SERVER DEPENDABILITY

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ABSTRACT:

Dependability is Availability plus Reliability. Reliability of the equipment in (0, t] = $P(X \geq t) = 1 - F(t)$. Availability at time during a short interval (t, t+dt) is $1–[F(t + dt)–F(t)]$. We analyse the "dependability" of a server. We define the server as dependable if all the customers arriving during a random clock time is served during another random clock time, both clocks start simultaneously with the arrival of the first customer to the system. This model has wide range of applications in real life.

We consider a single server queueing system in which customers arrive according to a Poisson process and service time is exponentially distributed. Two clocks start simultaneously at the beginning when a customer arrives to the empty system. The first clock is Erlang distributed and the second clock is phase-type distributed. We say that the server is DEPENDABLE if all customers arriving during the first clock time are served before the expiry of the second clock. The first clock is assumed to be stochastically much smaller than the second clock. Following the first clock's expiration, no arrivals are allowed to join that particular cycle. After the second clock has run out, no service is rendered until the following arrival. All arrivals that take place after the first clock expires, are lost to the system for that cycle on expiration of the second clock . Further any customer arriving during first clock time who do not get service before the realization of second clock, will have to leave the system without getting service. The justification for this is "to ensure the 100% dependability of the server". The next cycle begins with the arrival of the first customer to the idle server. The two clock starts ticking from this point of time. The second clock can be regarded as common life time (CLT) of messages received until the expiry of the first clock.

Though these messages come at different time points, they are to be served before the expiry of the second clock. On expiry time of the larger clock all messages that remain unserved are discarded. The duration of the time measured from the arrival of the first unit to an empty system is the starting epoch of the larger clock. Beginning from that epoch, until the clock expires, is called the CLT of the messages which have accumulated during the time when the first clock is on. For reference concerning CLT: it was introduced by Lian et al. (Maths. Of Operations Research 2005). They considered a discrete time inventory problem with discrete PH distributed CLT. The lead time and service times are assumed to be negligible. A finite shortage is allowed. Thus only when K customers wait in the queue, order for replenishment is placed and it materialization takes place immediately. Chakravarthy (OPSEARCH 2010) considered a continuous time analogue of the above referred work. The arrival process is assumed to be Markovian arrival Process (MAP), lead time and CLT are phase type (assumed to be distinct) and service time negligible. A finite buffer for customers to wait is provided. When inventory level is to zero, no customer joins. This is also the case when the buffer is full. In fact, the buffer considered here is an orbit (in the classical retrial jargon). Krishnamoorthy et al. (ANOR 2016) extended the model analysed by Chakravarthy to the case of queueing inventory (positive service time) and infinite capacity orbit.

For the model described above. the system stability is analysed. Under stability the system state probabilities are computed. Using these performance metrics of the system are evaluated. A cost function is considered. A few numerical illustrations are provided.