**Challenge Networks**

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## Delay Tolerant Networks

**Delay Tolerant Networks** (DTNs) can store packets in intermediate nodes for an extended period of time, until it is possible to forward the packet. This is useful in cases where the link to the next node has been broken or things like interplanetary communication, where the receiver is on the other side of a planet, which means it is not in the line of sight, which means we cannot communicate right now.

## Vehicular Ad-Hoc Networks

**Vehicular Ad-Hoc Networks** provide communication between vehicles on the road. There are also road-side nodes which act as central hubs. Vehicles can communicate between themselves or with hubs. This can be used to send warnings to other vehicles to avoid accidents or to manage traffic.

## Ad-Hoc Networks

**Ad-Hoc Networks** are ones that use no infrastructure. For example, Bluetooth is an ad-hoc network, since devices are directly communicating between themselves. Wi-Fi, however, is not since it requires an access point.

## Antennas

Radio signals are transmitted and received using **antennas**. These antennas can be of two types, **omnidirectional**, which send out and receive signals from every direction, but use a lower frequency, and **directional**, which send out and receive signals from a specific direction but use a higher frequency.

### Multiple-Input Multiple-Output

Multiple antennas can be used together at the sender or receiver to increase the data rate and transmission range. This sort of setup is called a **Multiple-Input Multiple-Output** (MIMO) setup.