



Comsat Laboratories

LinkStar™ Application Note

IP Quality of Service (QoS) on LinkStar's Inbound Channel

LS-APN-01

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INTRODUCTION

Internet Protocol (IP) performance for the end user has long encountered degradation and congestion when attempting to share bandwidth across networks with multiple applications and services. To alleviate this problem, the standards body and the network development community implemented IP Quality of Service (QoS) to classify IP traffic and guarantee performance in advance. IP QoS is implemented in the LinkStar product line using the Differentiated Services (DiffServ) implementation based on RFCs 2474, 2597, and 2598. This feature employs the same QoS implementation used in the LINKWAY products, which has been successfully deployed and applied on live customer networks. QoS is applied on the LinkStar terminals to the inbound channel and a similar implementation is applied on the outbound channel using an external QoS device. This application note describes the implementation of IP QoS on the inbound channel in LinkStar and presents an example of its application.

IP QOS DIFFSERV

DiffServ offers the ability to create different IP services and allows the end user to guarantee delivery and bandwidth in advance for specific intra-domain services and applications. DiffServ uses a replacement header field, called the Differentiated Services (DS) field, to supersede the Type of Service (TOS) octet field in the IP header. This header contains a codepoint, which identifies the priority defined per QoS.

On LinkStar, IP QoS is implemented on the Return Channel Satellite Terminal (RCST) for the inbound TDMA return link. The network operator can enable IP QoS and configure an RCST to apply QoS on the inbound traffic to the RCST from the local Ethernet interface and guarantee its delivery on the satellite bandwidth available to the terminal. This QoS implementation is defined as “intra-domain QoS.”

In implementing QoS on LinkStar, the first step is to enable QoS (Figure 1 – IP QoS Configuration Window)—an option that can be applied for each RNCC. The next step is to define queues for each IP service.

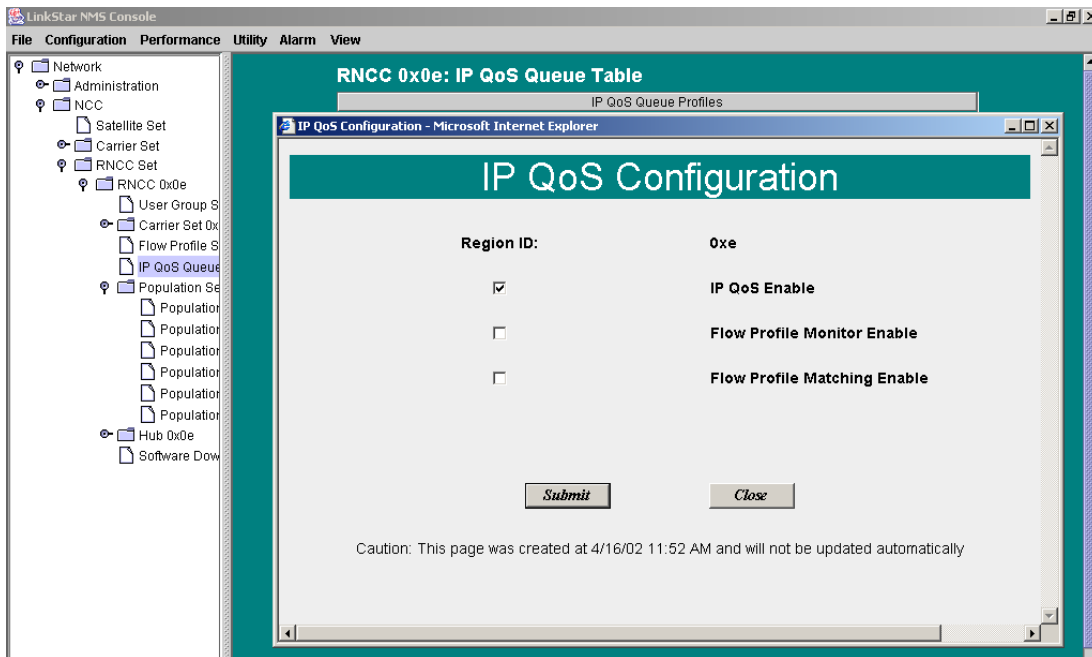


Figure 1 – IP QoS Configuration Window

QUEUE PROFILES

IP QoS assigns classes of queues for different levels of service. Each class is given a Committed Information Rate (CIR). This CIR should be allocated from the CIR allocated for the terminal to achieve best performance. IP QoS applies to traffic coming from the Ethernet interface within the RCST and not to the TDMA bandwidth.

