Traffic Engineering in IPTV networks

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1. Traffic control functions

TE in NGN-based IPTV networks will rely on open-loop preventive traffic control mechanisms due to the stringent performance requirements including video quality, channel change time and blocking probability for VoD requests. Reactive traffic control mechanisms may be useful for video streaming in public Internet TV but are not considered suitable for private IPTV networks. The peer-to-peer video streaming technology implemented by systems like Joost will not be used by NGN-based IPTV networks.

The basis for preventive traffic control is call admission control (CAC) at call set up and traffic stream enforcement (policing) during the data transfer phase. CAC and routing faces QoS constraints and, possibly, GoS constraints. First, the CAC_{QoS} function finds the set of feasible paths that comply with the end-to-end QoS constraints of the requested call class. Second, the routing function selects a path for the new call. Third, the CAC_{GoS} function accepts/rejects this choice based on revenue considerations and end-to-end GoS constraints of the requested call class.

Variable-bit-rate (VBR) video sources are often smoothed/shaped to improve the statistical multiplexing gain (known as capped VBR). Many VBR sources typically share an output link from the IP router. The aggregate input rate to the multiplexer may momentarily exceed the link capacity, a state known as congestion. Depending on the specific traffic flows, congestion may persist for a longer time period, forcing packets to wait in the queue or even be dropped in case the buffer runs out of empty space. CAC aims at keeping the risk of congestion within tolerable limits but transmission errors can still occur due to random effects. Packet corruption and loss are handled by forward error correction (FEC) and/or backward error correction (BEC). Traffic enforcement can be implemented by dual token/leaky buckets at the gateway router in the central and regional data centers (SHE,VHO) and the residential gateway.

TE for unicast flows is carried out for VoD and tsTV, while TE for multicast flows is carried out for BTV and NVoD. The latter is optimized by a special technique (IGMP snooping) which allows the regional data center (VHO) and access network multiplexer (DSLAM) to monitor signalling messages (IGMP join/leave messages) in order to prevent requesting a channel that already is available. Only when the channel is unavailable the multicast tree will be extended with a branch to the new user.

The routing function recommends an economical (or at least feasible) path for the IPTV flow. The design of core and metro networks involves global configuration of physical networks (PNs) and virtual networks (VNs). The global configuration involves assigning user communities (populations) to network nodes, dimensioning of the link capacities given the traffic demand and GoS such as call blocking probabilities, and configuration of packet schedulers in routers. The design of data centers includes configuration of number of video servers, selection of video server allocation rule, and scheduling of in-advance transfers of stored video information from the central data center (SHE) to regional data centers (VHOs).

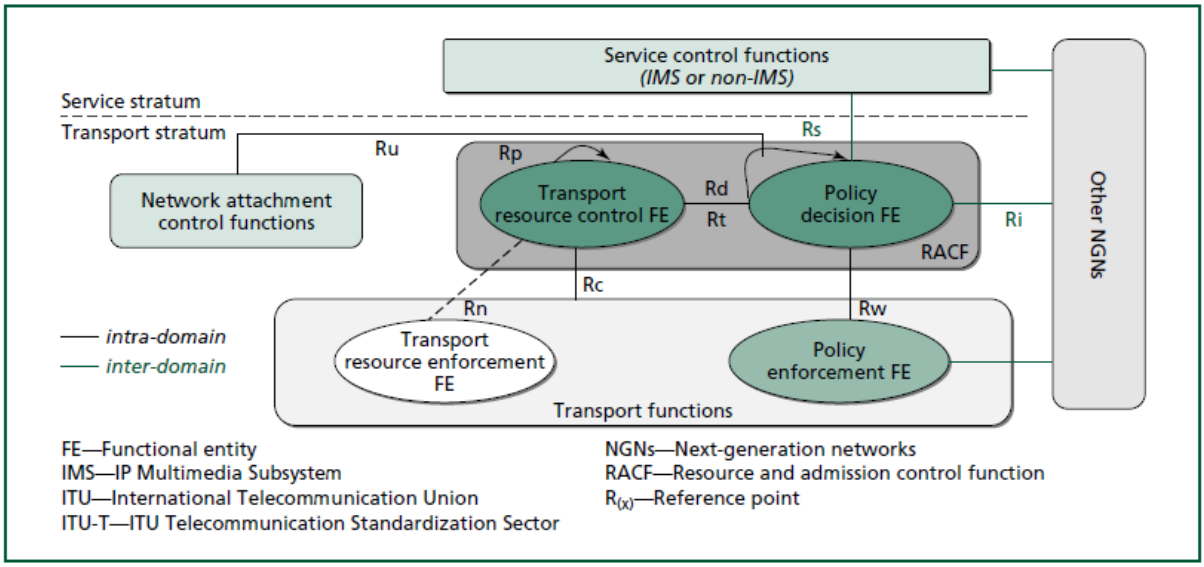

Figure 1. NGN RACF functional architecture (Hermsmeyer, 2007).

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