The following analysis in the next page is extracted from the paper:

L. Kleinrock and F. A. Tobagi, "Packet Switching in Radio Channels: Part I - Carrier Sense Multiple Access Modes and Their Throughput-Delay Characteristics"
IEEE transactions on communications, December, 1975
Consider a time cycle as a busy period plus the following idle period. In each this cycle, it could be either a successful transmission period following by an idle period or an unsuccessful transmission period following by an idle period.

Let us define following parameters:

- **B**: mean length of busy period
- **I**: mean length of idle period
- **T**: length of a frame transmission, **T=1**
- **U**: probability of a successful transmission in a busy period

Then, \((B+I)\) is the average length of a time cycle.

In general, the expected channel throughput can be regarded as the overall output by averaging all cycles:

\[
S = \frac{TU}{B+I} = \frac{U}{B+I}
\]

Now, let us view each transmission period from the first transmitter X’s perspective. If X is the first one to send a frame at time, it will succeed because no one else access the channel in \((t, t+a)\). This occur with a probability \(U = e^{-aG}\). Note that in this case, the busy period \(B\) is \(1+a\), but we cannot regard the whole “1+a” as the channel output, because only the “1” portion can be counted as throughput.

However, if during time \((t, t+a)\), there are other access events. X will experience a busy period as long as \(1+a+Y\), in which \(Y\) is a random variable between \((0, a)\).

The CDF of \(Y\) can be found by:

\[
F_Y(y) = P\{no packet occur in an duration of a-y \} = e^{-G(a-y)}
\]

Then, we can have the PDF and calculate the mean of \(Y\) is

\[
E(Y) = a - \frac{1}{G}(1 - e^{-aG})
\]

From, \(B, I, U\), we can have

\[
S = \frac{Ge^{-aG}}{G(1+2a) + e^{-aG}}
\]