Biomedical Parameters Monitoring and Sharing On TCP/IP using LabVIEW

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ABSTRACT
In this paper we deal with Bio-medical parameters monitoring and sharing on TCP/IP network using LabVIEW. Diagnosis and treatment of a patient at a remote location i.e. his home or inside the hospital ward by a doctor from a respective location in the hospital can be done by examining various parameters of the patient. These parameters have to be continuously monitored by the doctor. The vital parameters sharing from the patient to doctor is done be TCP/IP network. The Virtual Instrument is created using LabVIEW software which creates Graphical Control and monitoring system. As the parameters from the patient taken are analog signals, virtual instrument is used to see these signals as continuous waveforms for better understanding of the patient condition. This paper provides cost effective solution for information sharing with a hospital environment. If any of the parameters exceed the assigned nominal value, then the doctor can be intimated automatically.

General Terms
TCP/IP.

Keywords
Temperature, Blood Pressure, Heart Beat Rate, ECG, LabVIEW.

1. INTRODUCTION
It is widely accepted that biomedical parameter monitoring and sharing plays a vital role in the biomedical field. In multispecialty hospitals, there are cases which are under observation of many doctors specializing in different respects. In cases like these, the diagnosis and course of treatment is arrived after all doctors examine various parameters of the patient. Hence in condition like these, some means of information sharing is needed within a hospital. Using this information, the doctor can view and propose solutions from their respective locations. This paper aims at providing a solution for this requirement.

Most multispecialty hospitals have a LAN within the hospital. This aspect is used in this paper. In this paper, the parameters to be monitored are patient's temperature, blood pressure, heart beat rate, and Electrocardiograph (ECG) signals. VI running on the computer is connected to the hospital's LAN. Using Virtual Instrument, any doctor can forward patients parameters to the computers of other doctors which is also connected to LAN [3].

The need for using Virtual Instrument is because most of the parameters acquired from the patient are analog signals and need to be seen as continuous waveforms. Conventional software cannot display such signals in desired way [1]. In this application, VI has advantage such as signals can be recorded and viewed for future. Various thresholds can be set for parameters like if pulse rate exceeds a particular preset value, the doctor can be intimated automatically.

The Virtual Instrument is created using LabVIEW software which is specialized software for creating graphical controls and monitoring systems.

2. PROPOSED SYSTEM
This paper deals with acquiring biomedical parameters from the patient and digitizing using a microcontroller and the digitized data is then given to virtual instrument running on the computer which is connected to hospital's LAN.

The biomedical parameters which are to be monitored and shared are temperature, blood pressure, heart beat rate and ECG. These physiological signals are acquired by using various sensors. The sensor use to sense temperature is LM35. The sensor use to sense blood pressure is MPX 5010 pressure sensor. Kyoto is the sensor use to sense the heart beat rater and to acquire ECG signals, three electrodes are used. The microcontroller used in this paper is PIC 16F887A.

The Virtual Instrument, LabVIEW is used as a tool to trigger an alarm during panic conditions to the patient's caretakers and nurses at home or hospital. TCP/IP network helps in monitoring and sharing the information of the patient parameters to the system of the doctor by just knowing the IP address.

3. SYSTEM MODEL
To enhance the mobility of the doctor and the patient, we propose the design and development of a module as shown in Figure1, thereby leaping a step forward in healthcare industry. When the parameters values exceeds the normal value or decreases from the normal value, the doctor identifies the patient condition via TCP/IP network and immediately takes step to treat the patient. The system module consists of the sensors which sense the patient biomedical parameters. The output from these sensors is in analog form which is converted to digitized data using the PIC microcontroller. The digitized data is given to the computer of one of the doctor

from which he can forward the data to other doctor using TCP/IP network.

