Anhang 3

Graphische Darstellung der TC Messungen

```
setwd("/home/lisa/Darmstadt/05_Speicher und Datennetze IoT/Praktikum/Git/mqtt-qos-rountrip/R_Analysis/01
options(digits.secs=3) # needs to be set from time to time - otherwise R doesn't allow for ms
library("data.table", lib.loc="~/R/x86_64-pc-linux-gnu-library/3.4")
library("h2o", lib.loc="~/R/x86_64-pc-linux-gnu-library/3.4")
library("tidyr", lib.loc="~/R/x86_64-pc-linux-gnu-library/3.4")
library("plyr")
library(kableExtra)

load("./latenzTC1mbps.Rda")
load("./latenzTc10kbps.Rda")
load("./latenzTc10mbps.Rda")
load("./latenzTc100kbps.Rda")
load("./latenztc100mbps.Rda")
```

```
#files <- list.files(pattern = "*bps.Rda", full.names = TRUE, recursive = FALSE)
files <- c("latenzTc100kbps", "latenztc100mbps", "latenzTc10kbps", "latenzTc10mbps", "latenzTC1mbps")
```

Übersicht und notwendige Anpassung der Messungen für die mit dem TC der Mayimale Durchsatz (File Name) angepasst wurde. Die tatsächlich versendete Paketgröße und Anzahl pro Sekunde ist dem jeweiligen Lognamen zu entnehmen

```
latenzTc100kbps$MaxDurc <- "100kbps"
latenztc100mbps$MaxDurc <- "100mbps"
latenzTc10kbps$MaxDurc <- "10kbps"
latenzTc10mbps$MaxDurc <- "10mbps"
latenzTC1mbps$MaxDurc <- "1mbps"

tcLogs <- rbind(latenzTc100kbps, latenztc100mbps, latenzTc10kbps, latenzTc10mbps, latenzTC1mbps)
tcLogs$Size <- "10KByte"

colnames<-colnames(tcLogs)
colnames[5]<-"PproSek"
colnames(tcLogs)<- colnames

tcLogs$Byte<-tcLogs$Size
tcLogs$Byte[tcLogs$Byte == "1Byte"] <- 1
tcLogs$Byte[tcLogs$Byte == "10Byte"] <- 10
tcLogs$Byte[tcLogs$Byte == "100Byte"] <- 100
tcLogs$Byte[tcLogs$Byte == "1KByte"] <- 1000
tcLogs$Byte[tcLogs$Byte == "1500Byte"] <- 1500
tcLogs$Byte[tcLogs$Byte == "10KByte"] <- 10000
tcLogs$Byte[tcLogs$Byte == "100KByte"] <- 100000
tcLogs$Byte[tcLogs$Byte == "500KByte"] <- 500000
tcLogs$Byte[tcLogs$Byte == "1MByte"] <- 1000000
tcLogsSum <- summary(tcLogs)
tcLogsSum
#>       sent                          QoS               Size
#>  Min.   :2018-05-23 23:53:42.52   Length:34722       Length:34722
#>  1st Qu.:2018-05-24 00:28:49.04   Class :character   Class :character
#>  Median :2018-05-24 00:31:31.97   Mode  :character   Mode  :character
#>  Mean   :2018-05-24 00:29:49.74
```

```
#>  3rd Qu.:2018-05-24 00:33:27.54
#>  Max.   :2018-05-24 01:41:28.41
#>      Min              PproSek              rec
#>  Length:34722       Length:34722       Min.   :2018-05-23 23:53:42.53
#>  Class :character   Class :character   1st Qu.:2018-05-24 00:28:49.04
#>  Mode  :character   Mode  :character   Median :2018-05-24 00:31:31.98
#>                                        Mean   :2018-05-24 00:29:52.90
#>                                        3rd Qu.:2018-05-24 00:33:27.57
#>                                        Max.   :2018-05-24 01:43:25.93
#>    r_newid               rtt               id         MaxDurc
#>  Length:34722       Min.   : 0.001   Min.   :   1   Length:34722
#>  Class :character   1st Qu.: 0.002   1st Qu.: 342   Class :character
#>  Mode  :character   Median : 0.004   Median :1488   Mode  :character
#>                     Mean   : 1.352   Mean   :2043
#>                     3rd Qu.: 0.023   3rd Qu.:3658
#>                     Max.   :59.924   Max.   :5835
#>      Byte
#>  Length:34722
#>  Class :character
#>  Mode  :character
#>
#>
#>
```

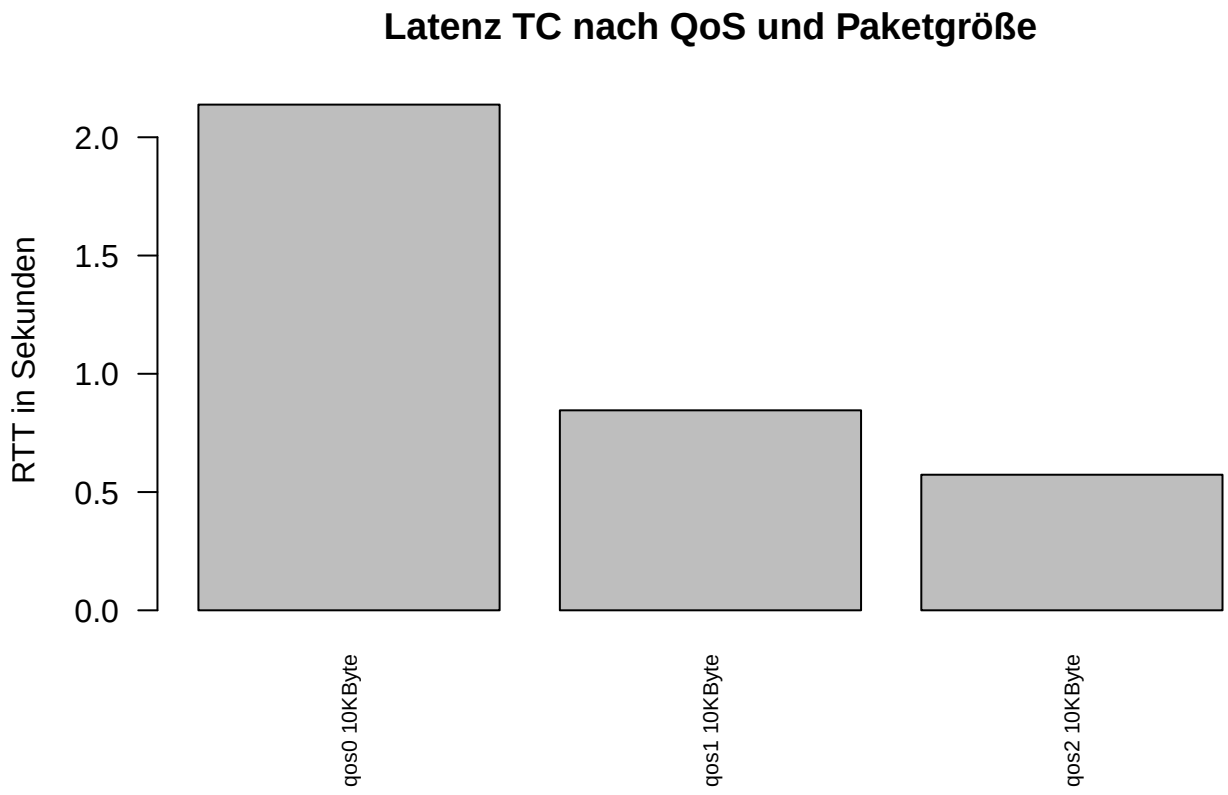
```
tcLogs$ByteD<-tcLogs$MaxDurc
tcLogs$ByteD[tcLogs$ByteD == "1Byte"] <-   1
tcLogs$ByteD[tcLogs$ByteD == "10BByte"] <- 10
tcLogs$ByteD[tcLogs$ByteD == "100Byte"] <- 100
tcLogs$ByteD[tcLogs$ByteD == "1kbps"] <-   1000
tcLogs$ByteD[tcLogs$ByteD == "10kbps"] <-  10000
tcLogs$ByteD[tcLogs$ByteD == "100kbps"] <- 100000
tcLogs$ByteD[tcLogs$ByteD == "1mbps"] <-   1000000
tcLogs$ByteD[tcLogs$ByteD == "10mbps"] <-  10000000
tcLogs$ByteD[tcLogs$ByteD == "100mbps"] <- 100000000

tcLogs$ByteD<-as.numeric(tcLogs$ByteD)
```

Aggregation der Daten zur Beantwortung der Fragestellung bzgl. Latenzzeiten in Abhängigkeit zu QoS Level und Paketgröße.

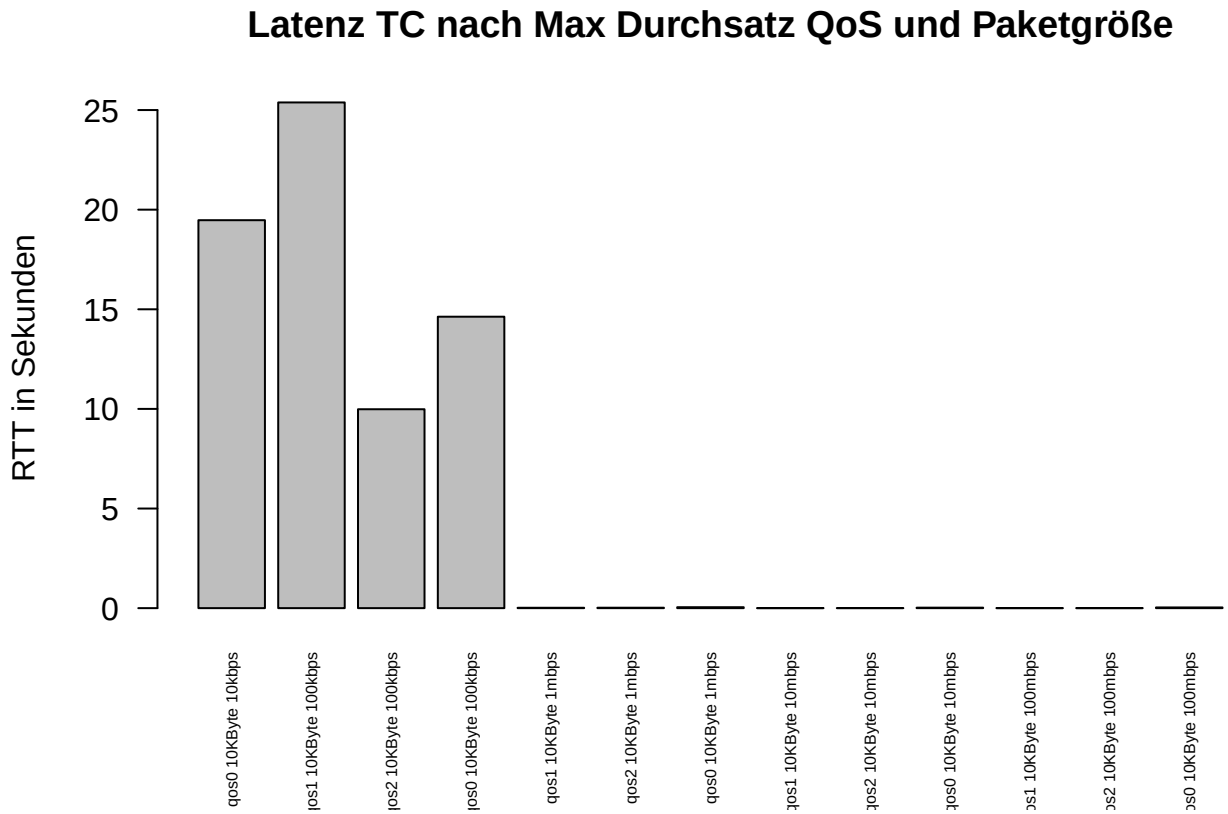
```
tcLogsAgg <- aggregate(tcLogs$rtt ~ tcLogs$QoS+tcLogs$Size+tcLogs$Byte, tcLogs, mean)
tcLogsAgg2 <- aggregate(tcLogs$rtt ~ tcLogs$QoS+tcLogs$Size+tcLogs$Byte + tcLogs$MaxDurc + tcLogs$ByteD

tcLogsAgg$`tcLogs$Byte`<-as.numeric(tcLogsAgg$`tcLogs$Byte`)
tcLogsAgg<-tcLogsAgg[order(tcLogsAgg$`tcLogs$Byte`),]

tcLogsAgg2$`tcLogs$Byte`<-as.numeric(tcLogsAgg2$`tcLogs$ByteD`)
tcLogsAgg2<-tcLogsAgg2[order(tcLogsAgg2$`tcLogs$ByteD`),]


tcLogsAgg2 %>%
  kable() %>%
  kable_styling()
```

tcLogs$QoS	tcLogs$Size	tcLogs$Byte	tcLogs$MaxDurc	tcLogs$ByteD	tcLogs$rtt
qos0	10KByte	1e+04	10kbps	1e+04	19.4711302
qos0	10KByte	1e+05	100kbps	1e+05	25.3815006
qos1	10KByte	1e+05	100kbps	1e+05	9.9820152
qos2	10KByte	1e+05	100kbps	1e+05	14.6274025
qos0	10KByte	1e+06	1mbps	1e+06	0.0190646
qos1	10KByte	1e+06	1mbps	1e+06	0.0211253
qos2	10KByte	1e+06	1mbps	1e+06	0.0474118
qos0	10KByte	1e+07	10mbps	1e+07	0.0021778
qos1	10KByte	1e+07	10mbps	1e+07	0.0043793
qos2	10KByte	1e+07	10mbps	1e+07	0.0242875
qos0	10KByte	1e+08	100mbps	1e+08	0.0022214
qos1	10KByte	1e+08	100mbps	1e+08	0.0030982
qos2	10KByte	1e+08	100mbps	1e+08	0.0341508

```
tcLogsAgg$Names <- paste(tcLogsAgg$`tcLogs$QoS`, tcLogsAgg$`tcLogs$Size`)
tcLogsAgg<-tcLogsAgg[order(tcLogsAgg$`tcLogs$Byte`),]
barplot(tcLogsAgg$`tcLogs$rtt`, main = "Latenz TC nach QoS und Paketgröße", ylab = "RTT in Sekunden", a
```




```
tcLogsAgg2$Names2 <- paste(tcLogsAgg$`tcLogs$QoS`, tcLogsAgg$`tcLogs$Size`, tcLogsAgg2$`tcLogs$MaxDurc`
tcLogsAgg<-tcLogsAgg[order(tcLogsAgg$`tcLogs$Byte`),]
barplot(tcLogsAgg2$`tcLogs$rtt`, main = "Latenz TC nach Max Durchsatz QoS und Paketgröße", ylab = "RTT
```

