logic circuitry to establish whether the lift is in service. Thus with most of the owners' existing lifts this 'watchdog' facility will have to be provided.

Similar integral 'watchdog' or external logic is necessary to monitor other items of plant. For boilers the temperature, supply pressure and any other critical variables should be monitored and checked to be within predefined limits. For pumps outflow and pump demand should be monitored and so on. For outstations carrying out heating control or energy management tasks the 'watchdog' function will be more complex and the outstation will actually be carrying out a control function itself.

Each outstation will however need to transmit its data via the Public Switched Telephone Network to the central remote monitoring system. The central monitoring system will also need to be able to dial up the outstations and change parameters or switch on

specific control devices. For lifts a remote loop back test should be possible whereby an operator at the central monitoring system can dial up a given lift, introduce a landing or car call and observe the lift move to that floor and open its doors. The format of communications between the outstations and the central monitoring system will all be standardised and include the site identification, fault codes etc.

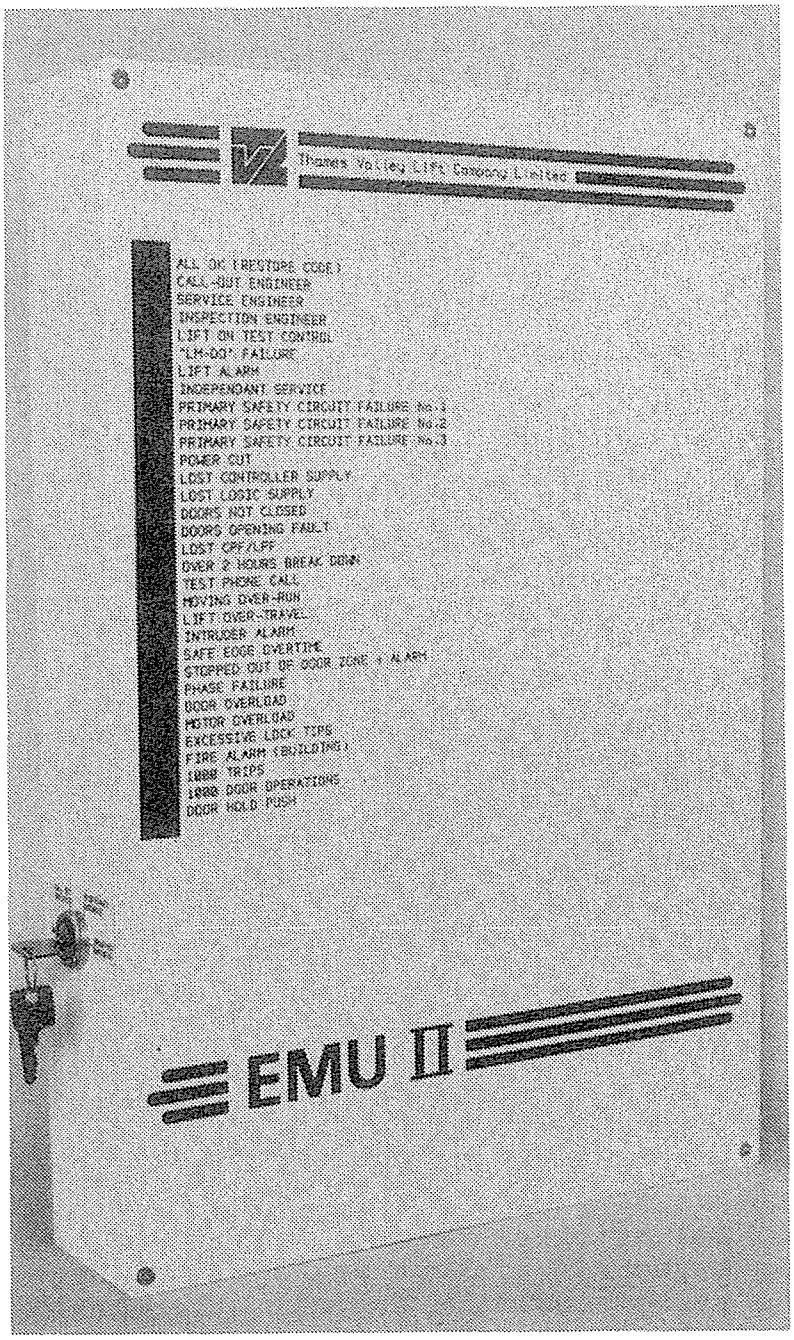

FIGURE 1. Typical outstation for lifts (Reproduced by kind permission of Thames Valley Lift Co. Ltd.)

