



Configuration Settings on Nokia 7750 SR Routers to Optimize Network Performance

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Abstract: One of the main advantages of the Nokia 7750 SR-7 / SR-12 router type is the fact that it meets the most advanced innovations of the time, enabling a network of very high performance (high capacity and speed). But even in these types of routers there are configurations which must be avoided in order to obtain exactly the optimal performance. In this paper we will treat two configurations for 7750 SR-7 which led to a problem where there was not enough capacity in the LAG and we will replace the configurations in order to have optimal parameters.

1 INTRODUCTION

Nokia Service Routers (SR) are undoubtedly one of the best network design options for many factors including: meeting the most advanced innovations of the time, enabling a very high performance network. In addition to the current market demands for high capacity and speed, this class of routers also enables the support of Cloud, 5G networks as well as the Internet of Things. This family of routers includes the following types: 7750 SR, 7750 SR-s, 7750 SR-a and 7750 SR-e. Capacity processing by these types of routers ranges from 200 Gb/s to 13.5 Tb/s. It is worth noting that these types of routers fit networks of different sizes as well as support Gigabit Ethernet interfaces as GE, 10GE, 100GE, 400GE. In this paper it is considered a network where router type 7750 SR-12 represents a core router and the other type 7750 SR-12 represent a BGW (Border Gateway Router) router. The focus stands on the optimal use of network parts, two configurations for the BGW router 7750 SR-7 will be addressed, which resulted in a drop in traffic above a certain value, resulting in QoS problem. New configurations will be implemented in order to have a capacity optimization.

2 NETWORK STRUCTURE

The network structure that is considered for the analysis of the problem is composed by the part of core routers and the part of routers that serve for Internet access. In the role of core router we have the type Nokia 7750 SR-12 while as outbound routers on the Internet we have the type Nokia 7750 SR-7. To have a clear view of the problem, the network diagram used is shown in figure 1.

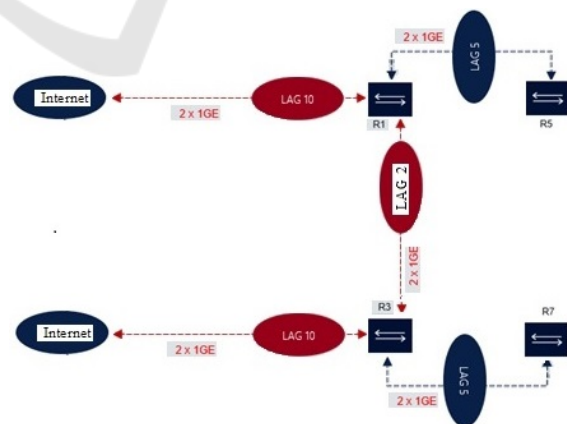




Figure 1: Network diagram.

In the diagram shown above, the routers R1 and R3 have the role of BGW routers type nokia 7750 SR-7, while routers R5 and R7 have the role of core routers type nokia 7750 SR-12. One technological

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aspect that definitely favors Nokia's choice of technology is the increase in Link capacity without the need to upgrade hardware components to have higher speeds (Lapukhov et al., 2016). On Nokia routers this is enabled using Link Aggregation Group (LAG) (LAG, 2011). So depending on the capacity required the router card ports (which can be at the same or different speeds) are mixed and form a LAG with a capacity equal to the sum of the capacities of each port. The LAG also offers stability, so if a LAG fails for various reasons then the standby LAG will take over the passage of traffic (Bhatia, 2014). In the above diagram we have specifically LAG 5 for the connection between R1 and R5, LAG 5 for the connection between R3 and R7, LAG 2 for the connection between R1 and R3, while LAG 10 in each of the BGW routers (R1 and R3) we have it for the output on the Internet, more specifically are the LAGs that connect end-to-end between our network and the ISP (Internet Service Provider). LAG 10 in R3 is also the primary line for the end-to-end connection with the ISP while LAG 10 in R1 is in the standby state, which means that if for various reasons LAG 10 to R3 (reasons related to the LAG itself for example fiber damages, reasons related to the router itself or the router card where we created the LAG is in trouble) is no longer in working condition then the active role will pass LAG 10 to R1. So the above description is known as the principle of redundancy (specifically, one runs as the primary router and the other as a backup router). In our case both LAG 10 on each router (R1 and R3) are terminated on the same ISP. Since we have taken as active LAG the LAG 10 at R3 after the traffic comes to this router from the ISP we send this traffic to the chorus routers which are in our case R5 and R7. We see again as in the case of BGW routers in the core part we have two routers and again we apply the principle of redundancy where R7 acts as the primary core router, so the traffic coming to R3 via LAG 5 will be sent to router R7. If for various reasons router R7 is not in working conditions or LAG 5 from R3 to R7 is dysfunctional then the traffic coming from ISP to router R3 must be routed in alternate routes in order for the traffic to end at the core router R5 (which serves as a standby router). To send traffic from R3 to R5 initially through LAG 2 we will send the traffic from R3 to R1 and here through LAG 5 we will send the traffic from R1 to R5. Each service is uniquely identified by a service ID and an optional service name within a service area (Bhatia, 2014). The Nokia service router model uses logical service entities to construct a service (Documentation, 2020). In the Nokia router services can provide Layer 2 bridged service or Layer 3 IP-routed connectivity between a service ac-