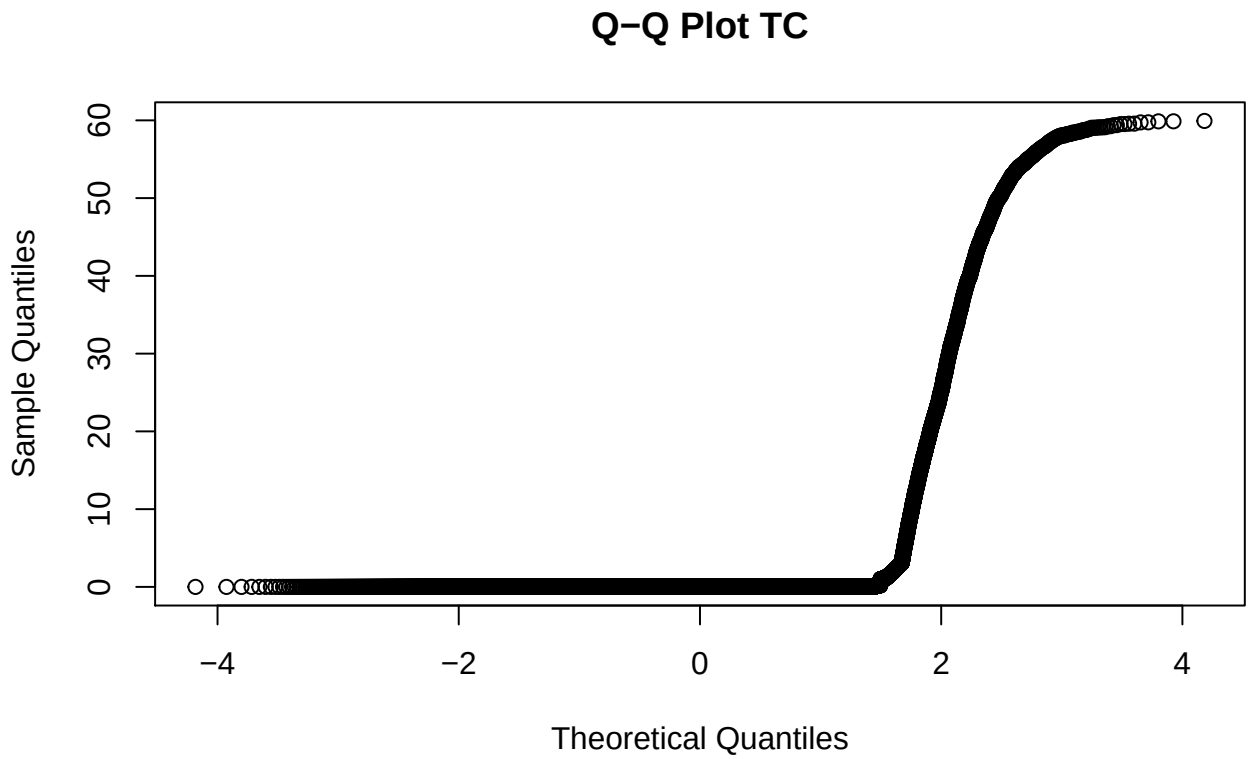


Im nächsten Schritt wird die statistische Abhngigkeit der rtt von QoS und Größe (Byte) untersucht. Im Falle einer einfachen linearen Regression sind nur qos2 und hohe Byte Zahlen signifikant.

```
reg_tcLogs <- lm(tcLogs$rtt~tcLogs$QoS+tcLogs$ByteD, data = tcLogs)
summary(reg_tcLogs)
#>
#> Call:
#> lm(formula = tcLogs$rtt ~ tcLogs$QoS + tcLogs$ByteD, data = tcLogs)
#>
#> Residuals:
#>    Min     1Q Median     3Q    Max
#> -3.689 -1.468 -0.926 -0.254 57.826
#>
#> Coefficients:
#>                   Estimate Std. Error t value Pr(>|t|)
#> (Intercept)     3.734e+00  6.867e-02   54.37   <2e-16 ***
#> tcLogs$QoSqos1 -2.210e+00  8.977e-02  -24.62   <2e-16 ***
#> tcLogs$QoSqos2 -2.448e+00  9.081e-02  -26.95   <2e-16 ***
#> tcLogs$ByteD   -3.477e-08  9.341e-10  -37.23   <2e-16 ***
#> ---
#> Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
#>
#> Residual standard error: 6.697 on 34718 degrees of freedom
#> Multiple R-squared:  0.04885,    Adjusted R-squared:  0.04876
#> F-statistic: 594.3 on 3 and 34718 DF,  p-value: < 2.2e-16
reg_tcLogs2 <- lm(tcLogs$rtt~tcLogs$QoS+tcLogs$MaxDurc, data = tcLogs)
summary(reg_tcLogs2)
#>
#> Call:
```

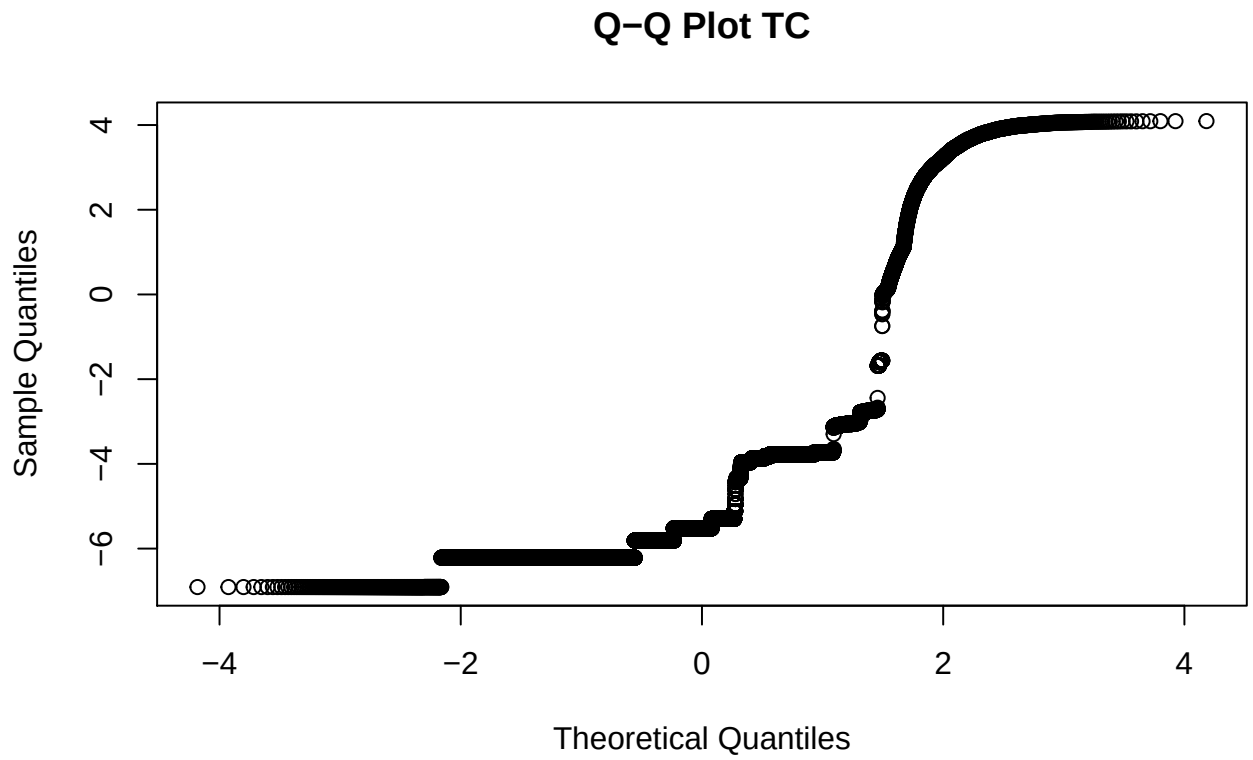
```
#> lm(formula = tcLogs$rtt ~ tcLogs$QoS + tcLogs$MaxDurc, data = tcLogs)
#>
#> Residuals:
#>     Min      1Q  Median      3Q     Max
#> -18.808  -0.721   0.077   0.643  41.494
#>
#> Coefficients:
#>                         Estimate Std. Error  t value Pr(>|t|)
#> (Intercept)             18.99314    0.10474  181.340   <2e-16 ***
#> tcLogs$QoSqos1          -1.36387    0.06587  -20.705   <2e-16 ***
#> tcLogs$QoSqos2          -0.77823    0.06707  -11.604   <2e-16 ***
#> tcLogs$MaxDurc100mbps -18.68789    0.11402 -163.907   <2e-16 ***
#> tcLogs$MaxDurc10kbps    0.47799    0.39360    1.214    0.225
#> tcLogs$MaxDurc10mbps  -18.26930    0.10731 -170.251   <2e-16 ***
#> tcLogs$MaxDurc1mbps   -18.24990    0.12901 -141.461   <2e-16 ***
#> ---
#> Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
#>
#> Residual standard error: 4.888 on 34715 degrees of freedom
#> Multiple R-squared:  0.4933, Adjusted R-squared:  0.4932
#> F-statistic:  5633 on 6 and 34715 DF,  p-value: < 2.2e-16
```

```
par(mfrow=c(1,1))
qqnorm(tcLogs$rtt, main = "Q-Q Plot TC")
```



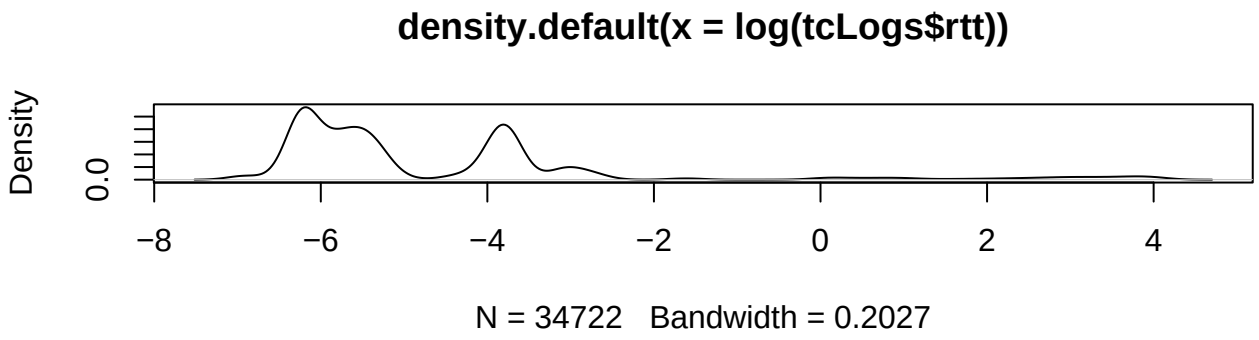
Da rtt nicht normal verteilt ist, liefert die Lineare Regression keine zuverlässigen Ergebnisse. Nach der Transformation (logarithmierung) nähert sich die Verteilung der Variable rtt der Normalverteilung. (Normalverteilung ist erreicht, wenn die Sample Quantile den Theoretischen entsprechen - die Beobachtugen also auf einer Geraden liegen)

```
par(mfrow=c(1,1))
qqnorm(log(tcLogs$rtt), main = "Q-Q Plot TC")
```



Trotz der Logarithmierung sind die Daten nicht perfekt Normalverteilt, jedoch annähernd.

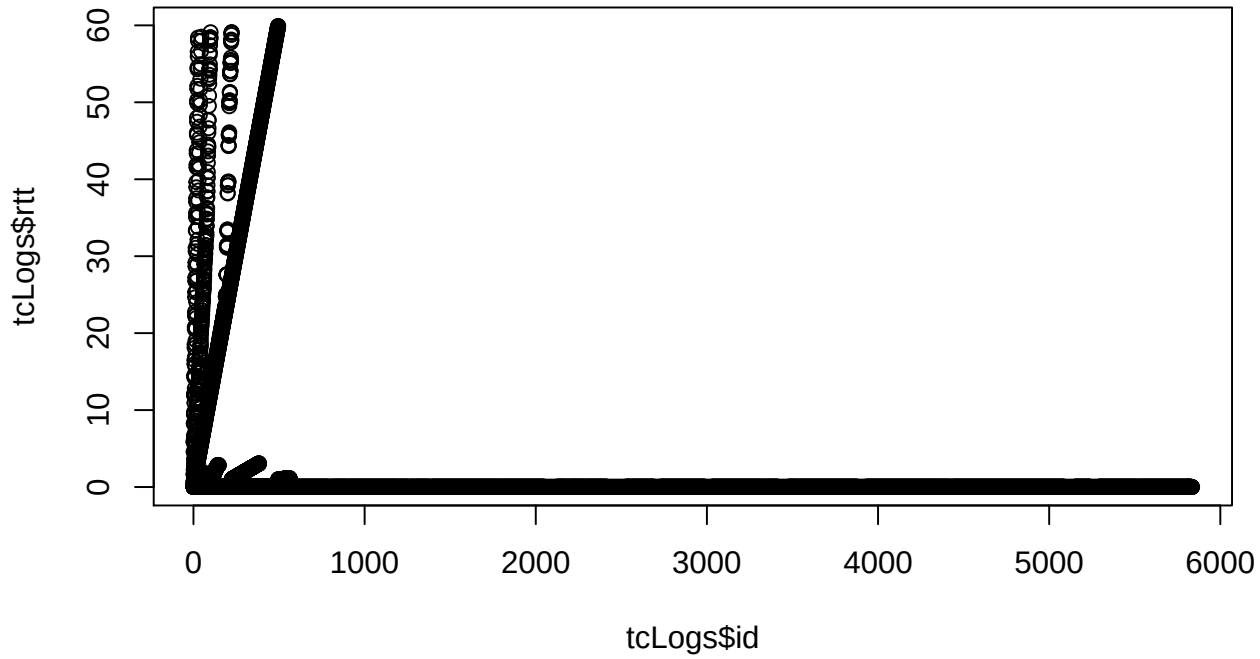
```
par(mfrow=c(2,1))
plot(density(log(tcLogs$rtt)))
```