There are a total of 6 different classes that can be assigned to a QoS queue. These classes are **Expedited Forwarding (EF)**, 4 classes of **Assured Forwarding (AF)**—each AF class with high, medium and low drop precedence, and **Best Effort**. The DS field will contain a codepoint for each class, which can then be used for queues. The codepoint is a 1-byte field and can be found in the IP header and be verified with a network analyzer or packet sniffer such as the one used in Figure 2 – Packet Analyzer. The possible values for the codepoints, and the associated priority and out-of-profile behavior, is displayed in Table 1 – Codepoint Values.

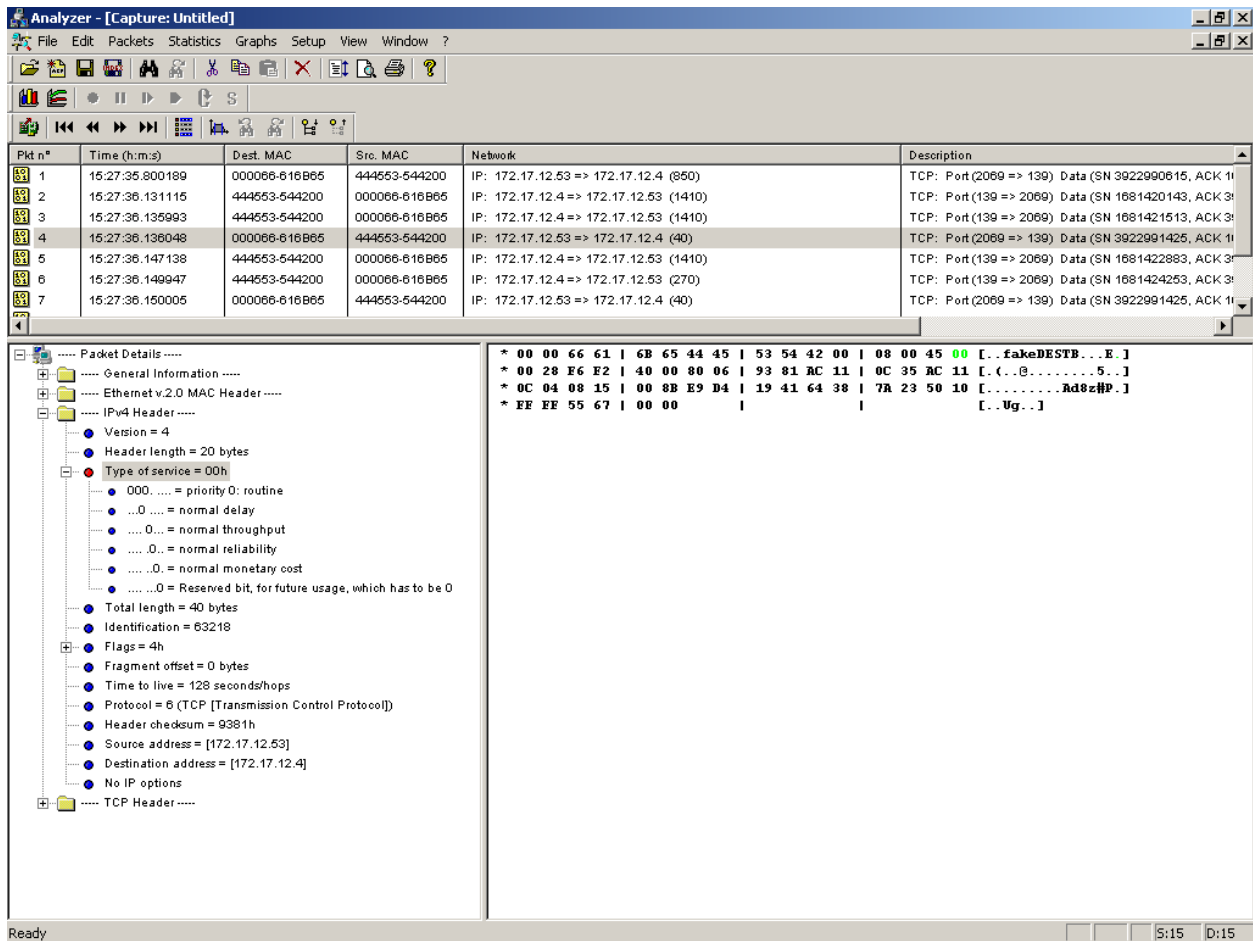


Figure 2 – Packet Analyzer

- Expedited Forwarding (EF) is given highest priority in delivery by QoS. A packet with an EF codepoint value will be given highest priority delivery. The assigned allocated bandwidth should be sufficient for all expected EF traffic since out-of-profile packets will be dropped.

- Assured Forwarding (AF) is given medium priority and guaranteed delivery for in-profile packets and is three levels of out of profile. characteristics. There are 4 “parallel” classes in AF, each given equal priority for their separate queues.
- Best Effort is given lowest priority and is not guaranteed.

IP QoS Classes					
Class	Codepoint Value (TOS) or (DS) xxxx xx 00			Profile Priority	Out of Profile Action
Expedited Forwarding (EF)	1011 1000			High	Drop
	High	Medium	Low		
Assured Forwarding (AF) 1	0011 1000	0011 0000	0010 1000	Medium	High, Medium or Low Drop Precedence
Assured Forwarding (AF) 2	0100 1000	0101 0000	0101 1000	Medium	High, Medium or Low Drop Precedence
Assured Forwarding (AF) 3	0111 1000	0111 0000	0110 1000	Medium	High, Medium or Low Drop Precedence
Assured Forwarding (AF) 4	1001 1000	1001 0000	1000 1000	Medium	High, Medium or Low Drop Precedence
Best Effort	0000 0000			Low	?

Table 1 – Codepoint Values

A network operator can create queue profiles on LinkStar, which can then be assigned to an RCST or a group of RCSTs. The profile contains the class and TDMA bandwidth for the queue. A queue configuration is shown in Figure 3 – IP QoS Queue Profile Configuration with an example of CIR distribution for a terminal with a CIR of 64kbps on the inbound TDMA carrier. Here, only one of the four AF classes is being utilized.