4. OPERATIONAL REQUIREMENTS

The following outlines what the author considers might be the basis of a set of operational requirements for a new central monitoring/management system to fulfill. The requirements have been developed for the most part around the remote monitoring of lifts and further detailed attention will be required in the areas of energy management and the monitoring of boilers, pumps, air conditioning plant etc. if the same system is to handle these services as well.

4.1 Communications and Data Handling

Suppose that a new central monitoring system has to monitor up to 200 different items of plant. Even if all the plant remains in service then every 24 hours there should be 200 calls to the central monitoring system in order that the system knows that each outstation is still in communication with it. If we assumed that each item of plant suffers from, say, seven faults per annum then on average there will be a call received every seven minutes.

This has a number of implications;

(i) The number of PSTN lines to the central monitoring system may need to be increased so that each outstation has a reasonable chance of making a successful call to a free receiver. Alternatively, a form of queueing at the local telephone exchange is required and/or each outstation must continue to dial the relevent number or numbers of the central monitoring system until it gets through. Obviously communications equipment connected to the PSTN will have to have the necessary approval.

(ii) The volume of calls received and the processing and updating of records that must occur as a result means that a 'state-of-the-art' 16 bit multi-tasking microcomputer or microcomputer network is required. The computational power available as a result means that the analysis of the data can be very sophisticated and at the same time the system will also allow fast access to historical records. In particular, colour graphics can be used to present data in an infomative and attractive way. Long term trend analysis can also be performed. All of these facilities must be accessible from a keyboard or keyboards without any apparent degradation to the user as the system deals with all the incoming calls in parallel with other tasks.

4.2 Outstation Features

The following list of requirements has been developed for different types of plant.

1. LIFTS

O1	Battery back-up
O2	Lift Out of Service/Lift In Service signal
O3	Alarm (with doors closed, lift not moving and lift not in door zone)
O4	Supply failure to outstation
O5	Restore code for all reports
O6	Intrinsically safe connection
O7	Battery low signal
O8	Lift on Test/inspection
O9	Lift on Independent/goods service
O10	Doors held
O11	Lift on fireman's service
O12	Engineer's attendance
O13	Tamper-proof and robust enclosure
O14	Fault/Signal Displays with LEDs
O15	User defined codes/signals
O16	Control supply present
O17	Door safety circuit
O18	Primary safety circuit

2. BOILERS

B1	Battery back-up
B2	Boiler In Service/Out of Service signal
B3	Boiler off line
B4	Supply failure to outstation
B5	Restore code for all reports
B6	Intrinsically safe connection
B7	Battery low signal
B8	Pressure high/low
B9	Temperature high/low
B10	Boiler on maintenance
B11	Engineer's attendance
B12	User defined codes/signals
B13	Tamper-proof and robust enclosure
B14	Fault/Signal Displays with LEDs

3. PUMPS

P1	Battery back-up
P2	Pump running/stopped
P3	Pump off line
P4	Supply failure to outstation
P5	Restore code for all reports
P6	Intrinsically safe connection

P7	Battery low signal
P8	Flow high/low
P9	Pump on maintenance
P10	Engineer's attendance
P11	User defined codes/signals
P12	Tamper-proof and robust enclosure
P13	Fault/Signal Displays with LEDs

Similar signals will also be collected for the following types of plant and outstation tasks:

4. CENTRAL HEATING

5. ELECTRICAL INTAKES

6. DOOR ENTRY PHONES

7. OIL & ENERGY USAGE

8. ESCALATORS

9. AUTOMATED CAR PARK EQUIPMENT

10. BUILDING SECURITY

11. ENERGY MANAGEMENT

4.3 Communications Protocol

The following list of requirements has been developed for the communications system.