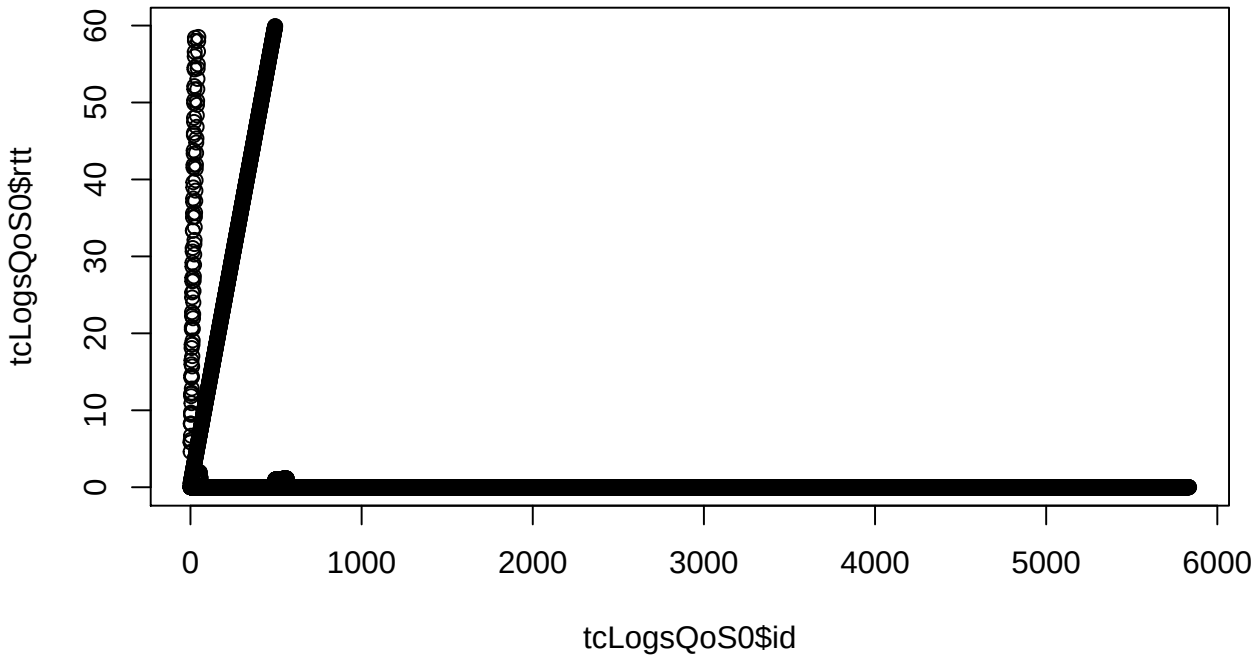

```
reg_tcLogs <- lm(log(tcLogs$rtt)~tcLogs$QoS, data = tcLogs)
summary(reg_tcLogs)
#>
#> Call:
#> lm(formula = log(tcLogs$rtt) ~ tcLogs$QoS, data = tcLogs)
#>
#> Residuals:
#>     Min      1Q  Median      3Q     Max
#> -2.3199 -0.9913 -0.5987 -0.2830  9.3164
#>
#> Coefficients:
#>                Estimate Std. Error t value Pr(>|t|)
```

```
#> (Intercept)    -5.22331    0.01665 -313.65   <2e-16 ***
#> tcLogs$QoSqos1  0.52375    0.02679   19.55   <2e-16 ***
#> tcLogs$QoSqos2  1.73401    0.02721   63.73   <2e-16 ***
#> ---
#> Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
#>
#> Residual standard error: 2.079 on 34719 degrees of freedom
#> Multiple R-squared:  0.1053, Adjusted R-squared:  0.1053
#> F-statistic:  2044 on 2 and 34719 DF,  p-value: < 2.2e-16
```

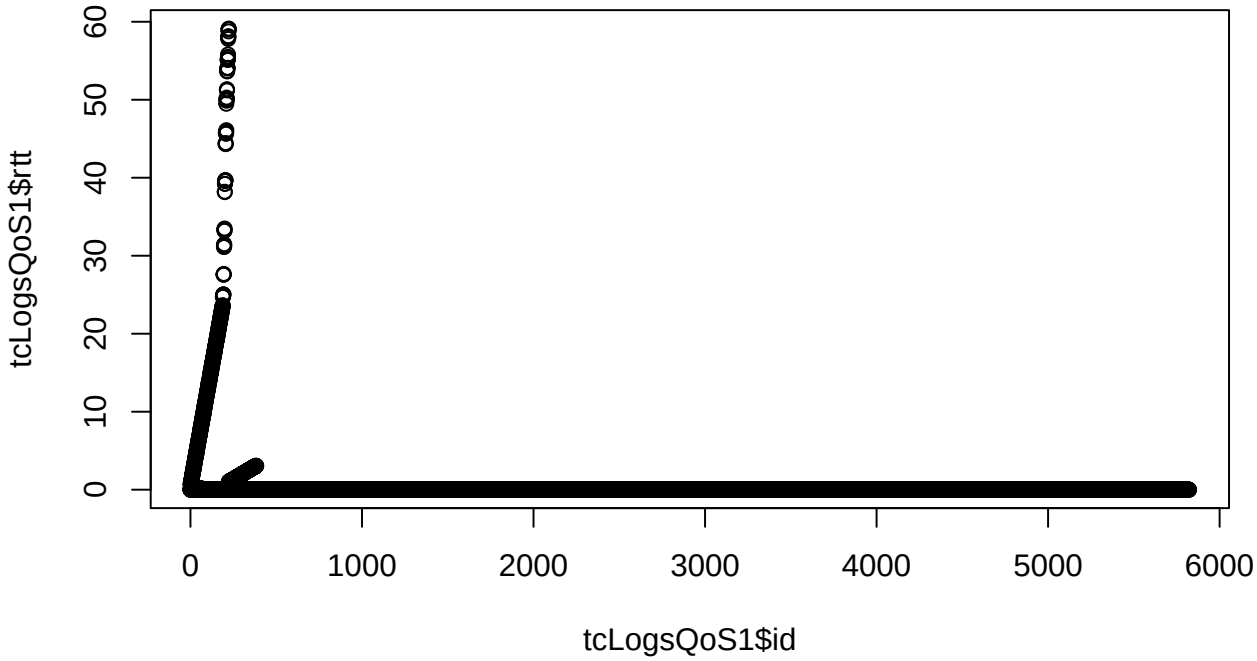
```
plot(tcLogs$id, tcLogs$rtt)
```



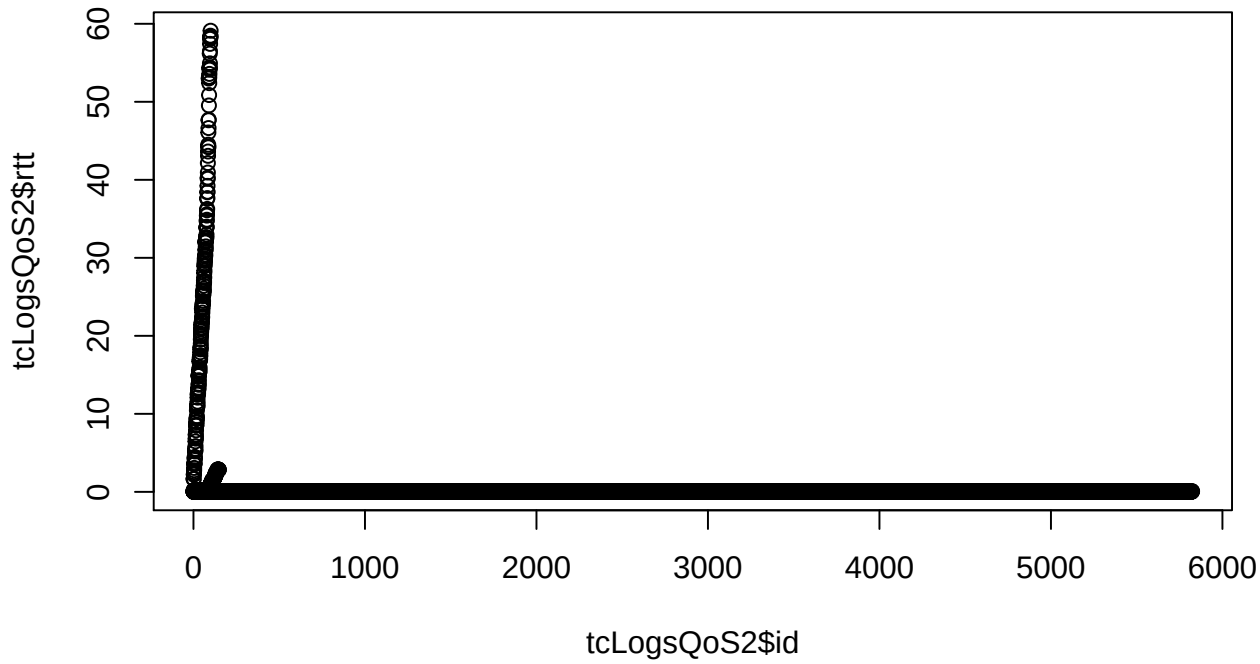

```
#########################
# Aufsplittung nach QoS #
#########################

tcLogsQoS0<-tcLogs[tcLogs$QoS == "qos0",]
tcLogsQoS1<-tcLogs[tcLogs$QoS == "qos1",]
tcLogsQoS2<-tcLogs[tcLogs$QoS == "qos2",]

plot(tcLogsQoS0$id, tcLogsQoS0$rtt)
```



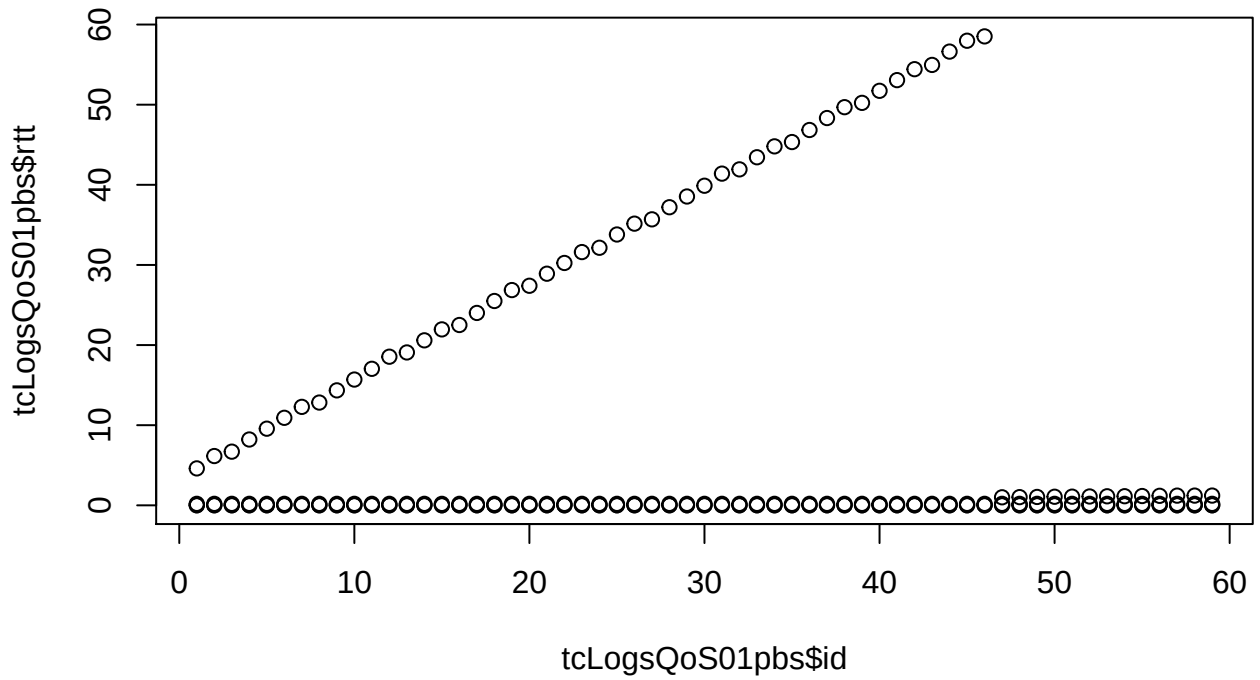

```
plot(tcLogsQoS1$id, tcLogsQoS1$rtt)
```



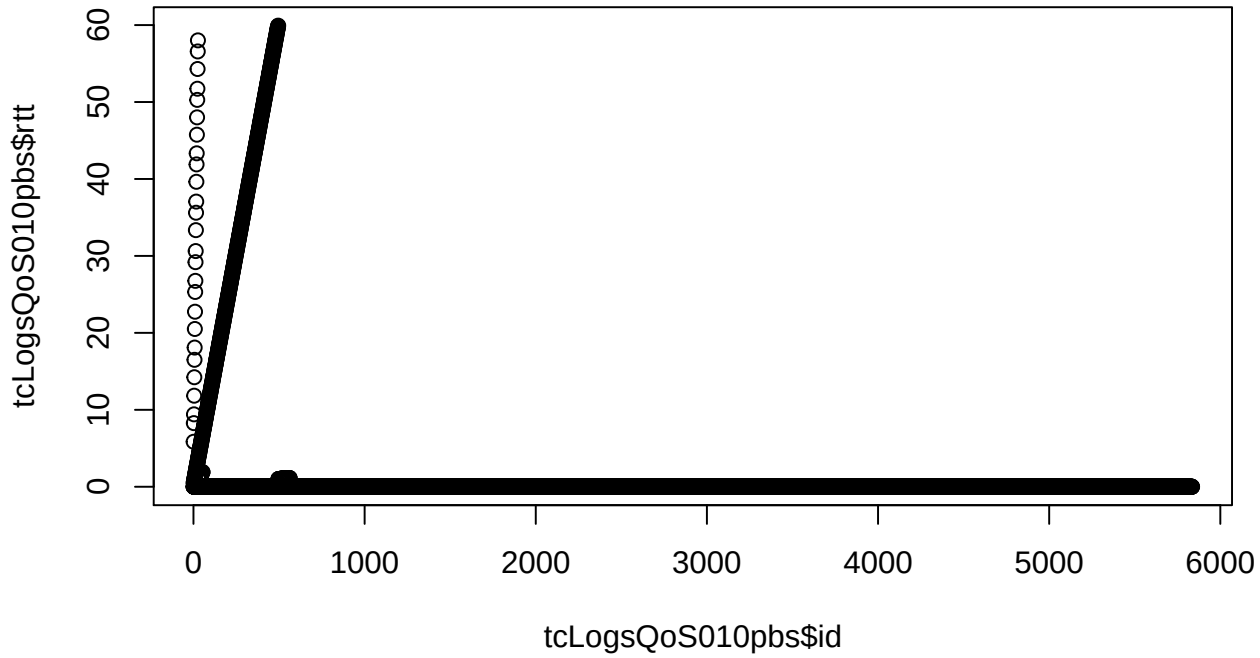

```
plot(tcLogsQoS2$id, tcLogsQoS2$rtt)
```



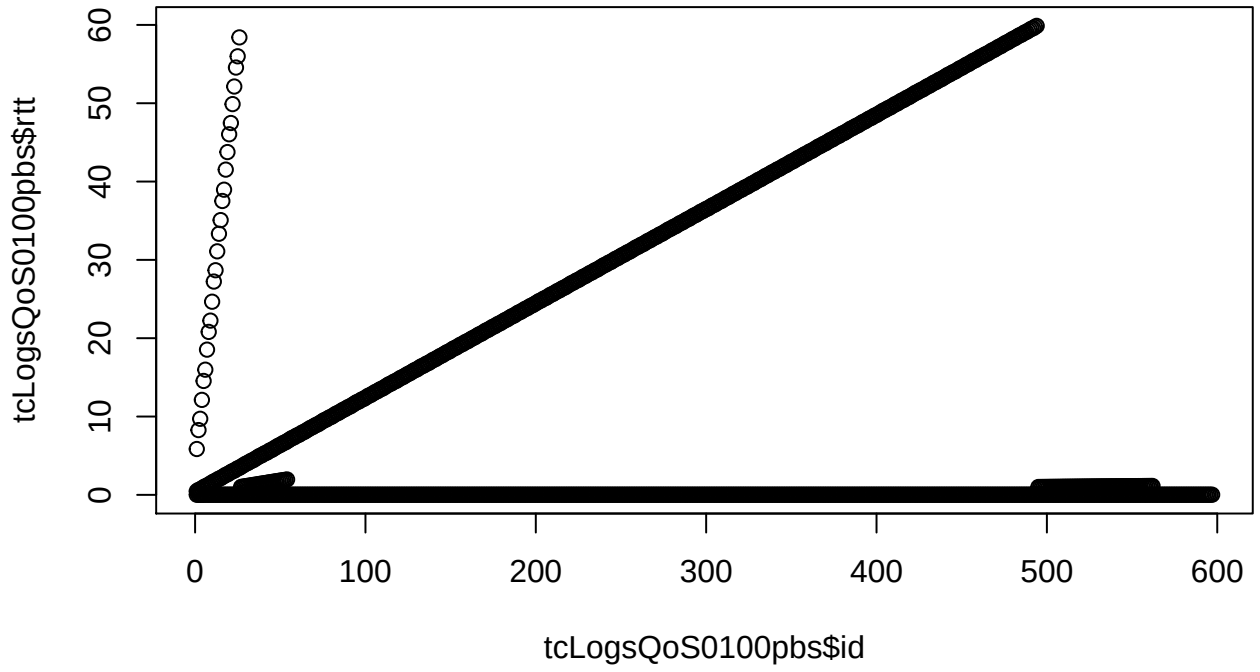

```
############################################################
# QoS Level _ Aufsplittung nach Pakete pro Sekunde Qos #
############################################################
## QoS0 - Aufsplittung
tcLogsQoS01pbs<-tcLogsQoS0[tcLogsQoS0$PproSek == "1pbs",]
tcLogsQoS010pbs<-tcLogsQoS0[tcLogsQoS0$PproSek == "10pbs",]
tcLogsQoS0100pbs<-tcLogsQoS0[tcLogsQoS0$PproSek == "100pbs",]

plot(tcLogsQoS01pbs$id, tcLogsQoS01pbs$rtt)
```