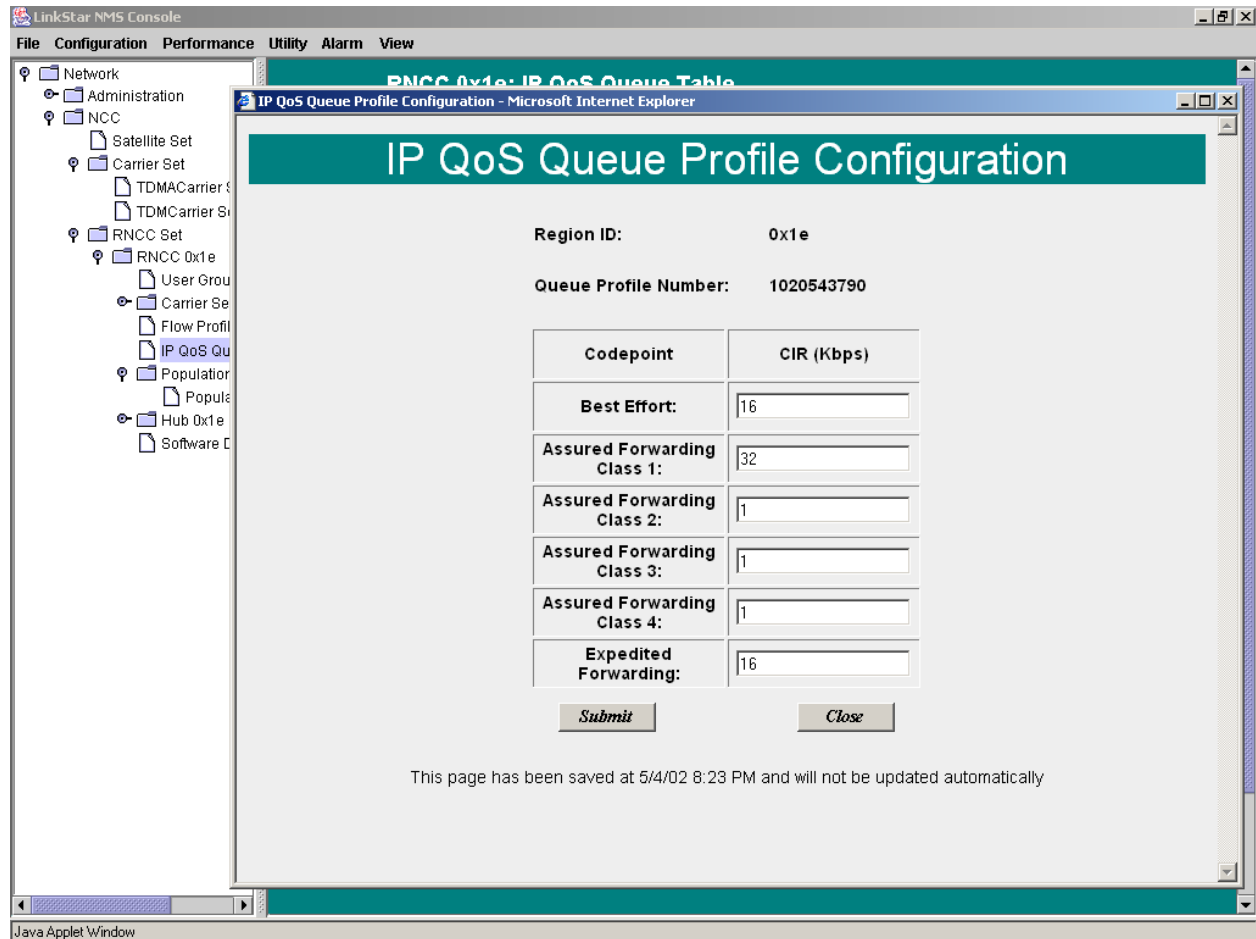


Figure 3 – IP QoS Queue Profile Configuration

An RCST, assigned to a queue profile, can then accept IP packets that have been tagged with the matching codepoints. This codepoint can be set either by an external QoS device or internally by the RCST. The default QoS configuration will look for the codepoint in the IP packet and match this to the appropriate queue in the RCST. This requires that the RCST be subscribed to a queue and also that the codepoint be set in the packet before its arrival at the RCST.

FLOW PROFILE MATCHING AND MONITORING

LinkStar can also be configured to set the codepoints for select IP packets matching various traffic profiles. This