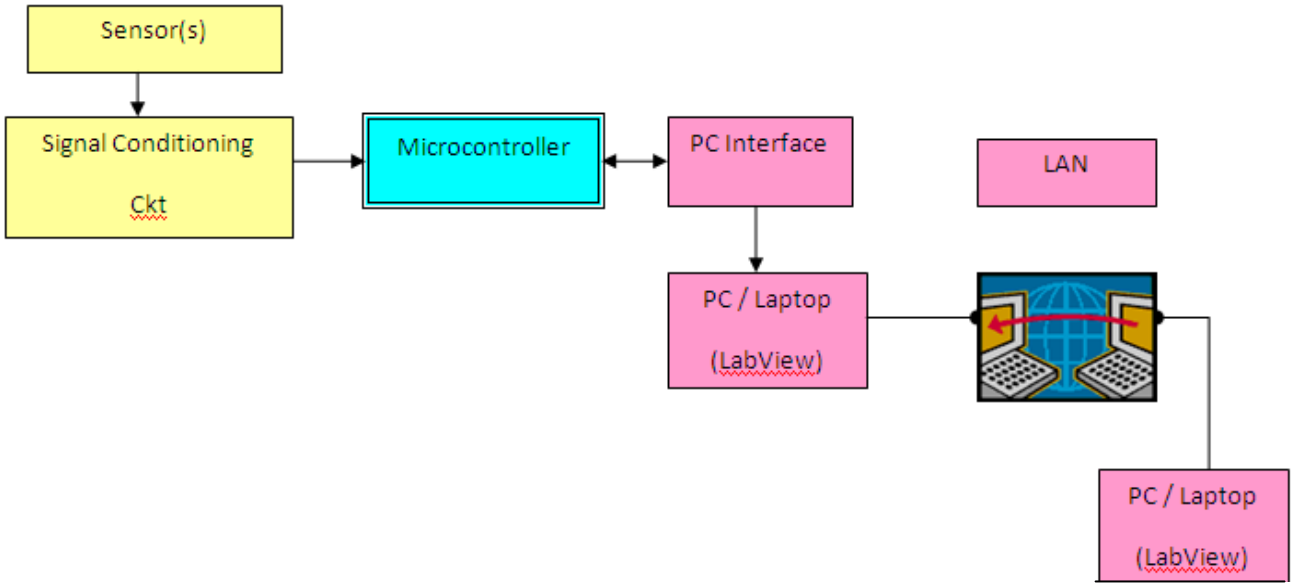

Figure 1: Block diagram of proposed system

4.1 Temperature Monitoring:

The temperature sensing is done by LM35 temperature sensor. It is an integrated sensor. Input of the sensor is 5V, whose output in ºC is given to the ADC of the microcontroller. Every ◦c is equal to 10mV. The nominal value of temperature is 37ºC and the sensor can sense a temperature between -55ºC to +55ºC.

4.2 Pressure Sensing:

MPX 5010 is the sensor used to sense the pressure. This sensor is an integrated sensor. Signal conditioning circuit is not used because it reduces calibration error if duplicating (i.e.) marking multiple products. MPX 5010 can give an output voltage of 0V to 5V depending on the pressure. It can measure pressure up to 10KP. The output is given to ADC of microcontroller. MPX 5010 is fabricated using micro machined piezoelectric technology.

4.3 Heart Beat Rate Determination

The sensor use to sense heart beat rate is Kyoto. Determination of heart beat is by the number of heartbeats per unit of time. It is expressed by beats per minute (BPM). The nominal heart beat rate is 72 times per minute. The sensor senses the change in blood pattern (i.e.) wavelength of IR rays will change depending on blood pattern and blood patterns and blood patterns will change depending on heart beat. This sensor will give pulse output of 0V to 5V. The output of this sensor is given to I/O pin of microcontroller. The microcontroller counts the number of pulses coming out per minute.

4.4 ECG Recording

ECG recording is done by using three leads. Body generates electricity when movement is present. When heart beats, the body generates small voltage which is ECG [8]. The value is in terms of very few µv. Since very small value, it cannot be given directly to µc ADC pin. It will have noise. To remove noise, an amplifier is used. Filters are also present. Output of the amplifier is analog. This analog waveform is given to the ADC. Graphical representation of ECG waveform is shown in Figure 2.

4.5 Microcontroller for signal acquisition

Using µc, the signals required are made digital and are connected to PC having LabVIEW. The microcontroller used here is PIC 16F877A. The controller has peripheral features like inbuilt ADC, required to get signals from various sensors. Maximum clock frequency is 20MHZ. Based on RISC and Hardware architecture and hence even faster. Embedded C is used for programming. A program is written to convert analog information into digital. 10 bit ADC is used. Figure 3 shows the conversion of analog signal into digital data by an ADC.

