Structural Health Monitoring (SHM)
Prof. Srinivasan Chandrasekaran
Department of Ocean Engineering
Indian Institute of Technology, Madras

Lecture - 73
SHM design- 2 for BSLRP-Part1

Friends welcome to the 5th Lecture in Module 4. We will continue with the design of Structural Health Monitoring System, where the option of system design 2 is being attempted and we are now applying this SHM design 2 for buoyant leg storage regasification platform on a lab scale. The third lecture in the series which talks about the design of SHM on a lab scale.

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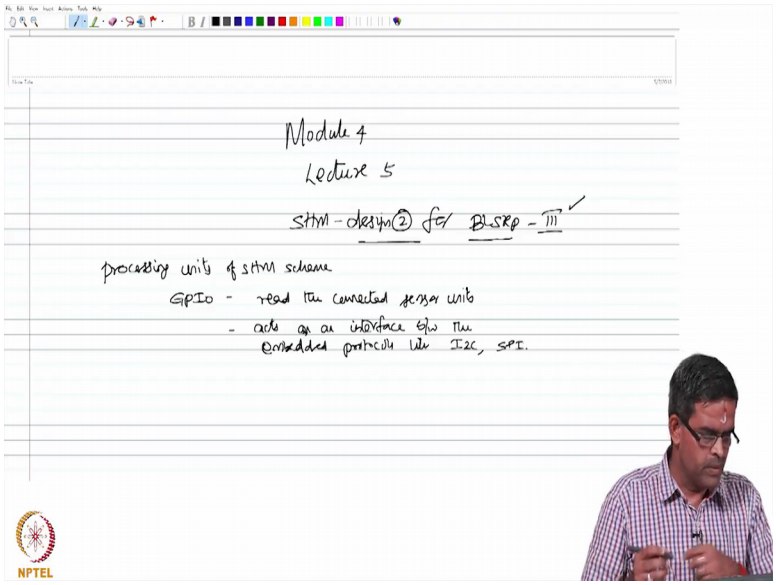

In the last lecture we talked about the power and the processing units of the health monitoring scheme. We said that the GPIO pins can read or can be useful to read the connected sensor units, and also acts as an interface between the embedded protocols like I 2 C, S P I etcetera.

Now, friends the sampling rate of sense is very important is an important parameter in monitoring process; sampling rate is selected such that the device is able to detect the changes associated with the maximum signal frequency.

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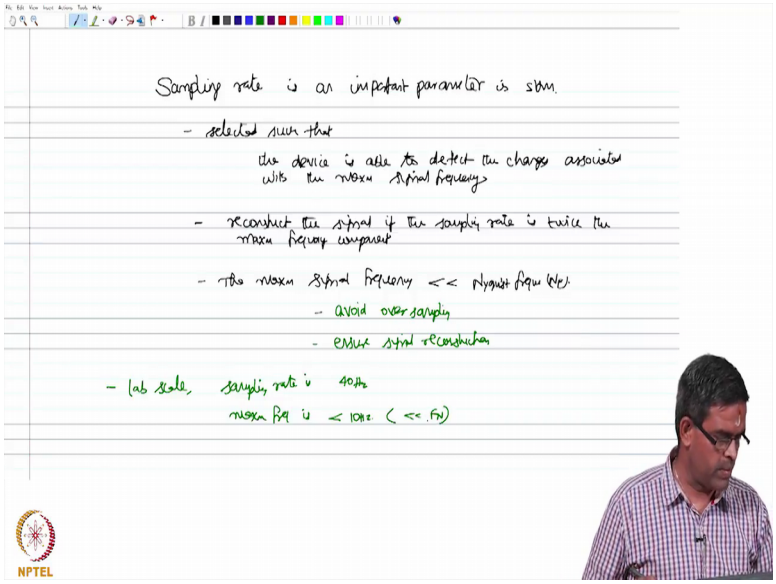

Now, one can reconstruct the signal, if the sampling rate twice the maximum frequency ok. So, it is very important that the maximum signal frequency shall be much lower than the Nyquist frequency.

So, that you can avoid over sampling and you can ensure signal reconstruction. So, in the present study in the lab scale the sampling rate is taken as forty hertz and the maximum frequency is expected to be below 10 hertz, which is much lower than the Nyquist frequency. The next issue comes is the power optimization.