feature is enabled at the RNCC QoS configuration screen (Figure 4 – IP QoS Configuration Window) and would then apply to that entire LinkStar region. This also requires that Traffic Flow Profiles exist to define priorities for all traffic. A default profile must be set for all traffic and then additional profiles are required as needed for select traffic. Each IP packet would be compared to the existing profiles and mapped to the appropriate queues.

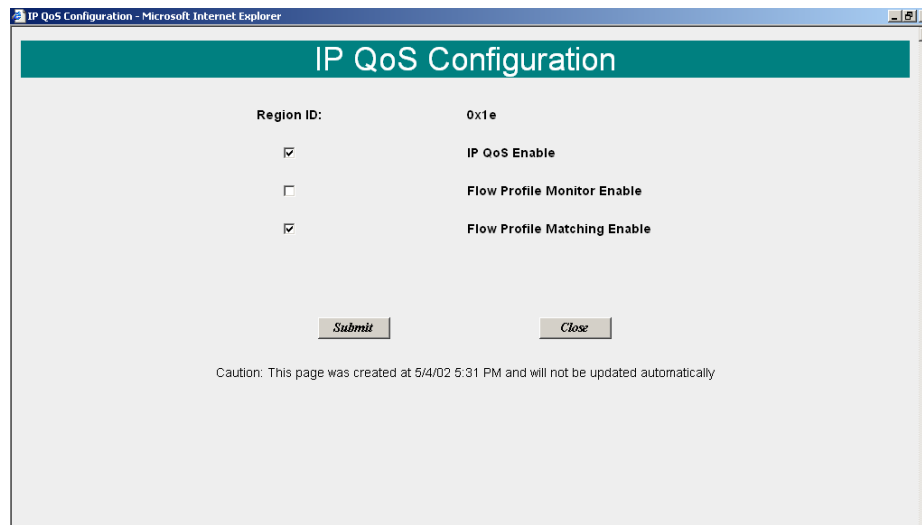


Figure 4 – IP QoS Configuration Window

Flow Monitoring can also be enabled in the same screen to offer rate limiting using flow-monitoring algorithm described in the Traffic Flow Profiles section below.