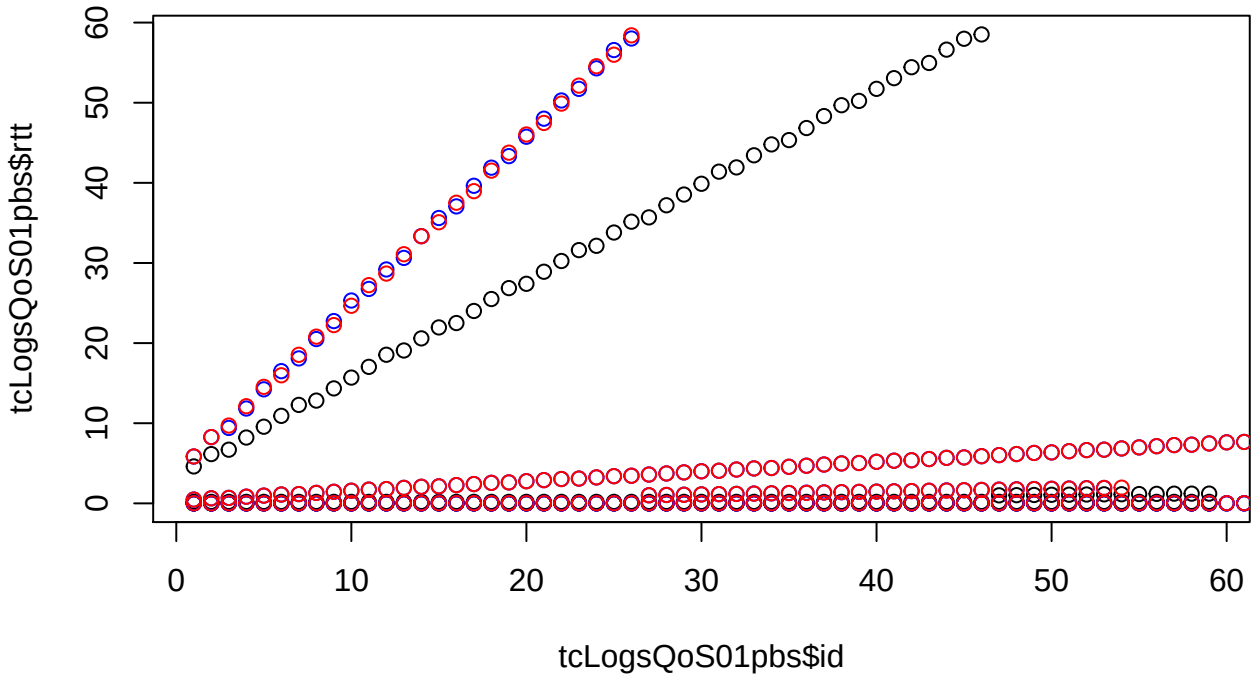
```
plot(tcLogsQoS010pbs$id, tcLogsQoS010pbs$rtt)
```



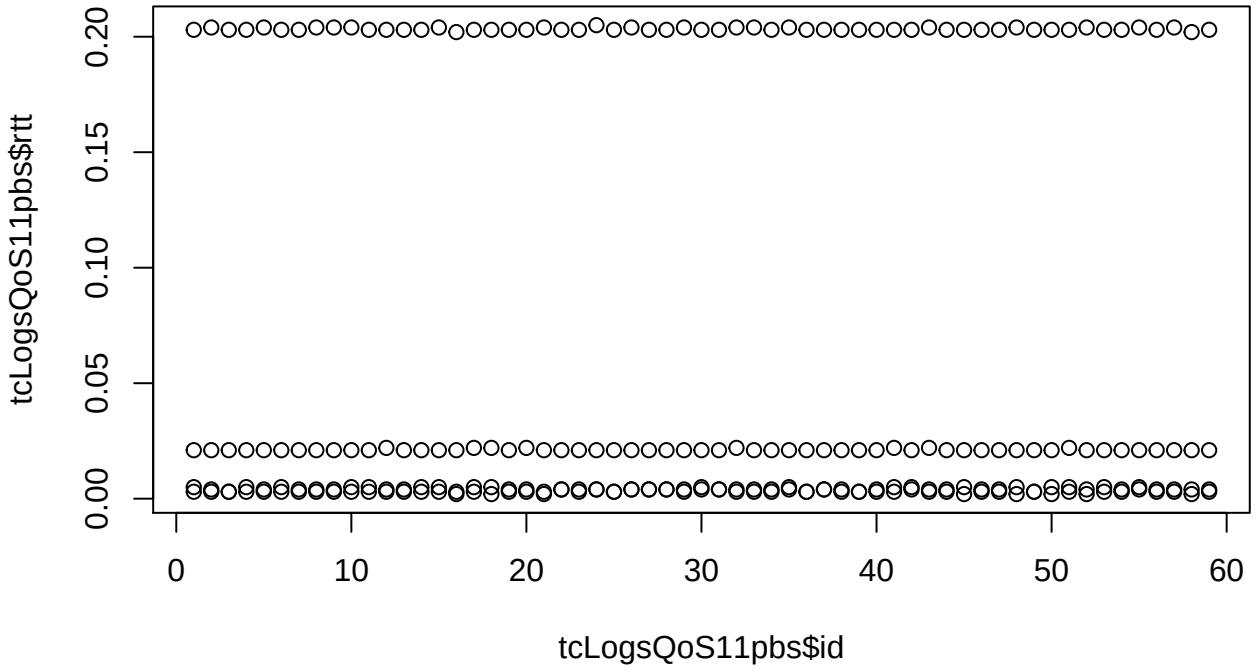

```
plot(tcLogsQoS0100pbs$id, tcLogsQoS0100pbs$rtt)
```



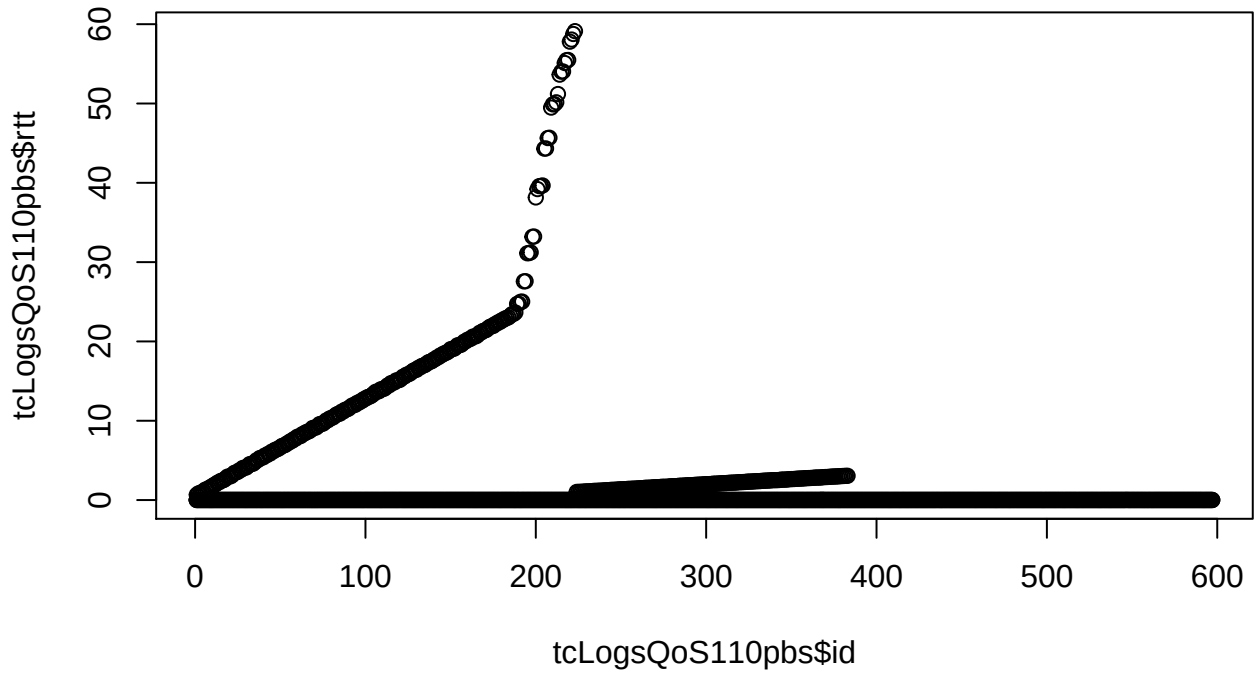

```
## QoS1 - Aufsplittung - Eine Grafik!
#par(mfrow=c(1,3))
plot(tcLogsQoS01pbs$id, tcLogsQoS01pbs$rtt)
points(tcLogsQoS010pbs$id, tcLogsQoS010pbs$rtt, col="blue")
points(tcLogsQoS0100pbs$id, tcLogsQoS0100pbs$rtt, col="red")
```



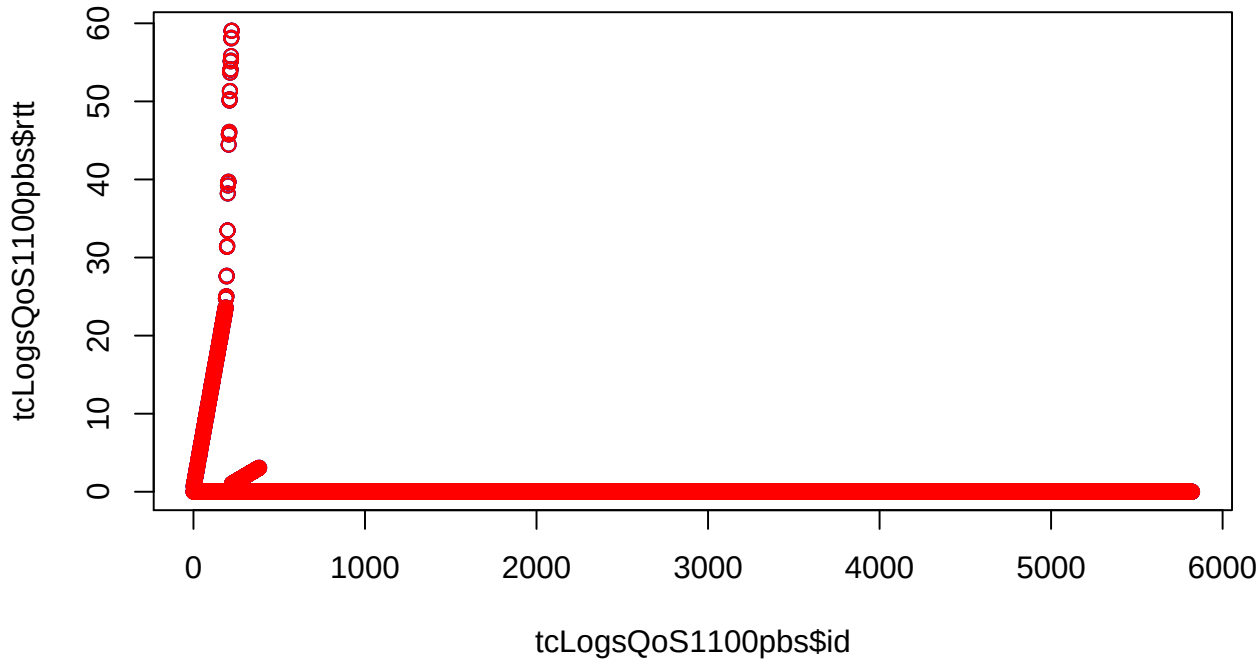

```
## QoS1 - Aufsplittung
tcLogsQoS11pbs<-tcLogsQoS1[tcLogsQoS1$PproSek == "1pbs",]
tcLogsQoS110pbs<-tcLogsQoS1[tcLogsQoS1$PproSek == "10pbs",]
tcLogsQoS1100pbs<-tcLogsQoS1[tcLogsQoS1$PproSek == "100pbs",]

plot(tcLogsQoS11pbs$id, tcLogsQoS11pbs$rtt)
```




```
plot(tcLogsQoS110pbs$id, tcLogsQoS110pbs$rtt)
```

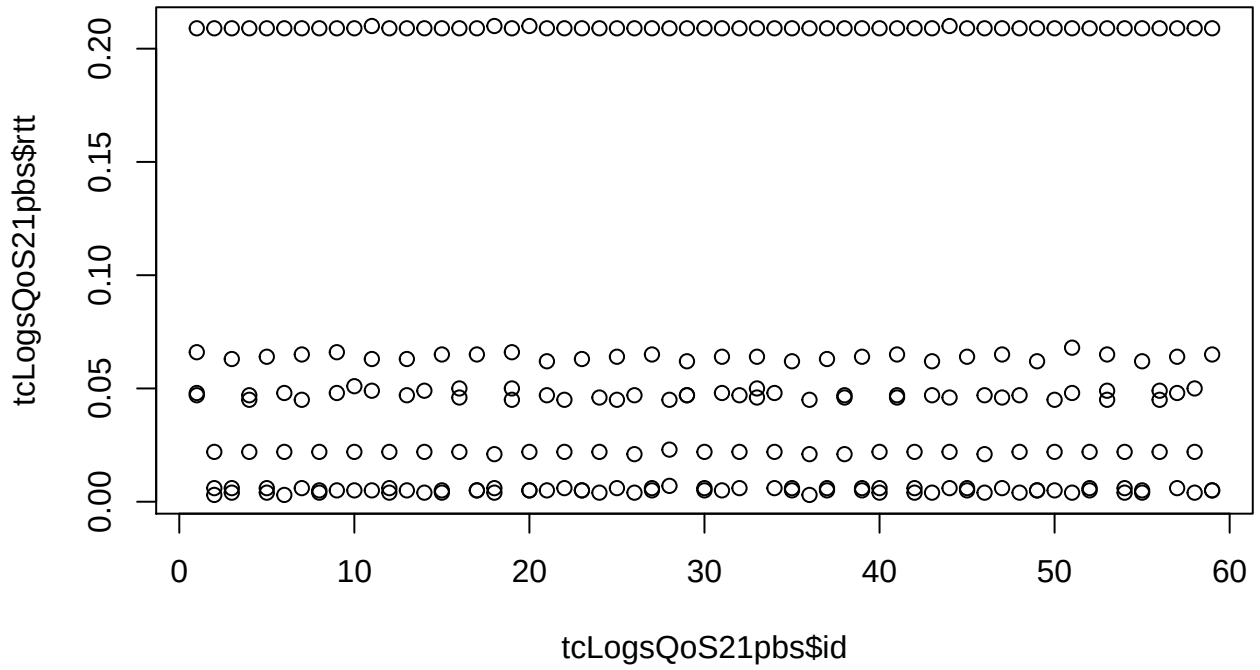



```
plot(tcLogsQoS1100pbs$id, tcLogsQoS1100pbs$rtt)

## QoS1 - Aufsplittung - eine Grafik!
plot(tcLogsQoS1100pbs$id, tcLogsQoS1100pbs$rtt)
points(tcLogsQoS1100pbs$id, tcLogsQoS1100pbs$rtt, col="blue")
points(tcLogsQoS1100pbs$id, tcLogsQoS1100pbs$rtt, col="red")
```