cess point (SAP) on one router and another service access point (a SAP is where traffic enters and exits the service) on the same (local) router or another router (distributed). A distributed service spans more than one router (Bhatia, 2014). Common to all Nokia service router connectivity services are policies that are assigned to the service (Documentation, 2020). Policies are defined at a global level and then applied to a service on the router (Nokia, 2017). Policies are used to define Nokia service router service enhancements (Nokia, 2019a). One type of policies that is common to the router's connectivity services is -SAP Quality of Service (QoS) policies which allow for different classes of traffic within a service at SAP ingress and SAP egress (Nokia, 2017). QoS ingress and egress policies determine the QoS characteristics for a SAP (Alcatel-Lucent, 2012). A QoS policy applied to a SAP specifies the number of queues, queue characteristics (such as forwarding class, committed, and peak information rates, and so on) and the mapping of traffic to a forwarding class (Router, 2017). A QoS policy must be created before it can be applied to a SAP. A single ingress and a single egress QoS policy can be associated with a SAP (Nokia, 2019b). The QoS policy of inbound (ingress) services defines how incoming traffic to an SAP is classified and ranked before it is forwarded to the outbound. The QoS policy of outbound services (egress) determines how traffic will be served just before it is forwarded to an SAP.

2.1 Experimental Analysis

In SAP-INGRESS QoS Policy and SAP-EGRESS QoS Policy, if we use the percent-rate command as well as in the LAG configuration we use the adapt-qos distribute command, then a traffic cut will be noticed. Logically if "percent-rate" is used and the gate is actually a LAG then a 100 PIR should give a rate equal to the capacity of the LAG. Analyzing traffic it is noticed that the calculation is actually based on a single gate, which yields in traffic intersection, the graphical representation of which is given in figures 2 and 3.

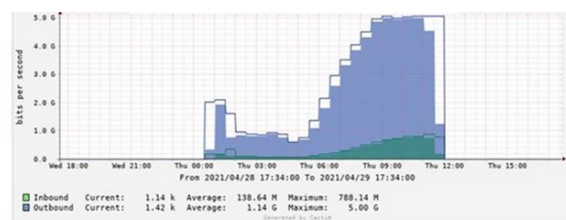


Figure 2: Traffic chart link 1 in LAG 10 to R3.

LAG-s taken into consideration in the router 7750 SR-7 are created with two ports each with a capacity

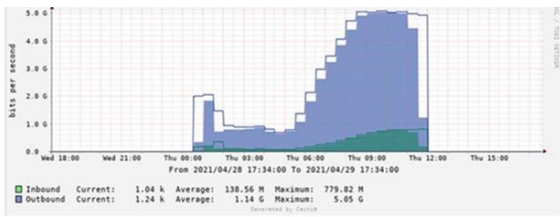


Figure 3: Traffic chart link 2 in LAG 10 to R3.

of 10G (in total the capacity of the LAG is 20G). But it was noticed that in both ports after 5G is reached (10 in total in both ports) the packages drop, a result that is given in figures 2 and 3.

We can see the above result from the statistics presented in table 1.

Table 1: Statistics with initial configurations.

Sap Aggregate Stats	Packets	Octets
Ingress		
Aggregate Offered:	16175424500708	19592527617233612
Aggregate Forwarded:	16111167561540	19517514259173874
Aggregate dropped:	642569399158	75013358047414
Egress		
Aggregate Forwarded:	10624079953591	1982395480328978

The percent-rate command within the QoS policy in SAP ingress and SAP egress allows the CIR and PIR scales to be configured as a percentage of the gateway exit rate. When we express the scale as a limit port then the use of the current scale will vary based on the gate speed. For example when the same QoS policy on a 1 Gigabit Ethernet and 10 Gigabit Ethernet gateway, then the next rate will be 10 times higher on the 10 Gigabit port this is due to the difference in gateway speed.