TRAFFIC FLOW PROFILES

A traffic flow defines a group of IP packets with a common origination and/or destination that may be carrying similar payload. Using LinkStar, a network administrator can create a Traffic Flow Profile to match IP packets to traffic flows and set the codepoint for the various levels service and respective queues for the RCSTs. A flow profile can be defined by the following:

Flow Profile Name: This field includes a name by which the Flow Profile can be referred to. This name is maintained as a convenience for the network administrator for easy reference and is not used by the QoS implementation.

Protocol: This field lets you choose the protocol for the flow for which you are trying to create a profile. The drop-down box provides a list of commonly used protocols. If the relevant protocol is not listed in the drop-down list, choose “OTHER” and specify the Protocol number in the “Value” field next to the “Protocol” field. If the intent is to wildcard the protocol, then choose “ANY” from the drop-down list. That is, if one wants to match an IP packet to this flow-profile irrespective of the Protocol, “ANY” should be chosen.

Src IP: This field is used in conjunction with “Src Mask” field to match the Source IP address in an IP packet. For example, if one wants to match all IP packets with source IP addresses starting with 134.133, then the Src IP = 134.133.0.0 and Src Mask = 255.255.0.0.

Dst IP: The explanation for this field is similar to the one for “Src IP.”

Src Port Mask: This field is used to match the source port in an IP packet. This is useful mostly for TCP and UDP flows. If the intent is wildcard the source port, then “ANY” should be chosen. If the intent is to match IP packets that originate from a particular port, then “Custom” should be chosen, and the value of the source port should be given in the “Src Port” field.

Dst Port Mask: The explanation for this field is similar to the one for “Src Port Mask.”

Codepoint: This is the one-byte value entered in the ToS field of the IP packet header if the packet matches the criteria described by the above-mentioned fields. The flow can be assigned a Best-Effort codepoint, an Assured Forwarding codepoint or an Expedited Forwarding codepoint. If one chooses Assured Forwarding, there are 4 sub-classes to choose from, each of which has 3 drop precedences (low, medium and high). For example, if a network is forced to drop a packet from a particular class due to congestion or any other reason, a packet with high drop precedence is chosen. If no such packet is available, then a packet with medium drop precedence is chosen. If again, no such packet is available, then a packet with low drop precedence is chosen.

Rate of Flow: This field denotes the average rate in kbps of the flow. The flow-monitoring algorithm uses the “Rate of Flow” and “Burst length” parameters to configure a flow profile.

Burst length: This field denotes the maximum length of any burst for the flow. This field holds significance if flow-monitoring has been enabled (described in below). This field defines the maximum length of the queue in milliseconds. If the total burst flow exceeds the length of time defined, the packets will be discarded. This is a “token bucket” algorithm with the “hole” being the Rate of Flow and the Burst length being the capacity of the bucket. Defining the value of this field as “0” limits the capacity of the flow to the value entered in Rate of Flow.

Figure 5 – Flow Profile Configuration shows an example of a wildcard profile for all UDP traffic with a codepoint setting to Expedited Forwarding, a Rate of Flow of 10 kbps, and Burst Length of 0ms. This type of configuration could be applied to UDP traffic such as VoIP, where 10kbps is for one call, and there is no need for buffering since this is a real-time application and delayed delivery of packets is not required.