C1	Battery back-up for receivers
C2	Approval for use on public telephone network
C3	Communications test facility eg. every 24 hours
C4	Repeated re-dial facility for outstations
C5	Failsafe back-up facilities
C6	Restore code for all reports from outstations
C7	Multiple number routing from outstations
C8	Multiple receiver channels on central monitoring system
C9	Simple interconnection of local outstations in one building to share single telephone line
C10	Use of master/slave outstations and interconnection for monitoring of multiple services in one building

4.4 Central Monitoring/Management Computer Facilities

The central monitoring/management computer should be able to receive calls from outstations and record site identification, fault code and time of receipt as a basic minimum. On receipt of a fault call the central station should alert a local watchkeeper or page the maintenance contractor automatically.

The central monitoring computer or associated equipment should be able to analyse historical information and produce management reports. The following list of operational requirements has been developed for the facilities and features required on the central monitoring system.

MS1	Battery back-up
MS2	Provision of two receiver channels as a minimum
MS3	Local audio alarm, current faults display
MS4	Hard copy journal of message codes/ operator actions
MS5	Hard disk for journal files etc
MS6	Automatic paging of owners' staff
MS7	Automatic back-up of hard disk & controlled archiving sequences
MS8	Password protection of communication channels, file system etc.
MS9	Remote loop back test i.e. dial-up and communication with outstation direct on-line
MS10	Provision of journal file
MS11	Provision of site file
MS12	Provision of summary site file
MS13	Provision of fault file
MS14	Access to files by keyboard/screen
MS15	On-line definition of sites, plant etc
MS16	Data compression into historical archives
MS17	User-defined reports from historical records
MS18	Use of order numbers etc and logging of costs of repairs and servicing of plant
MS19	Listing of plant details, given fault types etc across range of sites
MS20	Logging of response times of service personnel as well as plant downtime etc
MS21	Automatic paging of service contractors personnel
MS22	Facilities to provide historical reports on each site in terms of fault types, duration, number of faults, downtime, cost of repairs, log of insurance inspections and statutory

tests etc.

MS23 Logging of the hours each lift is on 'test/inspection' each month and reports on contractor attendance for maintenance etc.

MS24 Provides prompting reports for management on insurance reports not received, contractors not carrying out maintenance, excessive downtime etc.