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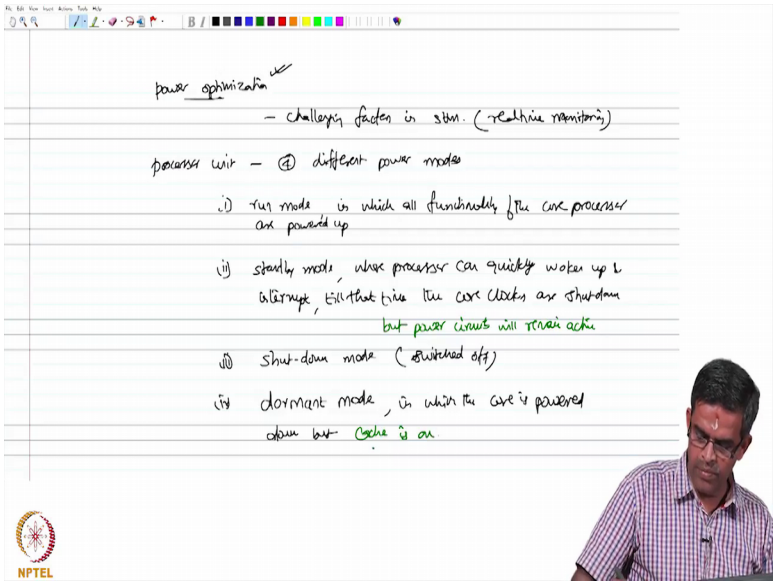

This is one of the challenging factors in structural health monitoring, when you really do a real time monitoring. In the lab scale it may not be that effective, but when you apply to a real time monitoring the power optimization is actually a big challenge. Now, if you look at the processor unit it has 4 different power modes one the run mode in which all functionality of the core processor or powered up. The second mode could be the standby mode where processor can quickly woken up and interrupt, till that time the core clocks are shut down, but interestingly the power circuits will remain active, that is the second mode.

Now, the third mode is completely shut down mode, the power is switched off and the fourth mode is called as dormant mode, in which the core is powered down, but the cache memory is on.

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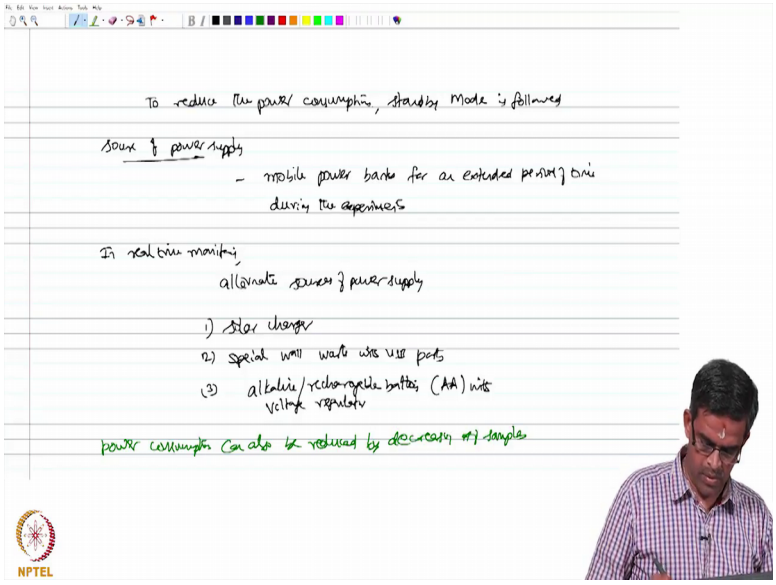

Now, to reduce the power consumption on the processing unit, standby mode is followed generally. Now, the source of supply for power in the lab scale for the present system design is taken from the mobile power banks for an extended period of time during the experiments ok.

So, this is possible in lab scale, but in real scale is a challenge. So, what people generally do is the following in real time monitoring one can use alternate sources of power supply, namely one can use a solar charger, one can use a special wall watts with USB ports, one can also use alkaline batteries or rechargeable batteries, which are essentially

double a batteries, which are used of course, with a voltage regulator. You can also reduce the power consumption, but decreasing the number of samples.

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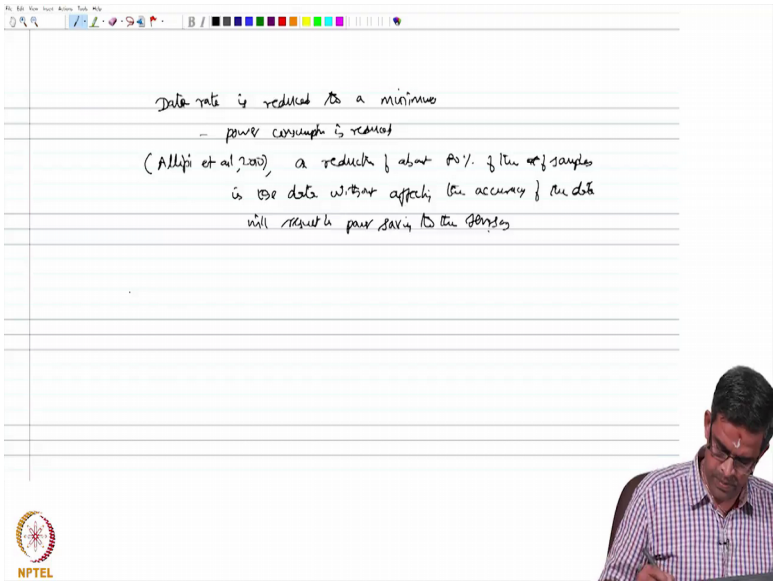

Now, in that case data rate is reduced to a minimum thereby power consumption is reduced, look at the recommendation made by Allipi et al in 2010 the researchers say that a reduction of about 80 percent of the number of samples, in the data without affecting the accuracy of the data will result in power savings to the sensors.