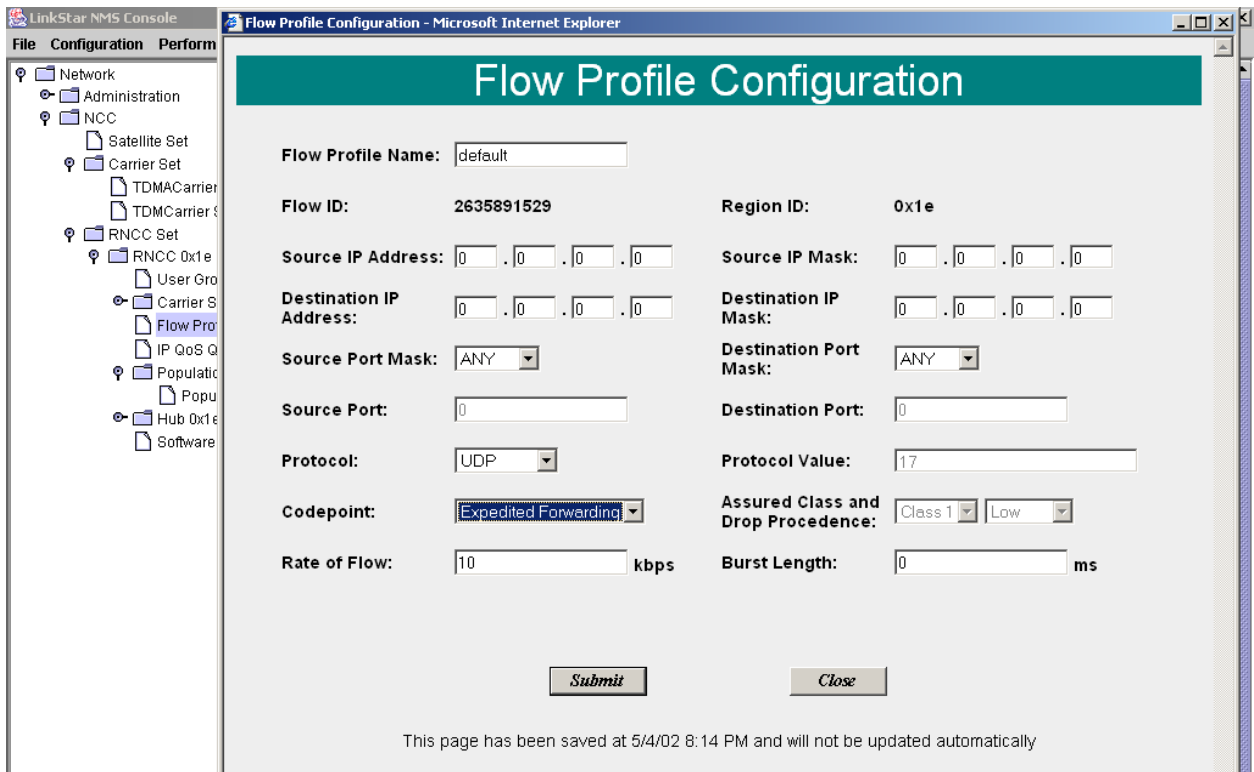


Figure 5 – Flow Profile Configuration

CONFIGURATION NOTES

Enabling Flow Profile Matching requires a flow profile for all traffic; therefore, a default profile must be created for all traffic, in addition to the specific traffic profiles requiring QoS servicing. Unrecognized traffic will bypass the QoS process and as such will be given highest priority. Should Flow Profile Monitoring be enabled, the default profile rate and burst length should be set for the aggregate non-priority traffic. Figure 6 – Flow Profile Configuration Example shows such a default Flow Profile Configuration. The rate is 16kbps and the burst length is 40ms.

The screenshot displays the LinkStar NMS Console interface. The main window is titled "Flow Profile Configuration" and is overlaid on a "Flow Profile Table" for RNCC 0x0e. The configuration form includes the following fields and values:

Field	Value
Flow Profile Name	default
Flow ID	1021884264361
Region ID	0x0e
Source IP Address	0 . 0 . 0 . 0
Source IP Mask	0 . 0 . 0 . 0
Destination IP Address	0 . 0 . 0 . 0
Destination IP Mask	0 . 0 . 0 . 0
Source Port Mask	ANY
Destination Port Mask	ANY
Source Port	0
Destination Port	0
Protocol	ANY
Protocol Value	0
Codepoint	Best Effort
Assured Class and Drop Precedence	Class 1 Low
Rate of Flow	16 kbps
Burst Length	40 ms

Buttons: Submit, Close

Caution: This page has not been saved in the database

Figure 6 – Flow Profile Configuration Example

Figure 7 – QoS Decision Flowchart on the next page provides a visual representation of the software logic decisions and is a summary of QoS functionality on the inbound channel.