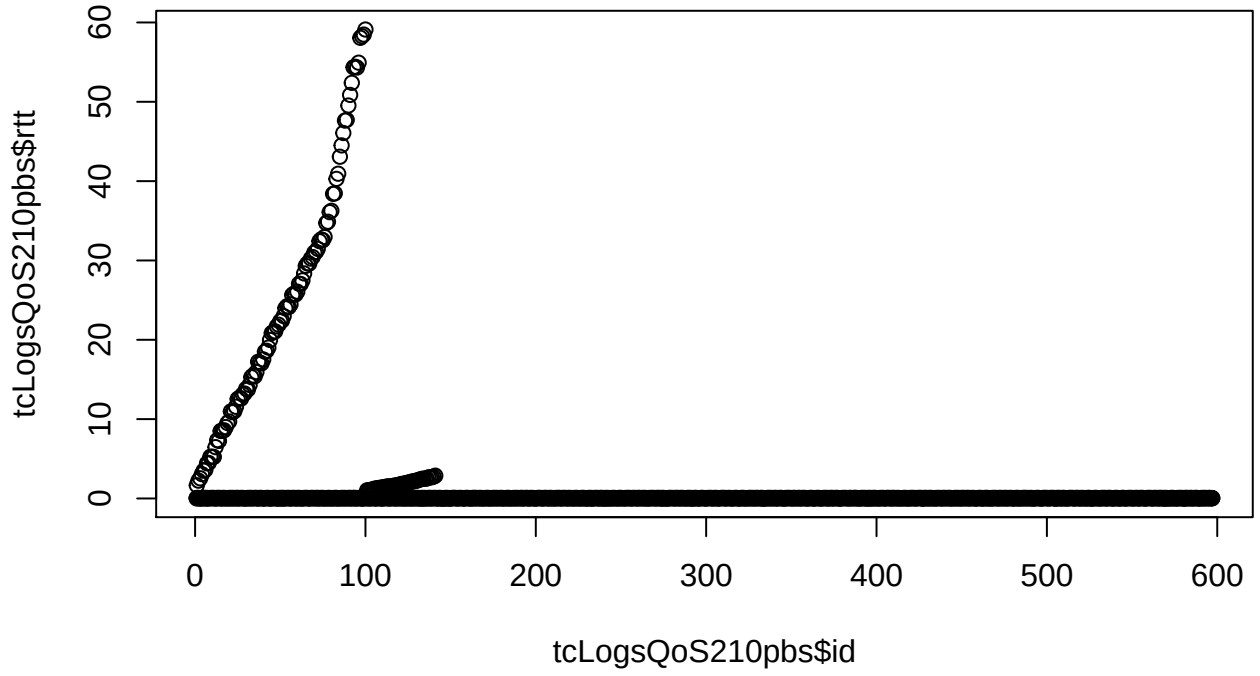



```
## QoS2 - Aufsplittung
tcLogsQoS21pbs<-tcLogsQoS2[tcLogsQoS2$PproSek == "1pbs",]
tcLogsQoS210pbs<-tcLogsQoS2[tcLogsQoS2$PproSek == "10pbs",]
tcLogsQoS2100pbs<-tcLogsQoS2[tcLogsQoS2$PproSek == "100pbs",]
```

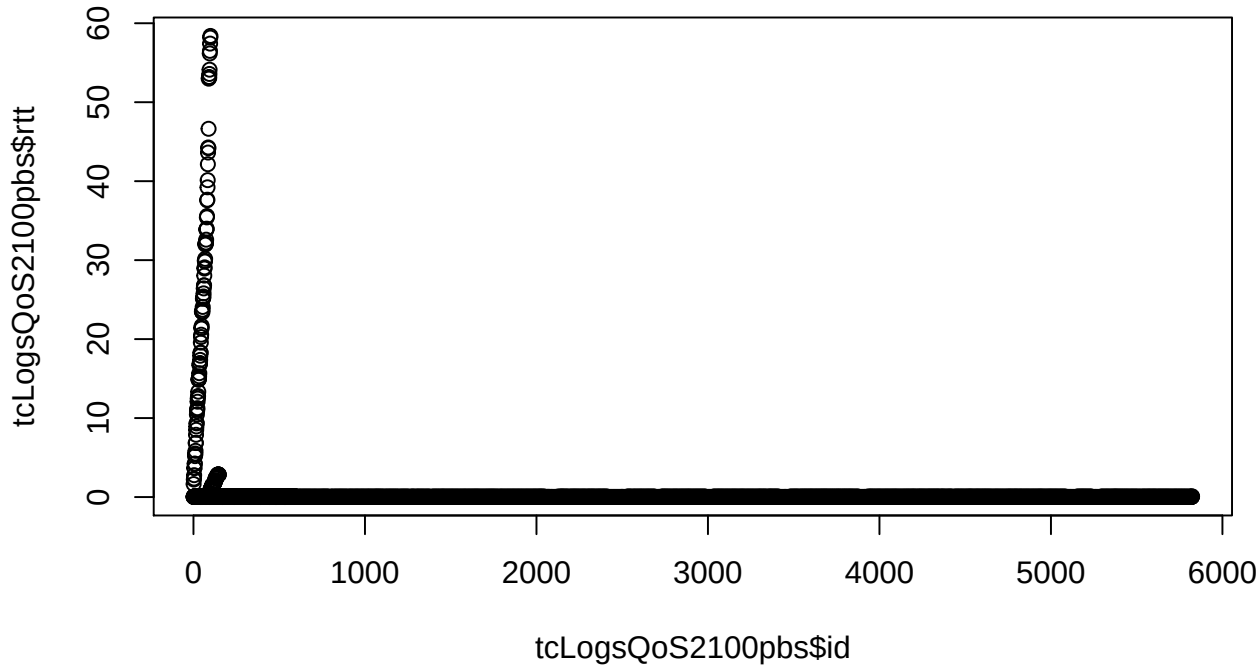
```
plot(tcLogsQoS21pbs$id, tcLogsQoS21pbs$rtt)
```



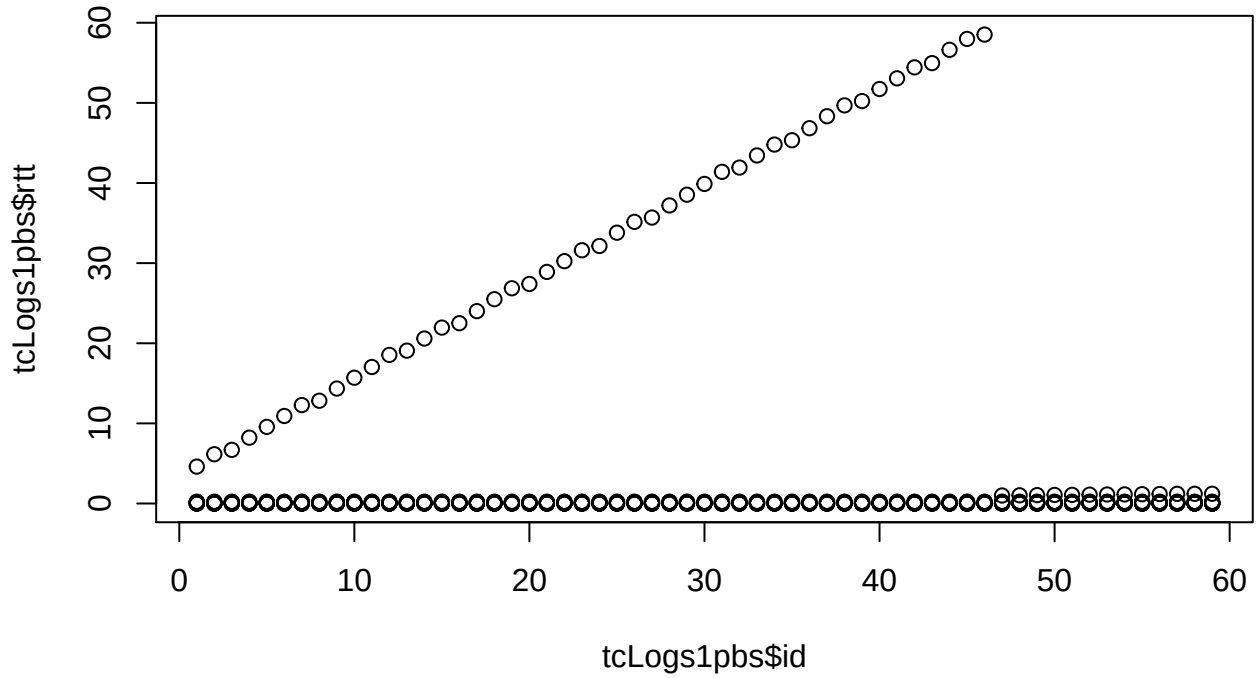

```
plot(tcLogsQoS210pbs$id, tcLogsQoS210pbs$rtt)
```



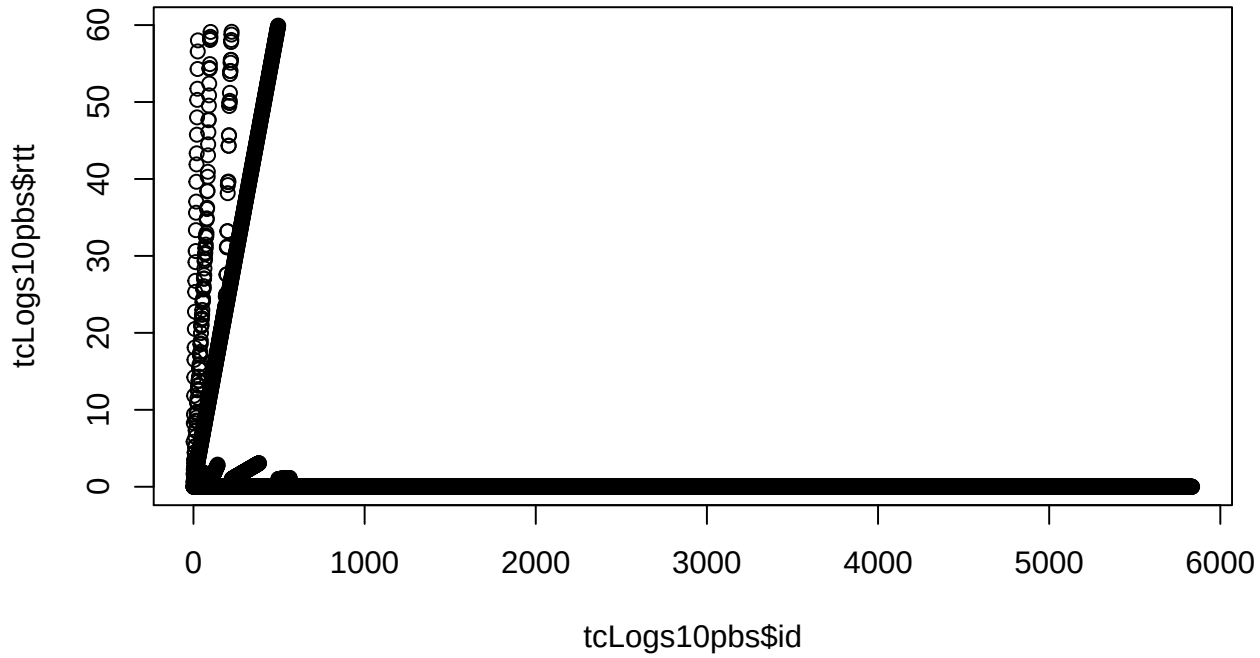

```
plot(tcLogsQoS2100pbs$id, tcLogsQoS2100pbs$rtt)
```



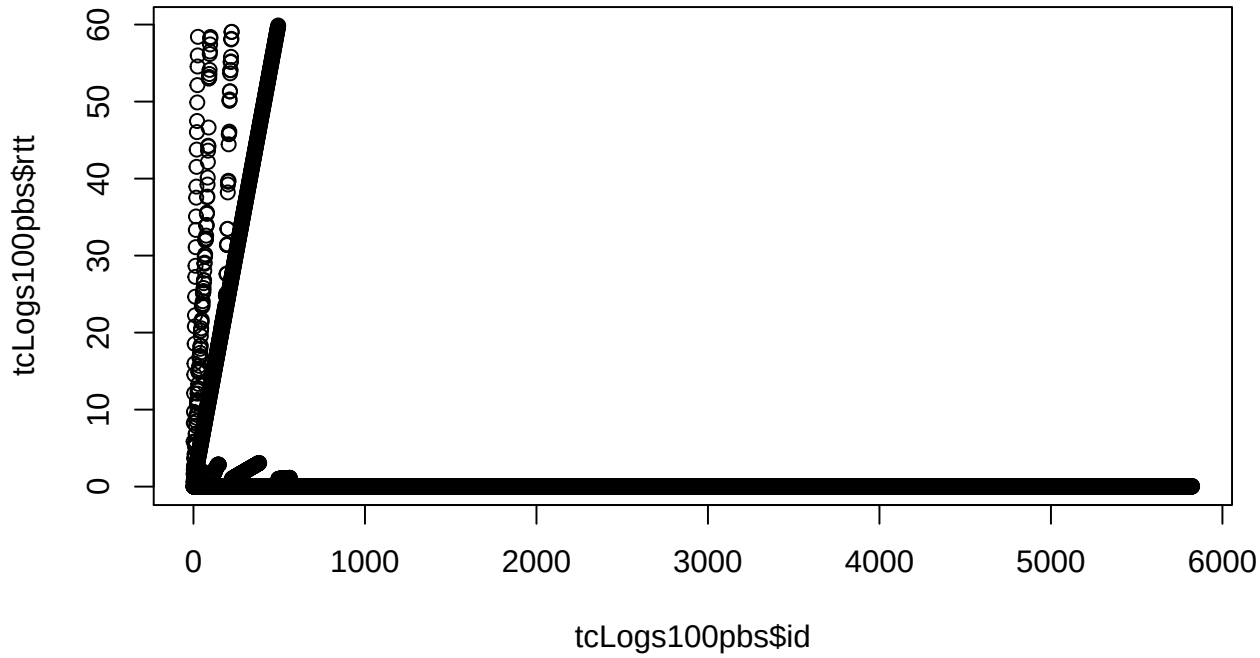

```
########################################
# Pakete pro Sekunde _ Aufsplittung Qos #
########################################

tcLogs1pbs<-tcLogs[tcLogs$PproSek == "1pbs",]
tcLogs10pbs<-tcLogs[tcLogs$PproSek == "10pbs",]
tcLogs100pbs<-tcLogs[tcLogs$PproSek == "100pbs",]

plot(tcLogs1pbs$id, tcLogs1pbs$rtt)
```



```r
plot(tcLogs10pbs$id, tcLogs10pbs$rtt)
```