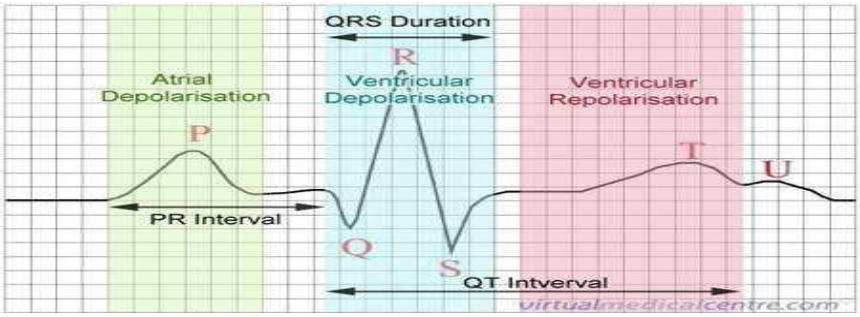

Figure.2: Graphical representation of ECG waveform

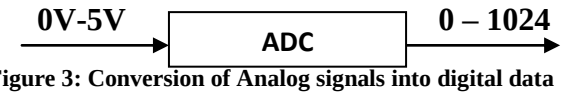

Figure 3: Conversion of Analog signals into digital data

Figure 4: Interfacing of microcontroller with PC using USB interface.

4.6 USB Interface:

USB interface is use to interface the microcontroller with the PC. It consists of FTDI. Output data is of UART format from microcontroller. This UART data is not given directly to PC. So FTDI converts UART data into USB data. Figure 4 represents the interfacing of microcontroller with PC using USB interface.

4.7 Lab VIEW

Lab VIEW is software used for acquiring, processing, and transmitting the physiological data. LabVIEW is an excellent graphical programming environment.

4.7.1 Programming in LabVIEW

Two computers with LabVIEW software installed are kept one at patient room and another at doctor's cabin. The PC on the patient side is termed as SERVER. The PC on the doctor's side is termed as CLIENT [5].

4.7.1.1 Server side programming

The TCP Listen icon on the server side block diagram looks for data from the client. Once the data is obtained, some error exists. This error is displayed and terminated. This is given to unbundle icon which separates the error from other information. TCP Read icon in the block diagram is use to read the data. The server transmits characters to the client. If client wants to shut down, it sends the character 'Q' to the server. Data's are first converted into strings in the server side.

4.7.1.2 Client side programming

TCP Open icon is used in programming in client side. In client side, strings are converted to numbers and are displayed. The while loop is used for continuous and multiple execution . If while loop is not present, execution takes place only once. TCP close connection stops the programming if the doctor moves away from his computer

4.8 IP Network

IP stands for Internet Protocol. Internet Protocol establishes connections between two processing devices. It communicates data across packet switched networking by using the TCP/IP suite of protocols [4]. Figure 5 represents the data flow from server to client and vice versa through TCP/IP network.

5. RESULTS AND DISCUSSION

This system can be used to monitor and share patient biomedical parameters in real time to remote locations. The alert system alerts the doctors if there is abnormality in the parameter values. A printable patient report can be generated from the LabVIEW page. As for medical applications, reliability plays a vital role. Thus this system uses a reliable TCP protocol implemented in LabVIEW via IP. Figure 6 shows patient side monitoring. Figure 7 shows doctor side monitoring. Fig 8 shows the IP connection.