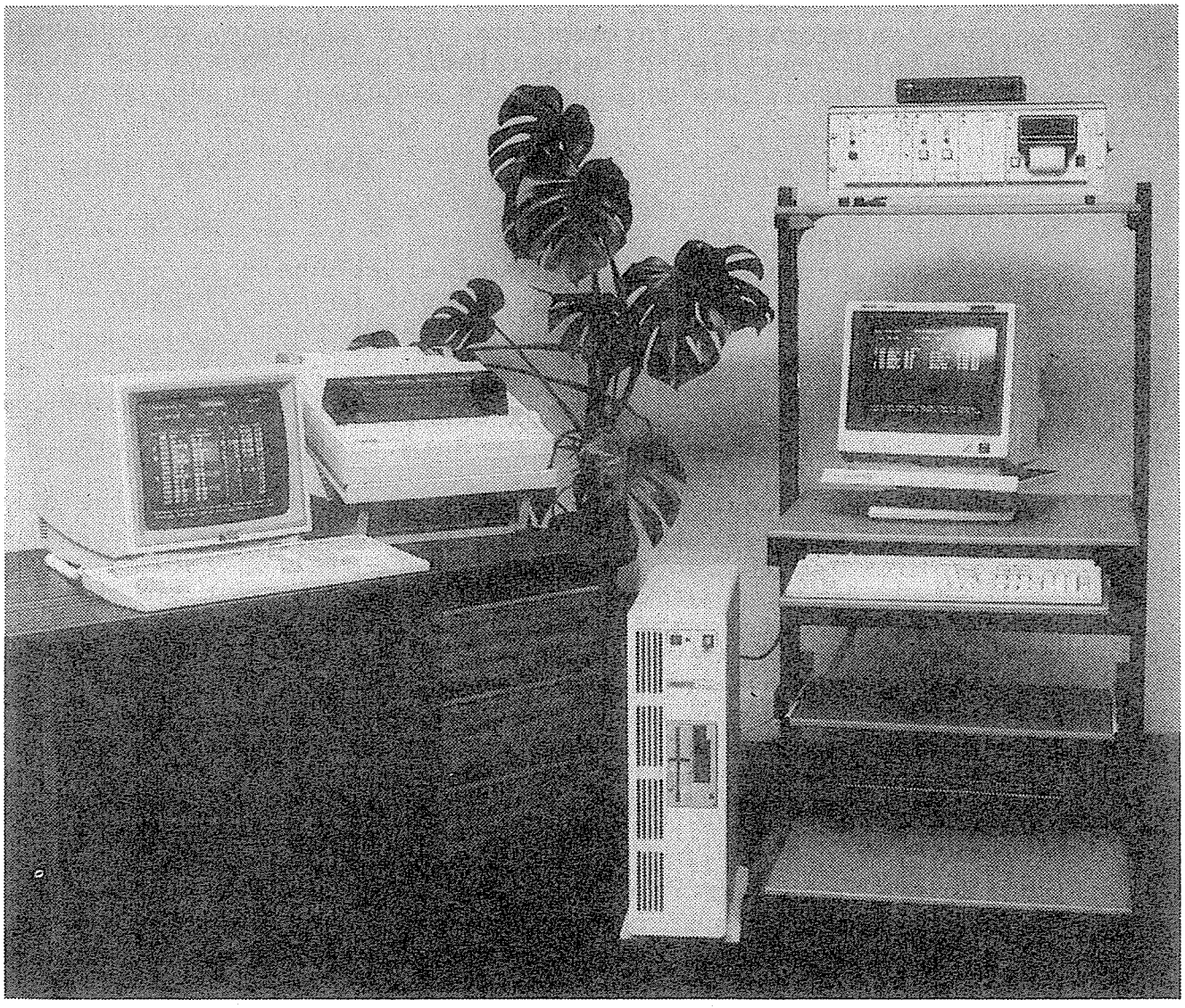

FIGURE 2. Typical central monitoring system (Reproduced by kind permission of Thames Valley Lift Co. Ltd.)

5. CONCLUSIONS

Having independently developed a set of operational requirements for the remote monitoring of lifts and certain other building services it was interesting to find that several companies in the U.K. are already able to offer systems that meet up to 80% of these requirements and that some will be able to meet all of them given some further development work on their existing products. Clearly therefore the remote monitoring and management of lifts and other services has come of age and will doubtless be a considerable growth industry over the coming decade.

Because these remote monitoring systems enable the immediate notification of plant failure to take place they can ensure that breakdowns are dealt with speedily thereby improving the serviceability ratio of all the plant being monitored. Energy management facilities, if included in the same system, can enable significant savings to be made that will go a long way towards justifying the costs of installation and maintenance of a monitoring system for all types of building services.

It should however be noted that whilst remote monitoring offers a way to very significant improvements in the management of outlying plant and services it will not at the present time remove the necessity for the owners' staff to regularly inspect the plant to ensure that maintenance is being carried out correctly. The installation of such a system does, however, enable the management of these building services to be carried out in a much more clear cut manner with management information at last available to all parties.

The new breed of remote monitoring and management systems therefore presents a sophisticated and powerful tool for the analysis of the performance and reliability of all services connected to the system as well as being able to communicate with intelligent outstations running complex energy management routines. These new systems will doubtless become an intrinsic part of the management of remote building services as they grow in size and power and become integrated with the other aspects of owners' management facilities.