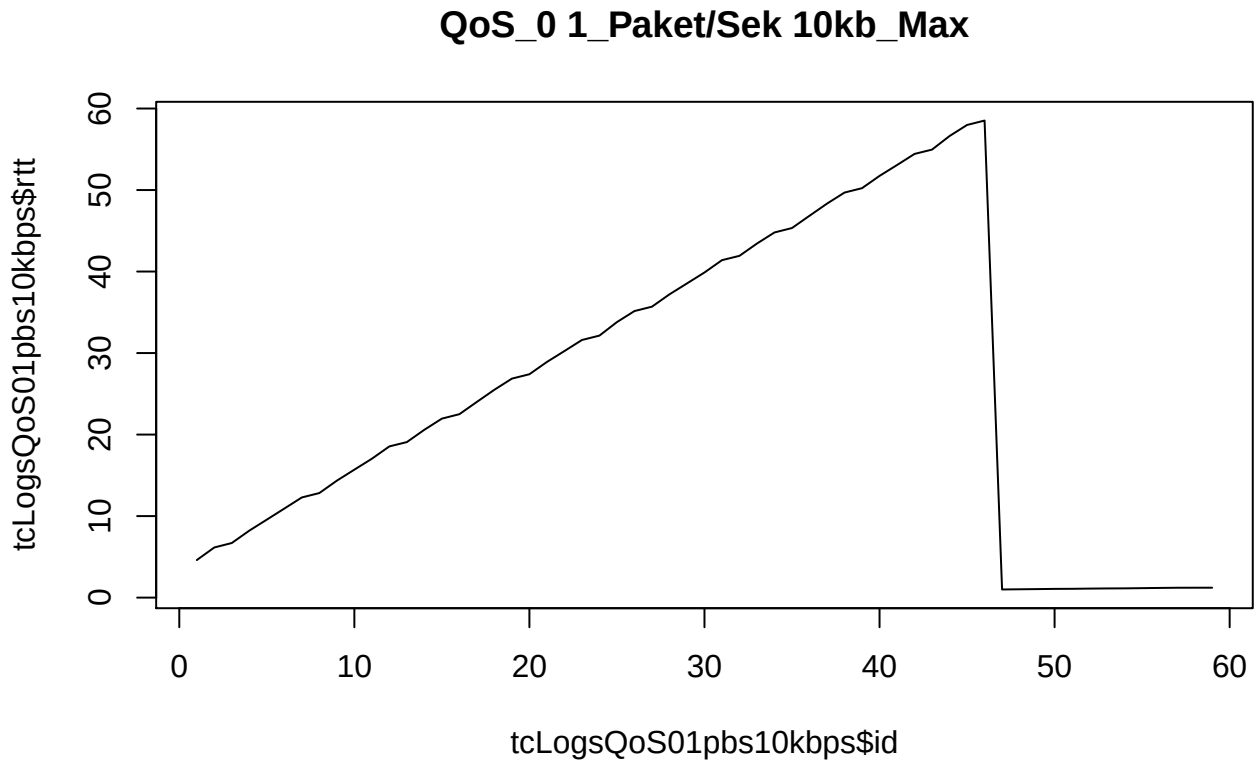



```r
plot(tcLogs100pbs$id, tcLogs100pbs$rtt)
```

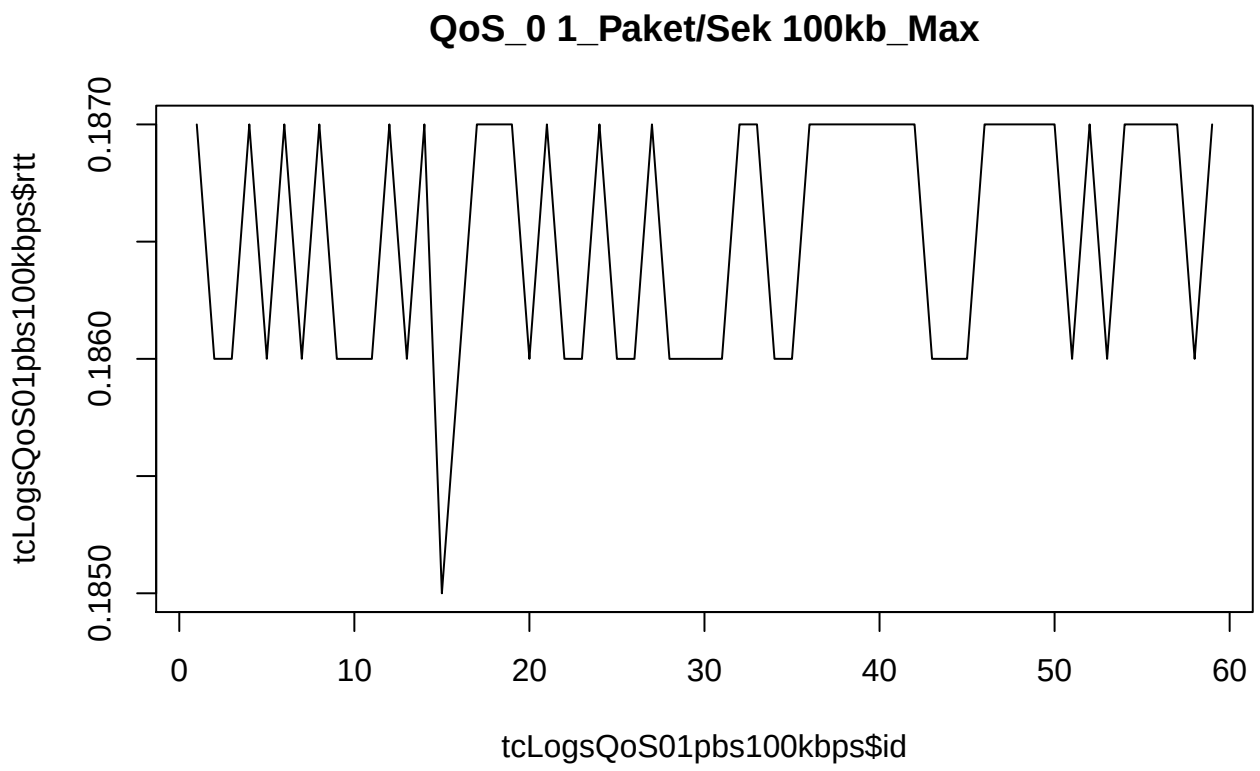



```r
#################################################################
# QoS Level _ Pakete pro Sekunde Qos _ Aufsplittung Grenze #
#################################################################
## QoS0_1pbs - Aufsplittung MaxDurc

tcLogsQoS01pbs10kbps<-tcLogsQoS01pbs[tcLogsQoS01pbs$MaxDurc == "10kbps",]
tcLogsQoS01pbs100kbps<-tcLogsQoS01pbs[tcLogsQoS01pbs$MaxDurc == "100kbps",]
tcLogsQoS01pbs1mbps<-tcLogsQoS01pbs[tcLogsQoS01pbs$MaxDurc == "1mbps",]
```

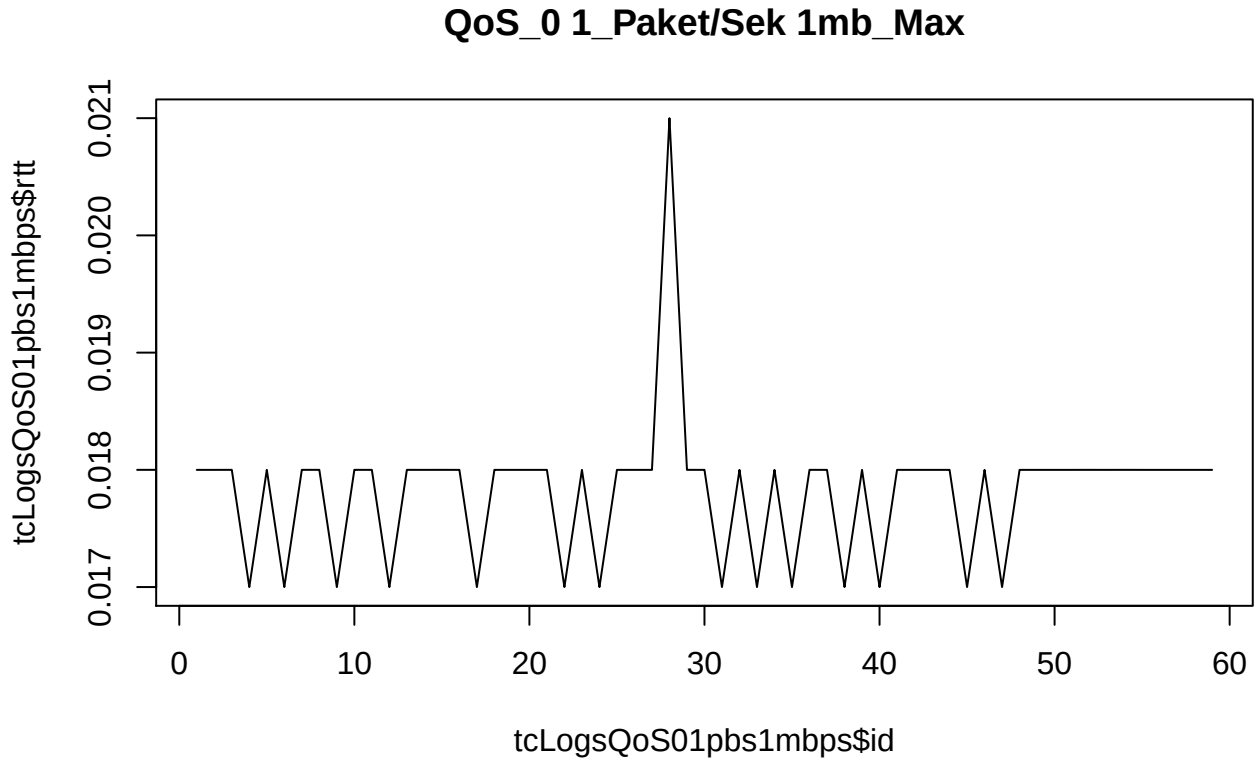
```
tcLogsQoS01pbs10mbps<-tcLogsQoS01pbs[tcLogsQoS01pbs$MaxDurc == "10mbps",]
tcLogsQoS01pbs100mbps<-tcLogsQoS01pbs[tcLogsQoS01pbs$MaxDurc == "100mbps",]

plot(tcLogsQoS01pbs10kbps$id, tcLogsQoS01pbs10kbps$rtt, type = "l", main = "QoS_0 1_Paket/Sek 10kb_Max")
```



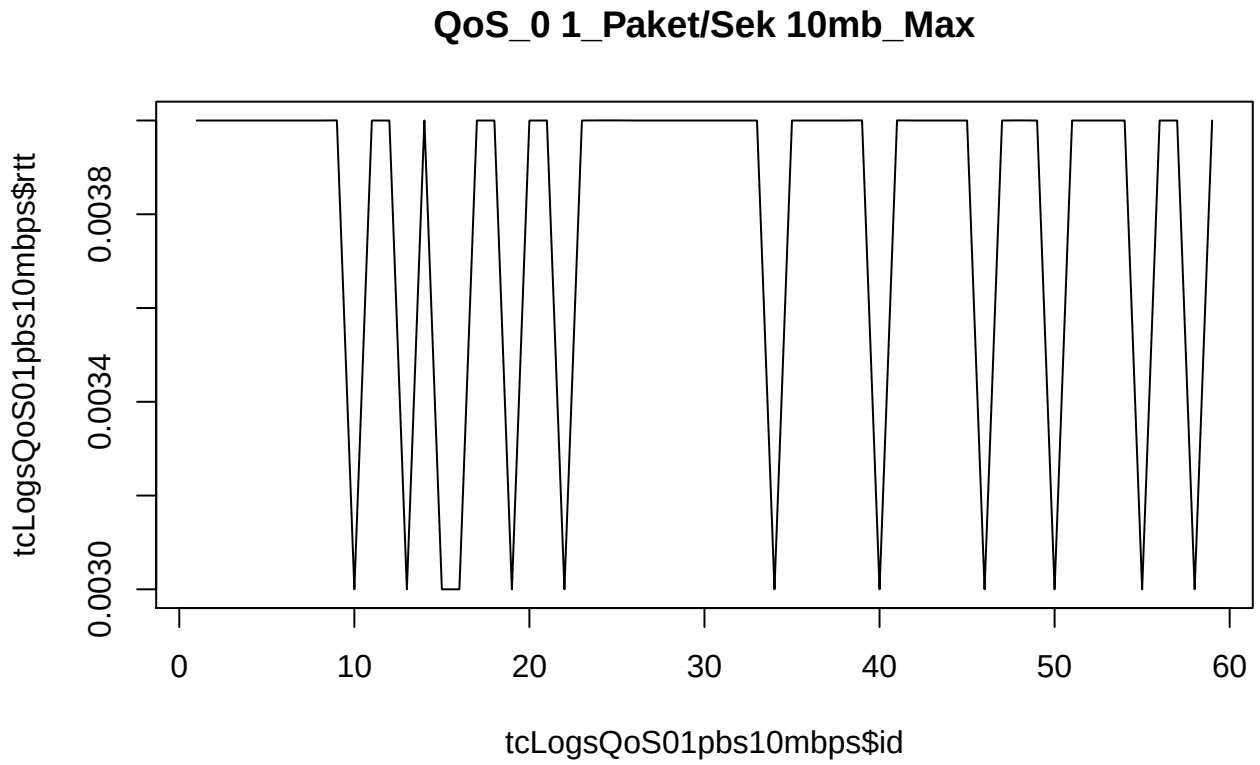

```
plot(tcLogsQoS01pbs100kbps$id, tcLogsQoS01pbs100kbps$rtt, type = "l", main = "QoS_0 1_Paket/Sek 100kb_Ma
```




```
plot(tcLogsQoS01pbs1mbps$id, tcLogsQoS01pbs1mbps$rtt, type = "l", main = "QoS_0 1_Paket/Sek 1mb_Max")
```