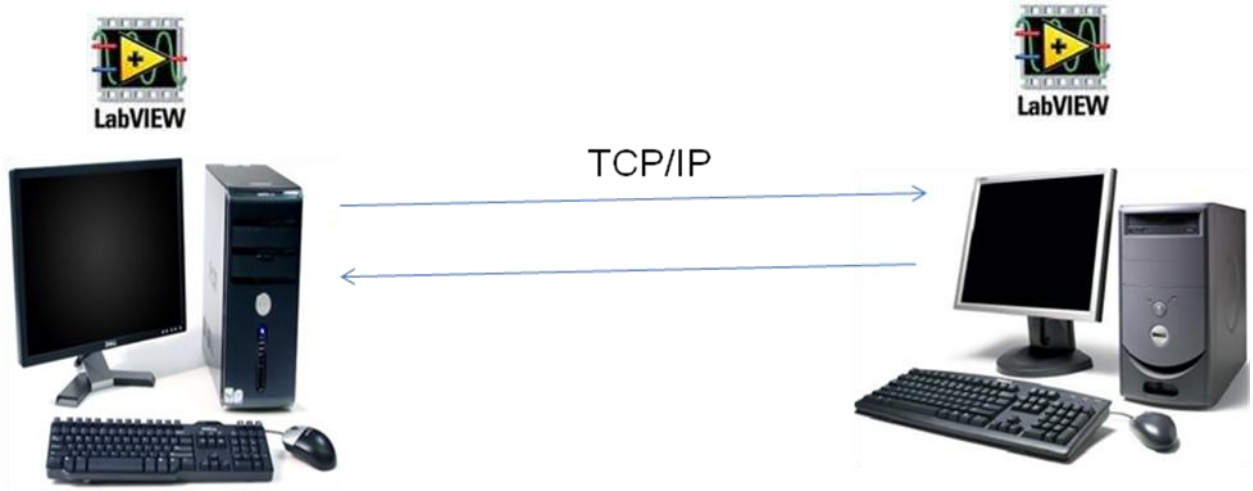

Fig 5. Data flow from server to client using TCP/IP Network

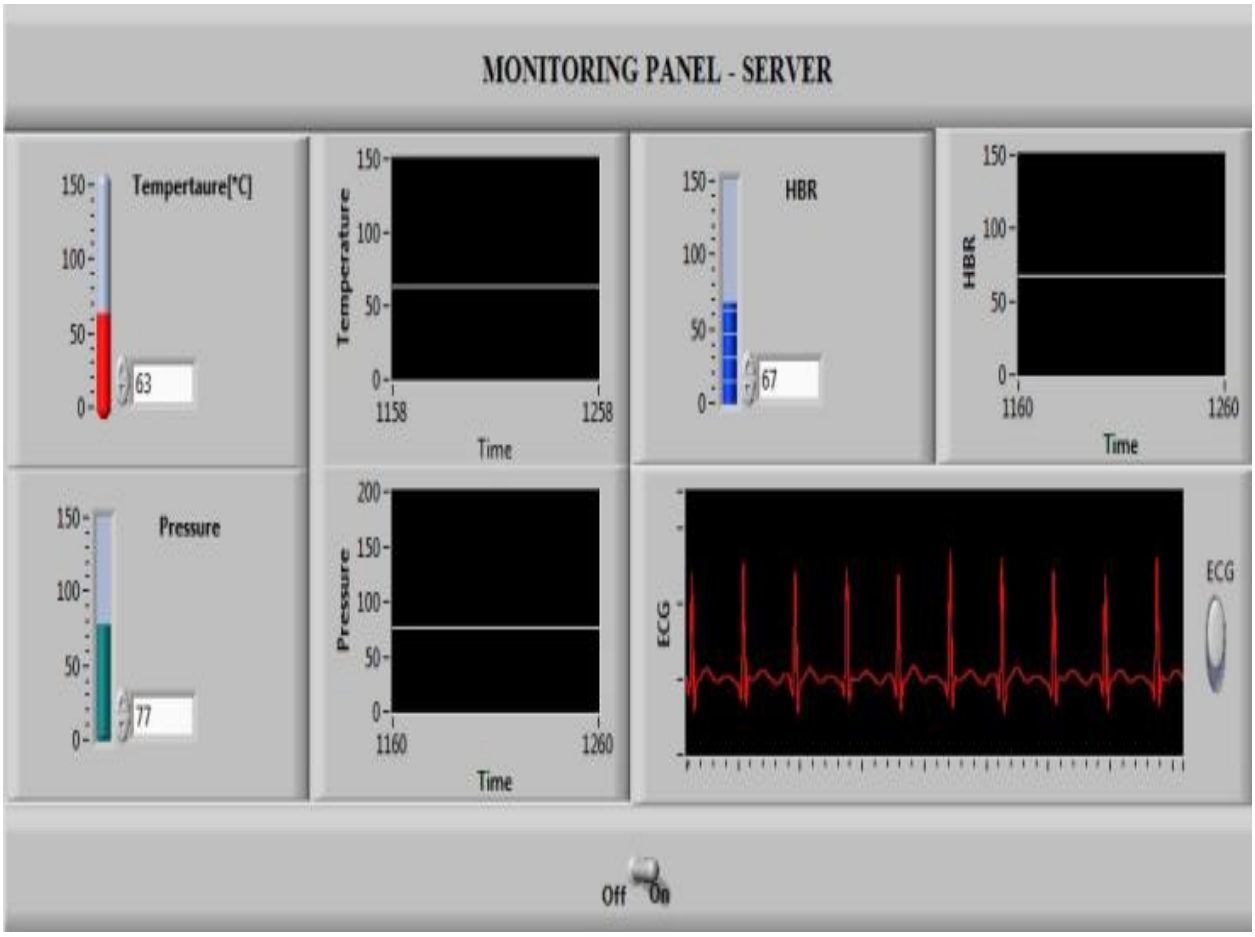

Figure 6: Patient side monitoring

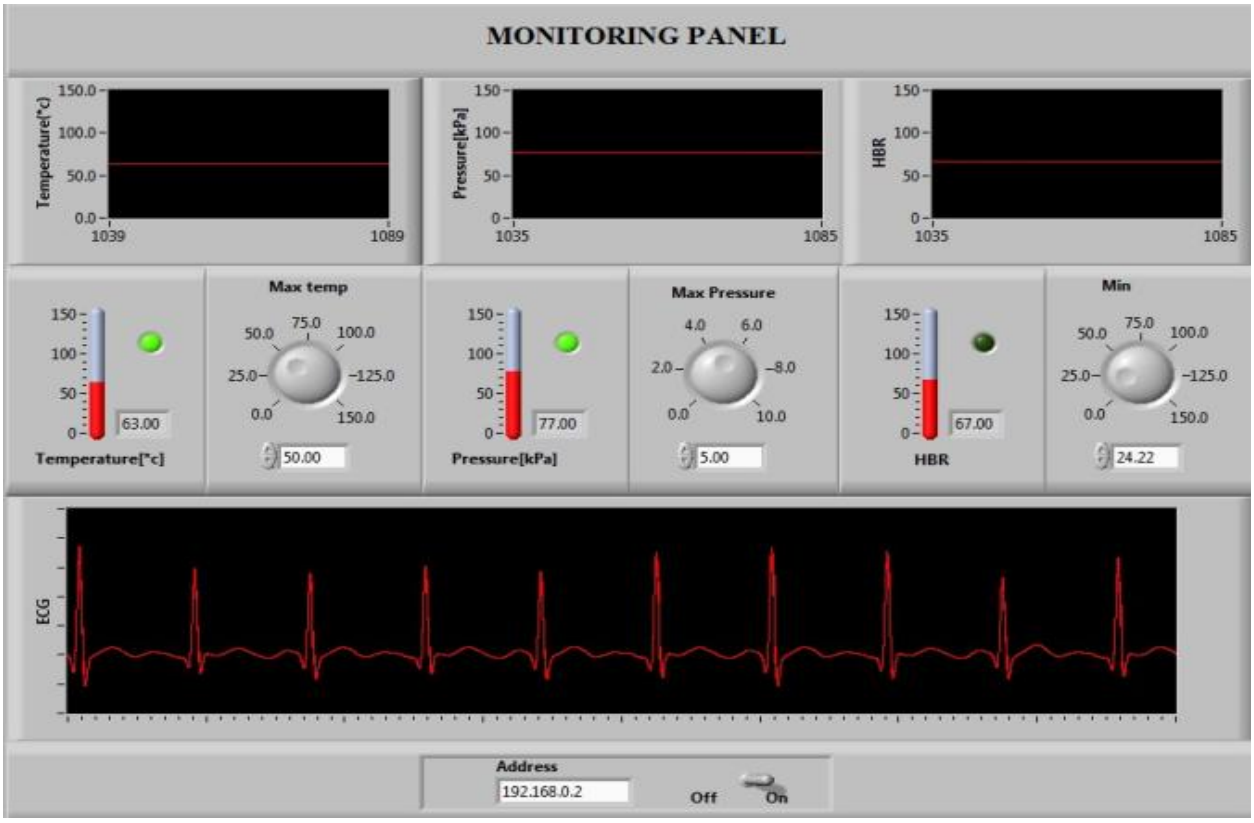

Figure 7: Doctor side monitoring

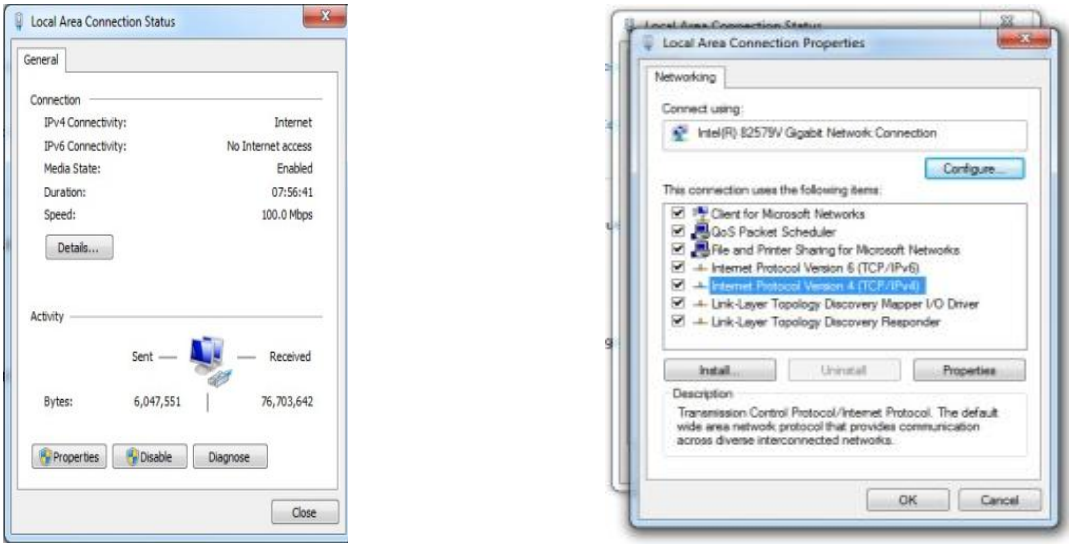

Figure: 8.a. Internet Protocol Connections.

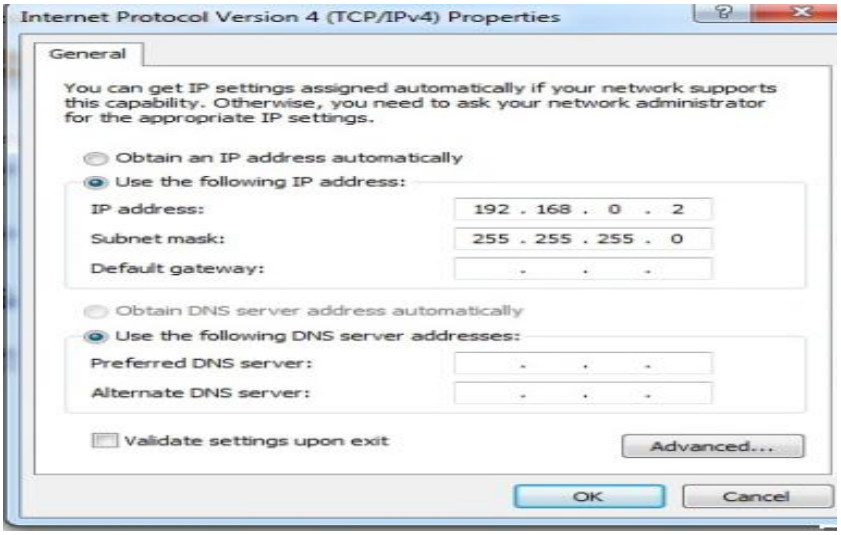

Figure: 8.b. Internet Protocol Connections.

6. CONCLUSION

In this paper biomedical parameters monitoring and sharing is done using LabVIEW via TCP/IP network in real-time using LAN access on the doctor and patient side. Both server and client uses LabVIEW programming. Using LabVIEW, the patient information can be sent to other doctor whose PC's are also connected to the LAN. Thus biomedical parameters such as temperature, blood pressure, heart beat rate and ECG signals are sensed using various sensors are transferred from server side to client side through TCP/IP network. Thus continuous monitoring takes place.

7. FUTURE SCOPE

In the future the project can be extended with mobile versions of LabView, where in the information can be made available even on portable devices too.

8. ACKNOWLEDGMENTS

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