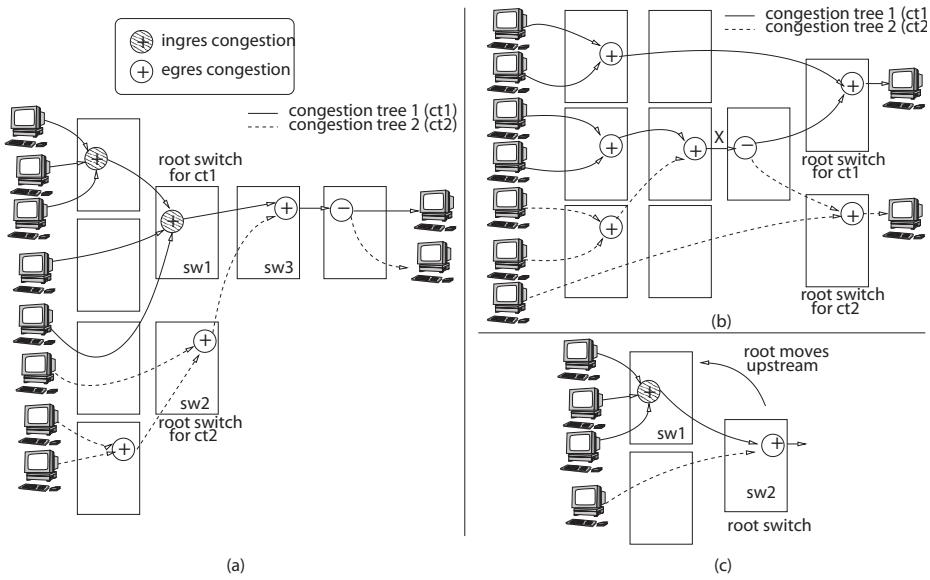


Fig. 3. Different dynamic formations of trees. Speedup is two. (a) two trees overlap and merge, (b) two trees overlap but do not merge, and (c) the root switch moves upstream.

are injecting at the full injection rate, the bandwidth at the egress port of sw1 must be shared among the four flows. Thus, a new congestion is formed at the egress side of sw1. In fact, two congestion trees have been created at different instants, but the first one later becomes a subtree of a larger tree. This situation can be viewed as if the root of the congestion tree had moved downstream in the network.

Another scenario occurs when two congestion trees overlap. This may happen quite frequently in server systems with different disks placed close to each other. As each accessed disk may produce a congestion tree, several trees may overlap.

When two congestion trees overlap, new dynamic behaviors appear. Figure 3.a shows two congestion trees. The one plotted in solid lines (ct1) is formed first, whereas the one plotted in dashed lines (ct2) appears later. In this situation, ct1 has its root switch at sw1 and ct2 at sw2. However, when ct2 appears, a new congestion point is located at sw3. This new congestion point can be viewed as a new root for both trees, that will finally merge into one. However, as the congestion point has been formed by flows headed to different destinations, it could be considered as two different overlapping congestion trees. Therefore, if congestion control mechanisms allocate resources depending on packet destination, separate resources will be needed for each congestion tree. On the other hand, if congestion within the network is going to be treated, this case should be considered as two trees merging into one, thus saving some resources.

Another interesting situation occurs when two congestion trees overlap but do not merge. For instance, once the congestion tree plotted in solid lines (ct1) in figure 3.b is formed, a second one (ct2, plotted in dots) forms. A ct2 branch shares a set of network resources with ct1. Thus, point X can be viewed as belonging to both trees. In this