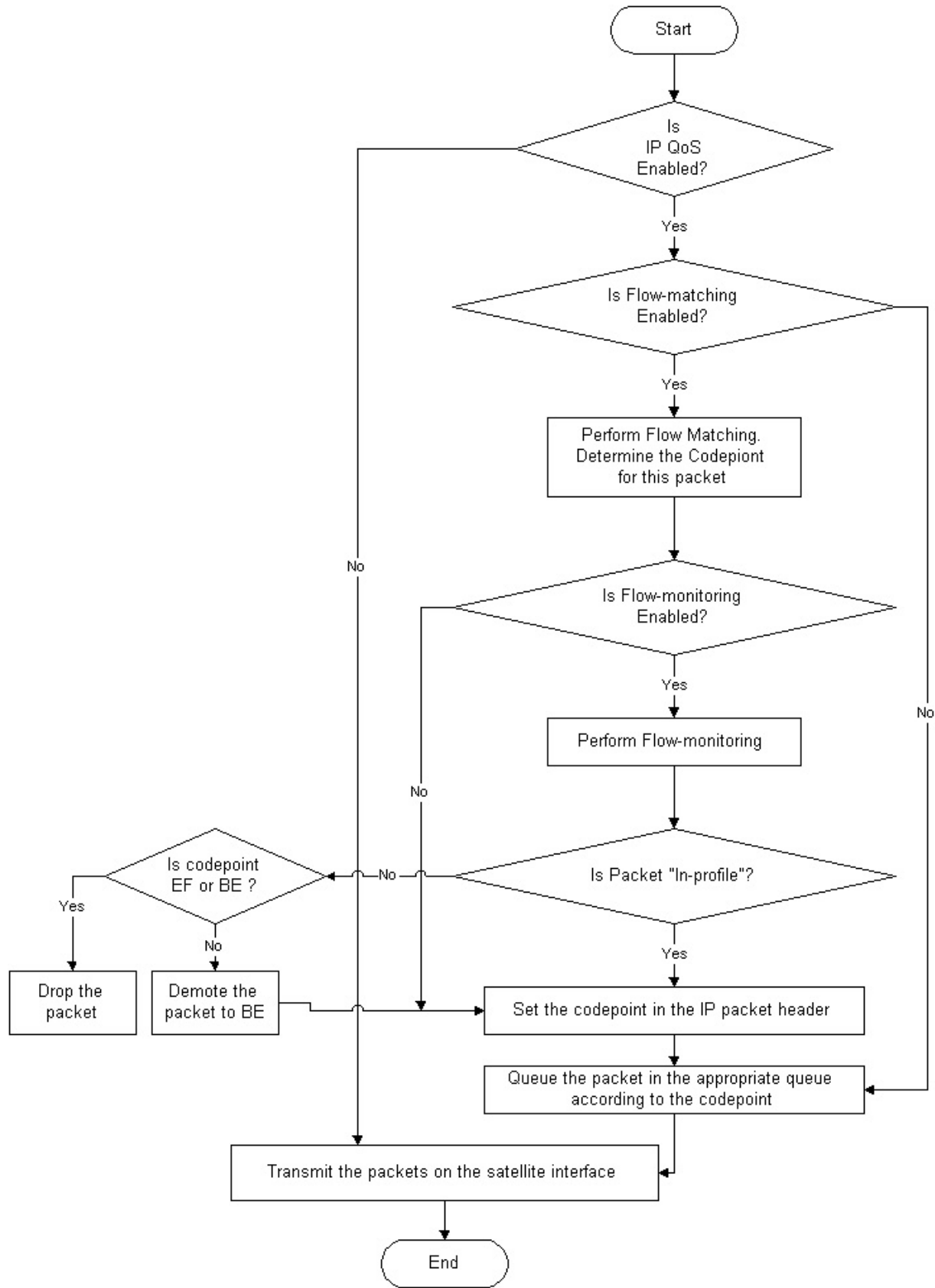


Figure 7 – QoS Decision Flowchart

SOFTWARE NOTES

Please refer to LinkStar software release notes to determine QoS feature availability.