This allows the same QoS on different SAP ports without having to modify the next scale. The percent-rate command is supported for pir and cir parameters for both queues and policers (Nokia, 2017). Also supported is the capability of specifying the rate as a percentage value of the line rate for sap-ingress and sap-egress qos policies. It is supported for both queues and policers (Nokia, 2017). Syntax e percent-rate: percent-rate pir-percent [cir-percent] [port-limit — local-time] percent-rate pir-percent police [port-limit — local-limit]

The user has the option of specifying percent-rate for pirand cirparameters (Nokia, 2017). PIR specifies the maximum average rate at which traffic can be planned in turn. Packets are forwarded only if the PIR header is not packed. With each packet forwarded, a token is added to the PIR head for each byte in the packet. Pir-percent - this parameter is used to express the pir order as a percentage dependent on port-limit — local-time (Value varies from 0.01 to 100.00. The default value is 100.00.) CIR is the guaranteed bandwidth in the queue. As long as the CIR head is not

full, an additional package can again be forwarded during the scheduled visit time. Cir-percent - Cir is optional even when this is defined will express the CIR queue as a percentage dependent on port-limit — local-time (Value varies from 0.00 to 100.00. The default value is 100.00.) (Nokia, 2019c). We also provide details about the adapt-qos distribute command in the LAG configuration section. There are three user-selectable modes that allow operator to best adapt QoS configured to a LAG the SAPs are using (Nokia, 2017)

1. adapt-qos distributed (default). In a distributed mode the SLA is divided among all line cards proportionally to the number of ports that exist on that line card for a given LAG. The disadvantage is that a single flow is limited to IOM's share of the SLA. This mode of operation may also result in underrun due to a "hash error" (traffic not sprayed equally over each link). This mode is best suited for services that spray traffic over all links of a LAG.
2. adapt-qos link. In a link mode the SLA is given to each and every port of a LAG. The advantage of this method is that a single flow can now achieve the full SLA. The disadvantage is that the overall SLA can be exceeded, if the flows span multiple ports. This mode is best suited for services that are guaranteed to hash to a single egress port.
3. adapt-qos distributed include-egr-hash-cfg. This mode can be considered a mix of link and distributed mode. The mode uses the configured hashing for LAG / SAP / service to choose either link or distributed adapt-qos modes.

In terms of solution I need to make sure that the solution allows full utilization of the resources of each LAG in the network, has a functional qos mechanism, is scalable and robust (in the sense that no qos configuration changes will be required in case of adding new ports to the LAG), the solution should also work even if a new IOM card is added.

After a detailed analysis, 3 possible solution options are ascertained: - Percent-rate (in SAP-INGRESS QoS Policy and SAP-EGRESS QoS Policy) and adapt-qos link (to LAG configuration) - Rate MAX (in SAP-INGRESS QoS Policy and SAP-EGRESS QoS Policy) and adapt-qos link (to LAG configuration) - Rate MAX (to SAP-INGRESS QoS Policy and SAP-EGRESS QoS Policy) and adapt-qos distribute (to LAG configuration)

When there is a LAG in adapt-qos distribute (default mode) and this LAG carries a queue with percent-rate ;value; then this value is relative to the capacity of one port and not relative to the capacity

of all LAGs. This is an expected behavior and not a computer problem. In order to obtain percent-rate based on the full capacity of the LAG, the adapt-qos mode in the LAG has been changed from "distribute" to "LINK" for egress. Network LAGs will work well with solution 2 above, namely: configuring "adapt qos link" under SAP LAG interfaces and replacing "percent rate" with the "rate max" command . It is worth noting that SAP LAG changes will be made to each router in order for each LAG to operate at 100After the results performed with the selected technique described above as a result the traffic was normalized. Reached about 12G traffic (based on gateway utilization). This is clearly shown in figure 4.

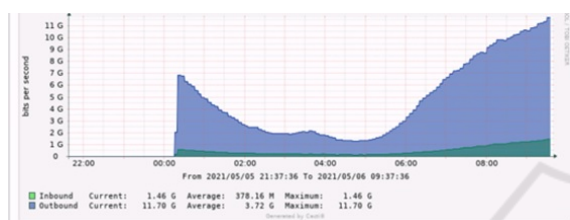


Figure 4: Traffic value in LAG 10 to R3.

Also from the table below it is noticed that we have no more package drop.

Table 2: Statistics after changing configurations.

Sap Aggregate Stats	Packets	Octets
Ingress		
Aggregate Offered:	4256776228302	5529986161549225
Aggregate Forwarded:	4256776228300	5529986161546349
Aggregate dropped:	0	0
Egress		
Aggregate Forwarded:	6903957515520	1813015801778448
Aggregate dropped:	0	0

3 CONCLUSIONS

In this paper we treated two configurations for 7750 SR-7 which led to a problem where there was insufficient capacity in the LAG (a QoS problem), also we presented the changes of these configurations through which we obtained the optimal parameters. Using the percent-rate command in SAP-INGRESS QoS Policy and SAP-EGRESS QoS Policy as well as using the adapt-qos distribute command in the LAG configuration resulted in a traffic cut. By replacing percent-rate with Rate MAX in SAP-INGRESS QoS Policy and SAP-EGRESS QoS Policy as well as replacing adapt-qos distribute with adapt-qos link in the LAG configuration, an optimal capacity value in LAG was obtained.

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