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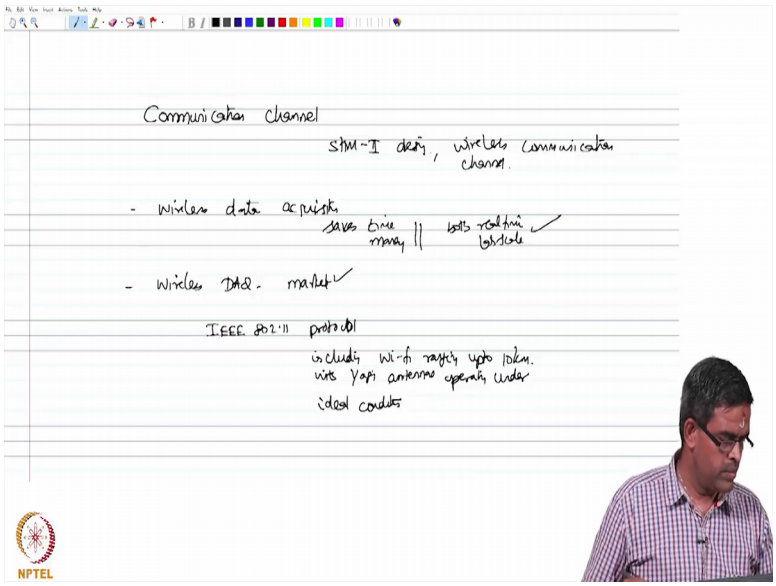

Then we talk about the communication channel in the design in the present SHM 2 design, we are using a wireless communication channel.

Now, we know that wireless data acquisition, saves, time, money, in both real time and (Refer Time: 12:13) lab scale. There are many wireless DAQ available in the market, some of them are I triple E 802.11 Protocol including, wifi ranging up to 10 kilometers with Yagi antennas operating under ideal condition.

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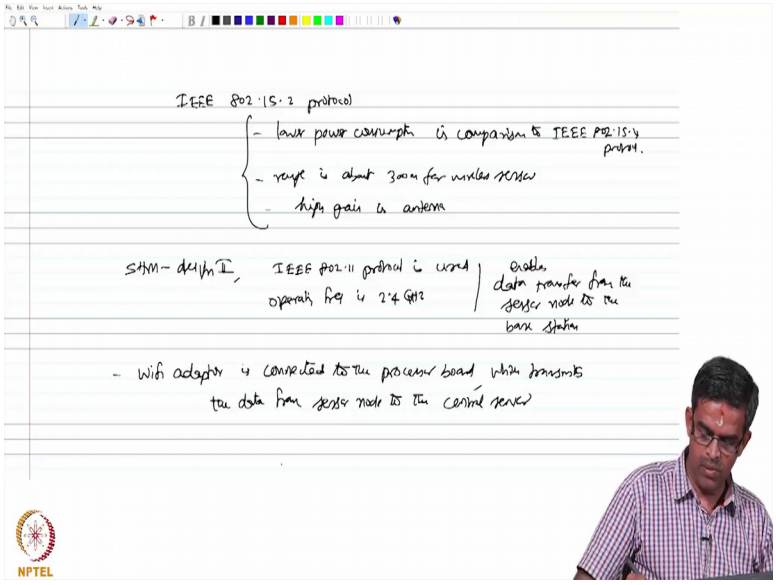

One can also use I triple E 802.15.2 protocol, which has a lower power consumption in comparison to I triple E A 0 2.15.4 protocol. The range is about 300 meters for the wireless sensors to be connected and there is a high gain in antenna signal. So, these are the positive points you can look for this particular protocol. Now in SHM design 2, which we were discussing currently I triple E 802.11 protocol is used the operating frequency is 2.4 gigahertz, this enables the data transfer from the sensor nodes to the base station.

Now in the design wifi adapter is connected to the board, which transmits the data from sensor node to the central server.

