PGRE - Flow Analysis Problem

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1. *Which is the flow model that characterizes each of these flows in the network?*
   Flows identified in the network are:

   - **E-mail** – client/server,
   - **Web access** – client/server,
   - **VoIP** – the flow for transmitting the digital voice is essentially peer-to-peer; call setup and teardown is a client/server flow (a phone needs to talk to a server that understands phone numbers),
   - **SAP** - client/server,
   - **Backup** - distributed system.

2. *Which are the important boundaries in the traffic flows of the corporate network?*
   The most important boundaries are between: *GW1/ISP1, GW2/ISP1, GW3/ISP1, GW1/ISP2.*

3. *Quantify to approximate values the flows of Email, web access and SAP, between buildings.*

   - **Email flows**

```
GW2/GW3:
    - around 150 e-mail clients each sending 10 Mbyte and receiving 50 Mbyte
    IN: 7500 Mbyte/day
    OUT: 1500 Mbyte/day
Headquarters:
    - around 330 e-mail clients each sending 10 Mbyte and receiving 50 Mbyte
    IN: 16500 Mbyte/day
    OUT: 3300 Mbyte/day
```

   - **Web access**

```
GW2/GW3:
    - around 150 users each accessing 20 Mbyte of enterprise content
    - receiving 200 Mbyte external content
    IN: 300 Mbyte/day
    OUT: 3000 Mbyte/day
Headquarters:
    - around 330 users each accessing 20 Mbyte of enterprise content
    - receiving 200 Mbyte external content
    IN: 6600 Mbyte/dat
    OUT: 66000 Mbyte/day
```

   - **SAP**

```
GW2/GW3:
    - around 10% of 150 users (15 users) makes an average of 20 transactions per day
    - one transaction is 15 kbyte
    Total = 15 * 20 * 15 = 4500 kbyte per day
Headquarters:
    - around 20% of 330 users (66 users) makes an average of 20 transactions per day
    - one transaction is 15 kbyte
    Total = 66 * 20 * 15 = 19800 kbyte per day
```

4. *Discuss the available bandwidth to access the Internet in the headquarters, taking into account the values obtained in the previous answer.*

In this discussion it is not necessary to take into account SAP transactions because the number is low and it will not influence the result. I understood from the question that we should take into account **obtained values** from previous question therefore VoIP traffic will not be counted.

From the assessment we know that Internet connection runs at 100 Mb/s between GW1 and ISP1, 10 Mb/s between GW2 and ISP1 (also GW2 and ISP1) therefore it will firstly be counted the total flow of data going in/out in these flows. Firstly, we will sum the total amount of data per day going IN GW2 taking data from previous question: $A_{IN} = 7500 + 300 = 7800$ MB/day, than we will count total amount of data going OUT $A_{OUT} = 1500 + 3000 = 4500$ MB/day. When we summarize everything, we get:

$$A_{IN} + A_{OUT} = 12300\ MB/day$$

Now, let's count the theoretical possible usage of Internet in the wire between GW2 and ISP1. It gives 20 MB/s. The working hours are between 9 and 18 (9 hours = 32400 seconds) so the maximum flow is $20 * 32400 = 648000$ MB per day (648 GB). However Ethernet's lines will never be used from 100 % so we must count on some losses. Considering a loss of 50 % we get **324 GB** while we need only 12,3 GB to satisfy Branch A. To conclude, we can see that for line between GW2 and ISP1 there is **available bandwidth**. For line between GW3 and ISP1 it is the same calculation. Regrading the line between **GW1 and ISP1**, we firstly need to calculate the amount of traffic going from GW2 + GW3 that makes 20 % of total traffic.

$$A_{IN} + A_{OUT} + B_{IN} + B_{OUT} = 12300 * 2 = 24600\ MB/day$$

This 24,5 GB makes 20 % of total traffic on the line. The total utilization is $24.5 * 5 = 122.5$ MB. Ethernet on this line gives as theoretically $100 * 32400 = 3240$ GB per day (counting working hours). The real number would be around $3240/2 = 1620$ GB per day. By looking at the result numbers we see that the network was wisely designed and the access to the Internet should be **available** even for not using the network constantly.

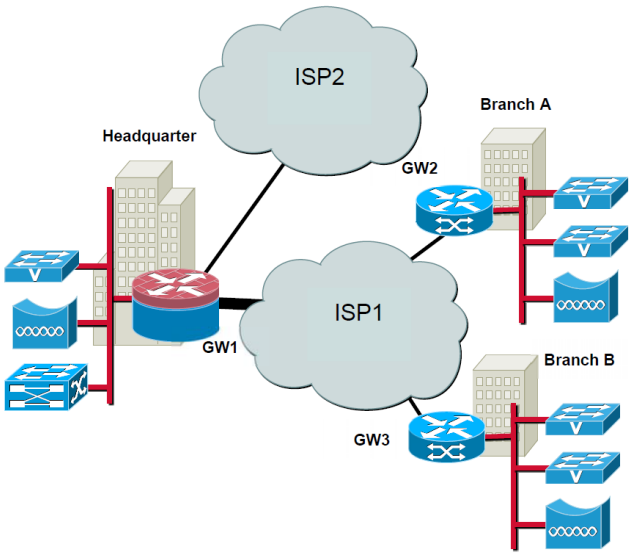

Figure 1: Infrastructure of the company