

About ECN:

Explicit Congestion Notification, or **ECN**, enables end-to-end network congestion notification between a client and a server, without dropping of packets. It is an extension to the **TCP/IP** protocol. When a congestion is encountered, instead of dropping packets, an ECN-aware router can '**mark**' the packets in order to signal an incoming congestion in the network. The receiver of such a marked packet echoes this message back to the sender, who then reduces their data transmission rate so as to prevent congestion and dropping of packets in the network.

Initial Setup:

In the **TCP header** the first two bits in byte 14 are defined as flags for the use of ECN, namely the **ECE** (Echo - Congestion Encountered) and **CWR** (Congestion Window Reduced) bits. According to the convention, a TCP client indicates it supports ECN by setting **ECE=CWR=1** in the **SYN**, and an ECN-enabled server confirms ECN support by setting **ECE=1** and **CWR=0** in the **SYN/ACK**.

During Transmission:

Once ECN has been negotiated with the receiver at the transport layer, an ECN sender can set two possible codepoints (**ECT(0)** or **ECT(1)**) in the IP header to indicate an ECN-capable transport (**ECT**). If both ECN bits are zero, the packet is considered to have been sent by a Not-ECN-capable Transport (**Not-ECT**). When a network node experiences congestion, it will occasionally either drop or **mark** a packet, with the choice depending on the packet's ECN codepoint. If the codepoint is Not-ECT, only drop is appropriate. If the codepoint is ECT(0) or ECT(1), the node can mark the packet by **setting both ECN bits**, which is termed '**Congestion Experienced**' (**CE**), or loosely a 'congestion mark'.

On reception of a CE-marked packet at the IP layer, the Data Receiver starts to set the **Echo Congestion Experienced (ECE)** flag continuously in the **TCP header** of **ACKs**, which ensures the signal is received reliably even if ACKs are lost. The TCP sender confirms that it has received at least one ECE signal by responding with the **Congestion Window Reduced (CWR)** flag, which allows the TCP receiver to stop repeating the ECN-Echo flag.

References:

https://en.wikipedia.org/wiki/Explicit_Congestion_Notification
<https://tools.ietf.org/id/draft-ietf-tcpm-accurate-ecn-05.html>