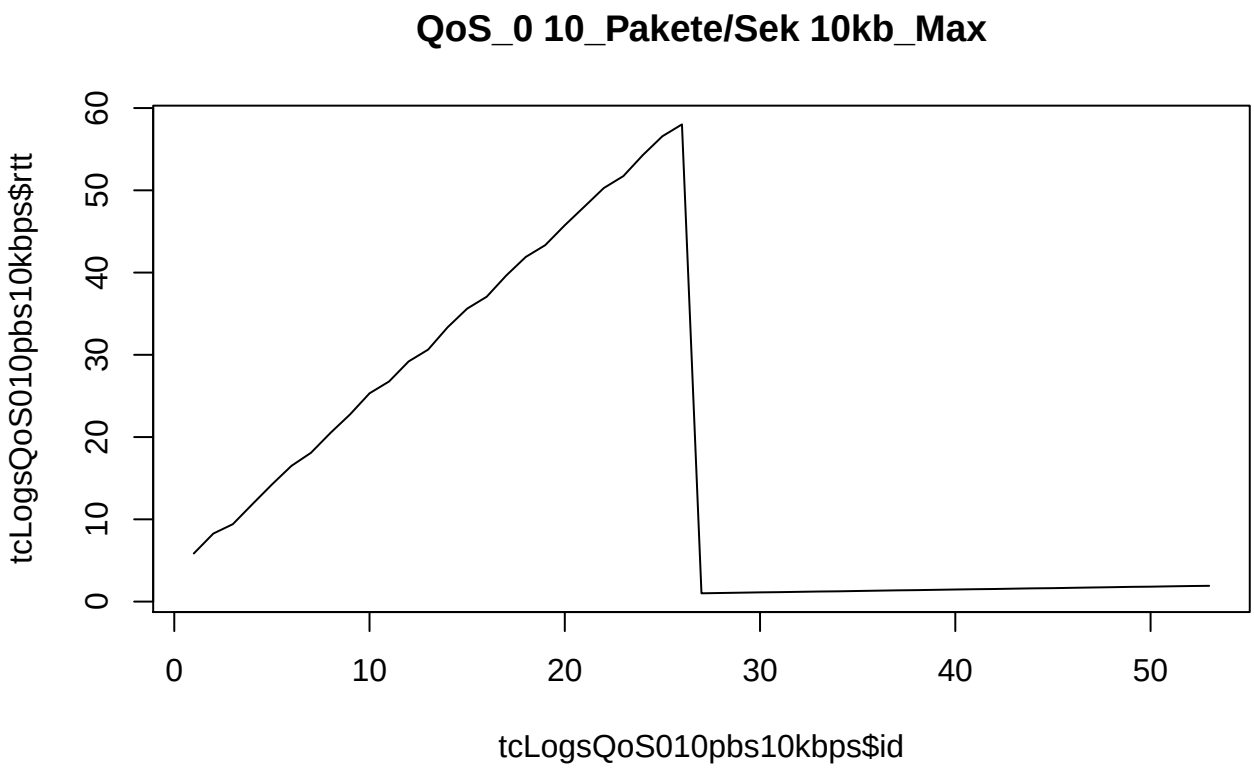



```
plot(tcLogsQoS01pbs10mbps$id, tcLogsQoS01pbs10mbps$rtt, type = "l", main = "QoS_0 1_Paket/Sek 10mb_Max"
```

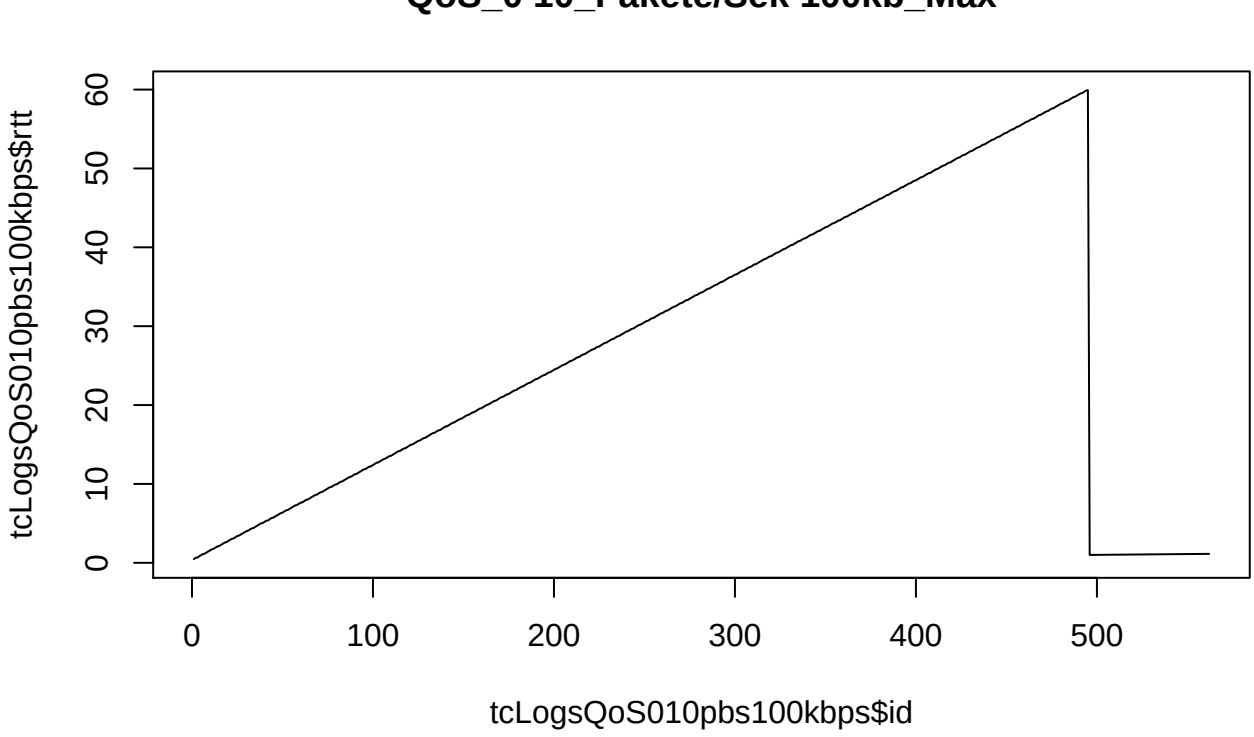



```
#plot(tcLogsQoS01pbs100mbps$id, tcLogsQoS01pbs100mbps$rtt, type = "l", main = "QoS_0 1_Paket/Sek 100mb_
```

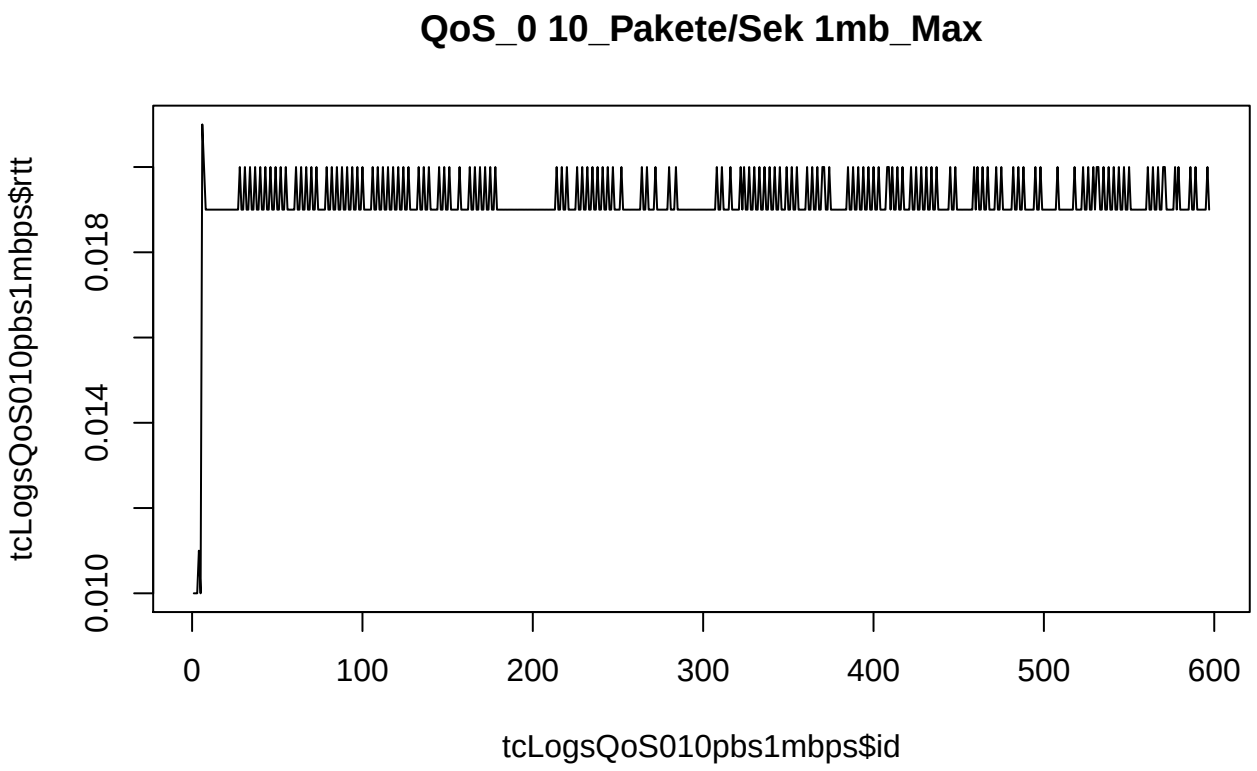
```
## QoS0_10pbs - Aufsplittung MaxDurc
tcLogsQoS010pbs10kbps<-tcLogsQoS010pbs[tcLogsQoS010pbs$MaxDurc == "10kbps",]
tcLogsQoS010pbs100kbps<-tcLogsQoS010pbs[tcLogsQoS010pbs$MaxDurc == "100kbps",]
tcLogsQoS010pbs1mbps<-tcLogsQoS010pbs[tcLogsQoS010pbs$MaxDurc == "1mbps",]
tcLogsQoS010pbs10mbps<-tcLogsQoS010pbs[tcLogsQoS010pbs$MaxDurc == "10mbps",]
tcLogsQoS010pbs100mbps<-tcLogsQoS010pbs[tcLogsQoS010pbs$MaxDurc == "100mbps",]

plot(tcLogsQoS010pbs10kbps$id, tcLogsQoS010pbs10kbps$rtt, type = "l", main = "QoS_0 10_Pakete/Sek 10kb_
```



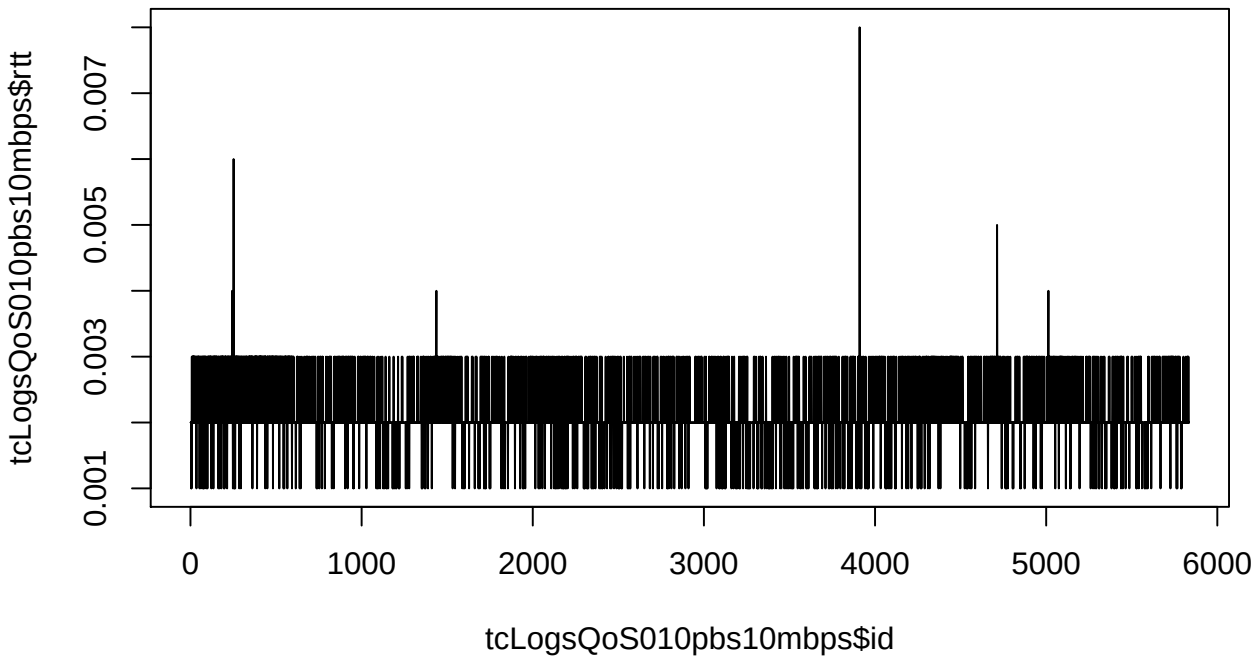

```
plot(tcLogsQoS010pbs100kbps$id, tcLogsQoS010pbs100kbps$rtt, type = "l", main = "QoS_0 10_Pakete/Sek 100
```




```
plot(tcLogsQoS010pbs1mbps$id, tcLogsQoS010pbs1mbps$rtt, type = "l", main = "QoS_0 10_Pakete/Sek 1mb_Max
```



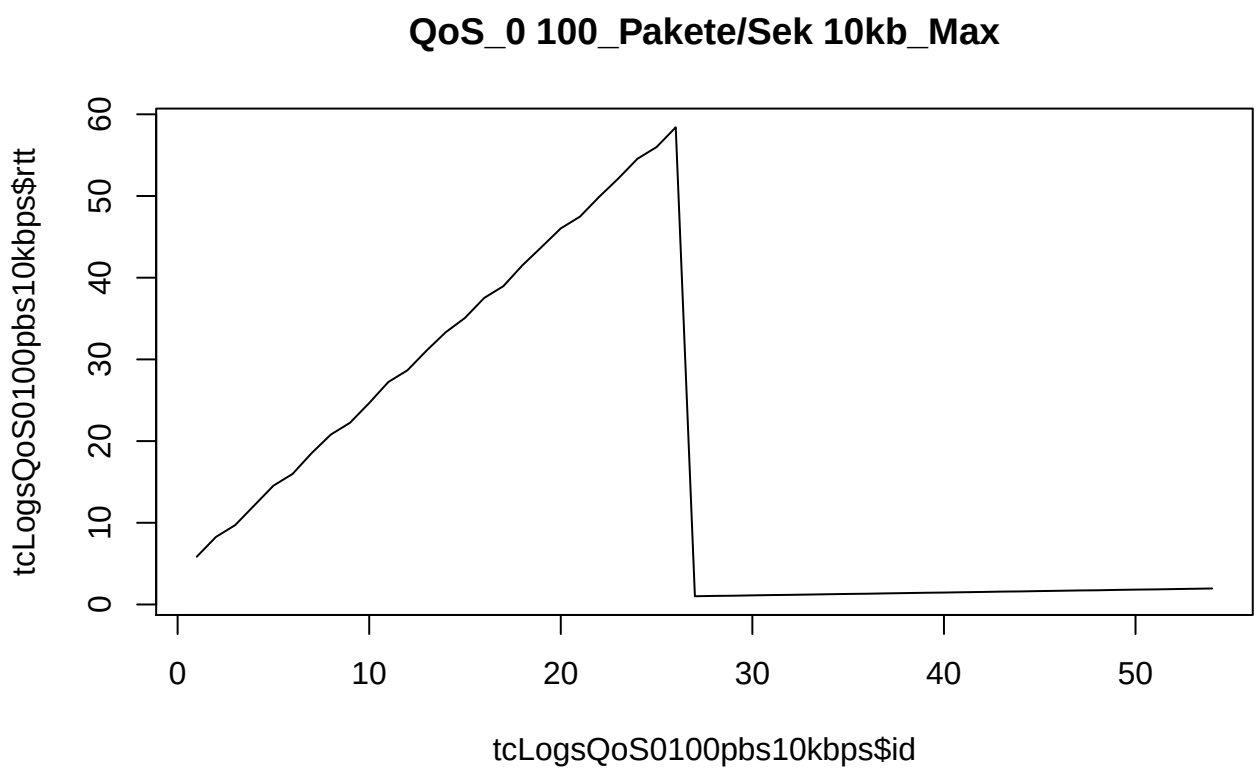

```
plot(tcLogsQoS010pbs10mbps$id, tcLogsQoS010pbs10mbps$rtt, type = "l", main = "QoS_0 10_Pakete/Sek 10mb_
```