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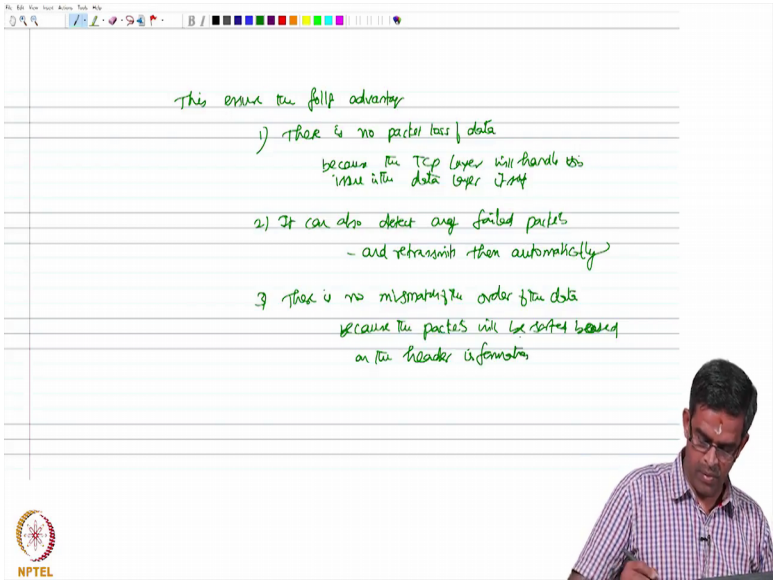

This ensures the following advantages; one there is no packet loss of data during transmission this is because the TCP layer will handle this issue in the data layer itself. Further it can also detect any failed packets and retransmits them automatically.

However, there is no mismatch of the data because the packets will be sorted based on the header information.

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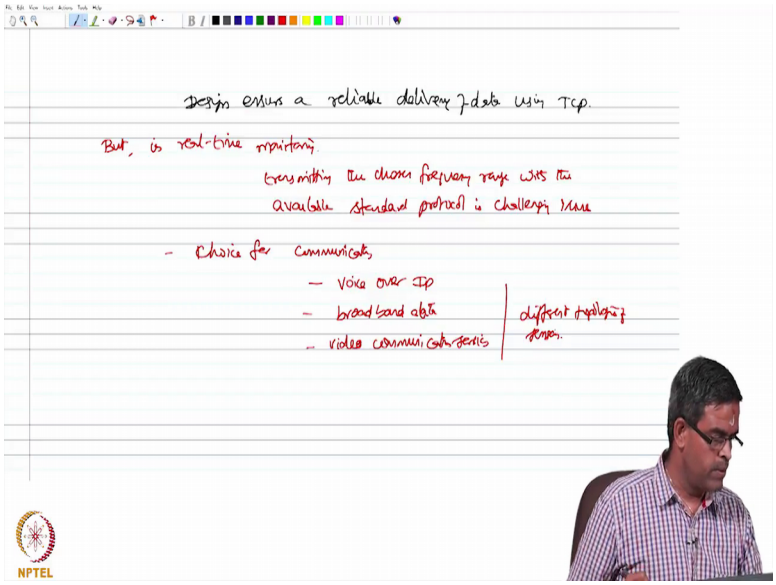

So, now the design ensures a reliable delivery of data using TCP, but in real time monitoring transmitting the chosen frequency range with the available standard protocol is a challenging issue.

So, in that cases the common choice for communication should be voice over IP, broadband data, and video communication services with different topology of sensors.

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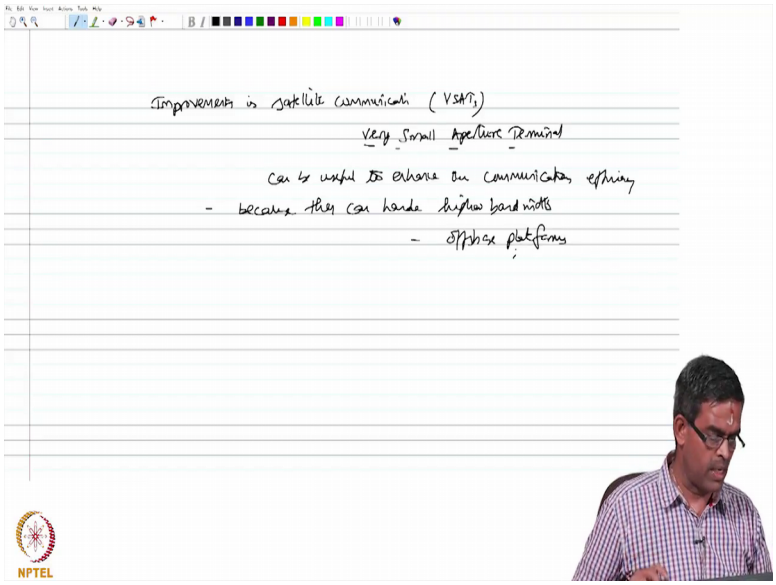

Further, improvements in satellite communication like VSATS nothing but very small aperture terminal. That is VSAT can be useful to enhance the communication efficiency, because they can handle higher bandwidth which is required for offshore platforms because a frequency bandwidth in this case is very broad.