

TALK TIME

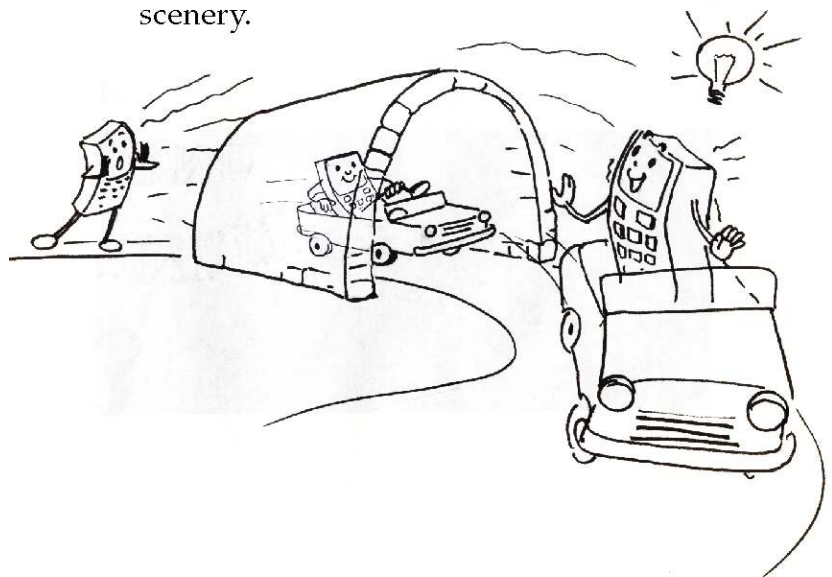
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It was the monsoon season and the Trekkers club at Anirudh's college had arranged a trip to Lonavala. They had hired a bus from Mumbai and were approaching Lonavala on the Mumbai-Pune Expressway. Some people were admiring the greenery on the mountains while others were ecstatic over the innumerable waterfalls along the ghats. Suddenly the peace was shattered by a shrill sound. Someone's cell phone was ringing. Before Sakshi could answer the call, the ringing stopped abruptly. Professor Paranjpe who seldom missed an opportunity to challenge the students, asked "Now, what could be the reasons for that phone to stop ringing?". "Maybe it was a wrong number and the caller realized it", said Sameer, who had a penchant for giving quick responses. "Maybe Sakshi and her friend have some code for missed call rings", said Anirudh who delighted in thinking differently. "We are passing through a tunnel", observed Sakshi quietly. Professor Paranjpe laughed and said, "Yes, a cell phone cannot receive any signal in a tunnel".

Meanwhile the bus came out of the tunnel and Sakshi immediately tried to call back her friend. However the call did not go through and she kept getting the message 'Network Busy' on her cell phone. "What could be happening now?", asked the Professor, with a twinkle. Sameer made a guess, "Maybe there are too many people calling simultaneously and there are not enough frequencies". "I thought frequencies are used mainly in radios. I often listen to Radio Mirchi, 98.3 FM", said Sakshi. "Cell phones use wireless communications. In any wireless communication, the sender transmits signals on a specific frequency and the receiver has to be tuned to the

same frequency to receive the signals. If many senders are transmitting signals on the same frequency, the signals will interfere and the receivers will not be able to decode the signals properly", said Sameer, in his most scientific manner. "Different radio stations use different frequencies to avoid interfering with each other. Cell phones also work in a similar manner", summarized Anirudh. "Here is a puzzle", said the Professor, "Suppose we have 10 frequencies available for communication. How many simultaneous calls can we have?". "Obviously, 10 calls. Each call will need one frequency for itself, to avoid interfering with the others", said Sameer. "That is too few. There must be a way of accomodating more calls", said Sakshi. This set them thinking and finally Anirudh observed, "When we make a call, we dont talk continuously. So maybe two calls can share the same frequency, as long as they send their signals at different times. The first call sends its signals for one second and waits. Then it is the turn of the next call for one second.

After that the first call can send its signals for another second and the cycle continues. So if we have two calls that take turns in using a frequency, we can have 20 calls in 10 frequencies", Anirudh concluded. "Hey, that is great. If we have 5 calls taking turns in each frequency, then we can have 50 calls totally", said Sameer. "Very good", remarked Professor Paranjpe, getting ready to deliver a lecture on multiplexing mechanisms. Fortunately for everyone, Sakshi's call got through at this point and they all went back to admiring the scenery.



What is "multiplexing"? It is simply a way to share resources by taking turns to use it. For example, suppose you and your sister are both eager to read this issue of Jantar Mantar as soon as it arrives. One way of sharing would be - one of you reads the JM from start to end and then gives it to the other. This way of sharing is generally called "First Come First Served". The problem here is that it is not fair. The second person has to wait till the first one has finished. Suppose your sister grabs the JM and starts reading first. While reading she gets a phone call and starts talking to her friend. Now you have to wait much longer for her to finish reading the JM. So what do you do? You read the JM while she is talking on the phone! When she finishes talking on the phone, you give the JM back to her. This is the basic idea of "multiplexing". Share the resource (JM) in such a way that each user (you) does not have to wait for long time to get access to the resource. A fair way of sharing would be - You take turns to read the JM. She reads a few articles and gives it to you. You read a few articles and give it back to her and the cycle continues. This way of sharing is generally called "Round Robin" and it is one way of doing multiplexing. We also use this multiplexing principle for shared access to the T.V. Suppose you want to watch the cricket match but others want to watch some serials. What do you do?

We usually resolve the problem by switching back and forth between the channels during the

advertisement breaks! In cell phone advertisements you may have seen terms like GSM, TDMA and CDMA. These are different multiplexing mechanisms. A good multiplexing mechanism ensures that the resource is never idle and minimizes the waiting time for the users. What the difference between GSM and CDMA? Which one of these is used by Orange, AirTel, Reliance and other cell phone services? Which technology is better? Try and find out.

Frequency: The number of repetitions per unit time of an electromagnetic wave.

Modulation: The transmission of a signal on a chosen frequency.

Multiplexing: Combining several signals for transmission on some shared channel. This is also known as "multiple access". The communications channel may be shared between the independent signals in different ways: frequency division multiplexing (FDMA), time division multiplexing (TDMA), or code division multiplexing (CDMA).

TDMA: A type of multiplexing where multiple signals are transmitted over the same channel by allocating a different time interval for each signal.

Some interesting related websites are:

<http://express.howstuffworks.com/>

<http://www.iec.org/online/tutorials/>

You can find an interesting story about the origin of the term "Round Robin" at

http://en.wikipedia.org/wiki/Round_robin/

