**The network core**

Its a mesh of interconnected routers.

How to send message:

* split message on several chunks (packets) which size is certain value (bits)
* transmit packet into access network with transmission rate

Packet transmission delay (PTD) - time needed to transmit single packet.

PTD = bits / bits per second (bps)

**Packet switching**

Router stores each packet in itself. Packet wont be transmitted forward until it will completely stored in router (meant received from source).

Out-bound link - link between router and packet destination.

In-bound link - link between source and router.

Kinds of packet delay:

* nodal-processing delay
* queuing delay
* transmission delay
* propagation delay

**Processing delay** - the time required to exam the packets headers and determine which is the destination of it.

**Queuing delay** - the time a packet waits to be transmitted.

If the queue is empty, the delay is zero.

**Transmission delay** - the amount of time required to push all the packet's bits into to the out-bound link

**Propagation delay** - the distance between two routers divided by propagation speed. (physical value)

For example:

A - average packet arrival time

R - link bandwidth (bps)

L - packet size (bits)

IN = L \* A / R - traffic intensity

So:

switch IN:

* 0 - avg queuing delay is small
* going to 1 - queuing delay is large
* greater than 1 - delay is infinite

In addition to previous delays, there is another performance measure in networks - throughput.

Example:

If the file size is F bits.

Transfer takes T seconds.

Avg throughput = F / T bits per second

Instanteneous throughput - rate at which destination receiving the file.

Average end-to-end throughput - the less throughput value between source and dest.

Bottleneck link - link with the smallest throughput.

**Two key network-core functions**

* Routing - determining the destination of packet
* Forward - push the packet to packet known destination