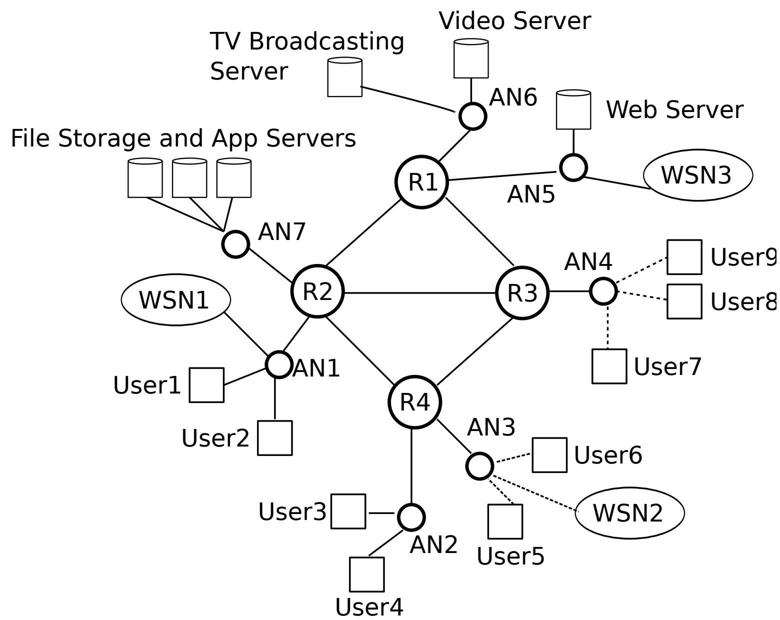

Figure 1: Basic Network

Seminar 3: Exercises

Exercise 1

Access Network (AN) 4 represents a WiFI AP used to deliver virtual reality contents in a museum. Each virtual reality session has a random duration, exponentially distributed, with average equal to $E[D_s] = 4$ minutes. New service requests arrive with an average rate of $\lambda = 30$ requests/hour, following a Poisson process.

Since potential clients (visitors) agree on waiting if the number of active sessions is the maximum supported by the AP, the museum is considering two options:

- a) Deploy a WiFi AP that supports up to 4 simultaneous connections, and a management system with $Q = 4$ buffer positions.
- b) Deploy a WiFi AP that supports up to 5 simultaneous connections, and a management system with $Q = 1$ buffer positions.

To decide between option a) or b), it is requested to:

1. Identify in each case what is the stochastic process X(t), and its state space.
2. Draw the Markov chains for each case, indicating arrival and service rates.
3. Write the balance equations for each case.
4. Compute the blocking probability and the waiting probability for each case.
5. Choose the option that minimizes the function $f = 10P_b + 2P_w$, with P_b the probability that a new request is blocked and P_w the probability that a new request has to wait.

Exercise 2

An AP that supports up to 6 data connections receives (following a Poisson process) both new (originated after a station is associated to the target AP) and handoff connections (originated before the station was associated to the target AP), with rate $\lambda_n = 0.5$ connections/second and $\lambda_h = 0.1$ connections/second respectively. Assuming that the duration of a connection is in average of $E[D_s] = 5$ seconds (exponentially distributed);

1. Draw the Markov chains for the case in which we have 2 and 4 guard channels.
2. Are they birth and death Markov processes? Are they reversible?
3. Write the local balance equations for the two cases.
4. Compute the blocking and dropping probabilities for the two cases.
5. Evaluate which system performs better if we have the following Grade of Service function: $f = P_b + 4P_d$, with P_d the probability of dropping an incoming handoff connection.
6. Calculate the first and second moments of the number of on-going connections for the two cases.