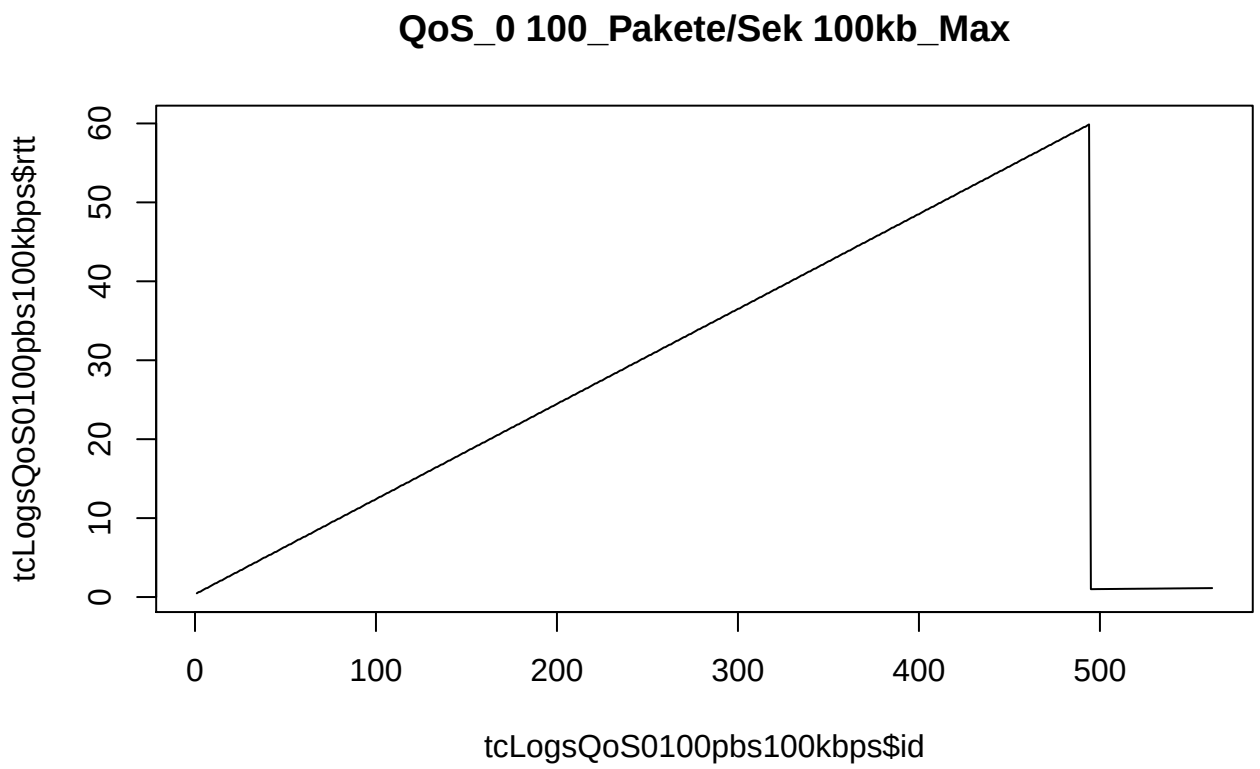

```
#plot(tcLogsQoS010pbs100mbps$id, tcLogsQoS010pbs100mbps$rtt, type = "l", main = "QoS_0 10_Pakete/Sek 10
```

```
## QoS0_100pbs - Aufsplittung MaxDurc
tcLogsQoS0100pbs10kbps<-tcLogsQoS0100pbs[tcLogsQoS0100pbs$MaxDurc == "10kbps",]
```

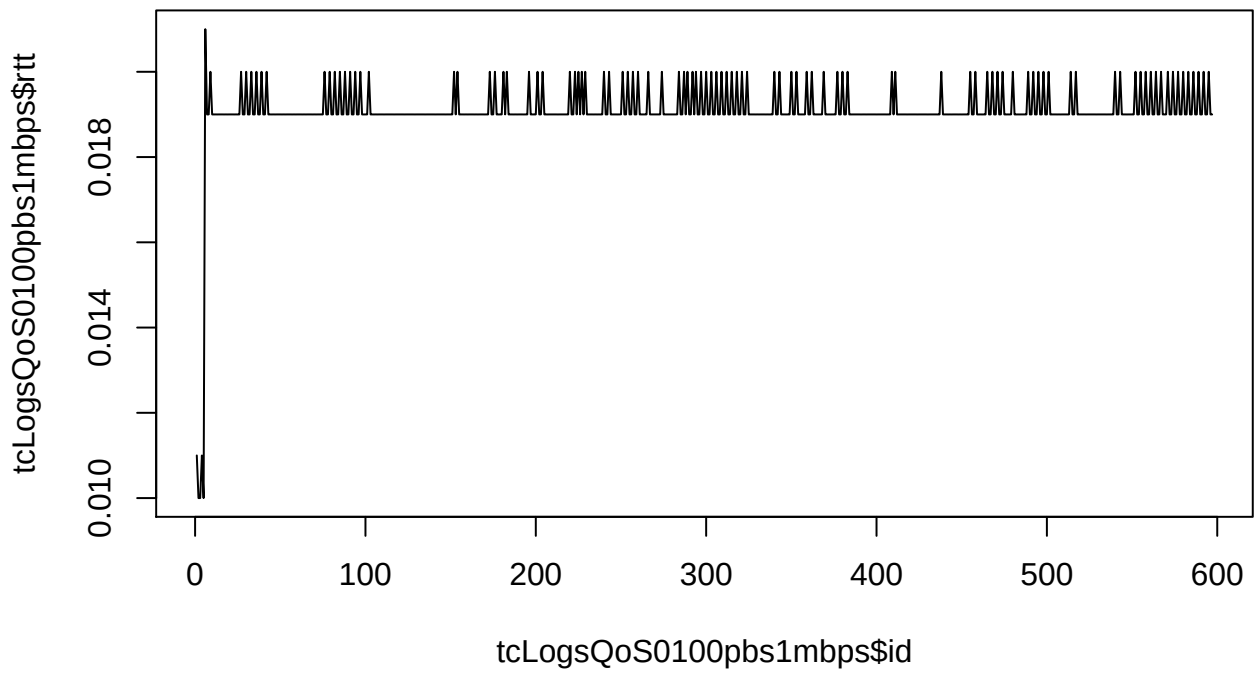
```r
tcLogsQoS0100pbs100kbps<-tcLogsQoS0100pbs[tcLogsQoS0100pbs$MaxDurc == "100kbps",]
tcLogsQoS0100pbs1mbps<-tcLogsQoS0100pbs[tcLogsQoS0100pbs$MaxDurc == "1mbps",]
#tcLogsQoS0100pbs10mbps<-tcLogsQoS0100pbs[tcLogsQoS0100pbs$MaxDurc == "10mbps",]
#tcLogsQoS0100pbs100mbps<-tcLogsQoS0100pbs[tcLogsQoS0100pbs$MaxDurc == "100mbps",]

plot(tcLogsQoS0100pbs10kbps$id, tcLogsQoS0100pbs10kbps$rtt, type = "l", main = "QoS_0 100_Pakete/Sek 10
```




```r
plot(tcLogsQoS0100pbs100kbps$id, tcLogsQoS0100pbs100kbps$rtt, type = "l", main = "QoS_0 100_Pakete/Sek
```

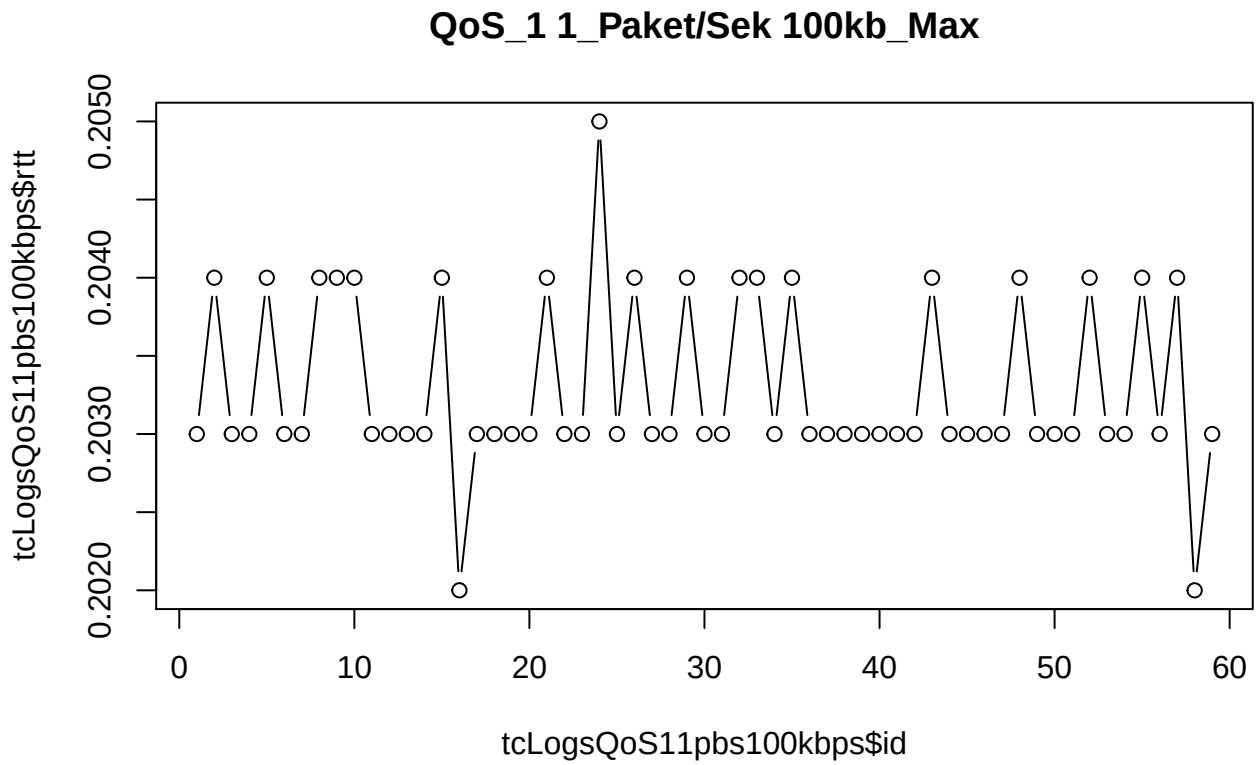



```
plot(tcLogsQoS0100pbs1mbps$id, tcLogsQoS0100pbs1mbps$rtt, type = "l", main = "QoS_0 100_Pakete/Sek 1mb_
```

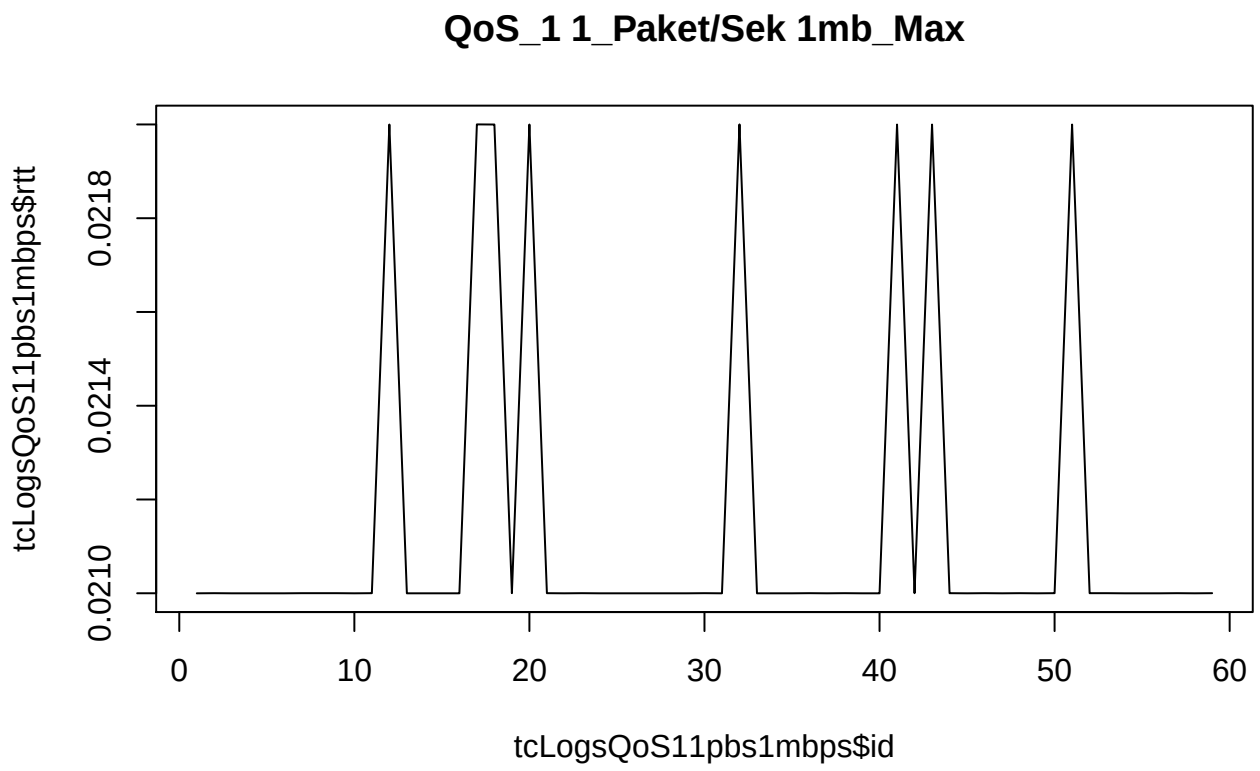



```
#plot(tcLogsQoS0100pbs10mbps$id, tcLogsQoS0100pbs10mbps$rtt, type = "l", main = "QoS_0 100_Pakete/Sek 1
#plot(tcLogsQoS0100pbs100mbps$id, tcLogsQoS0100pbs100mbps$rtt, type = "l", main = "QoS_0 100_Pakete/Sek
```

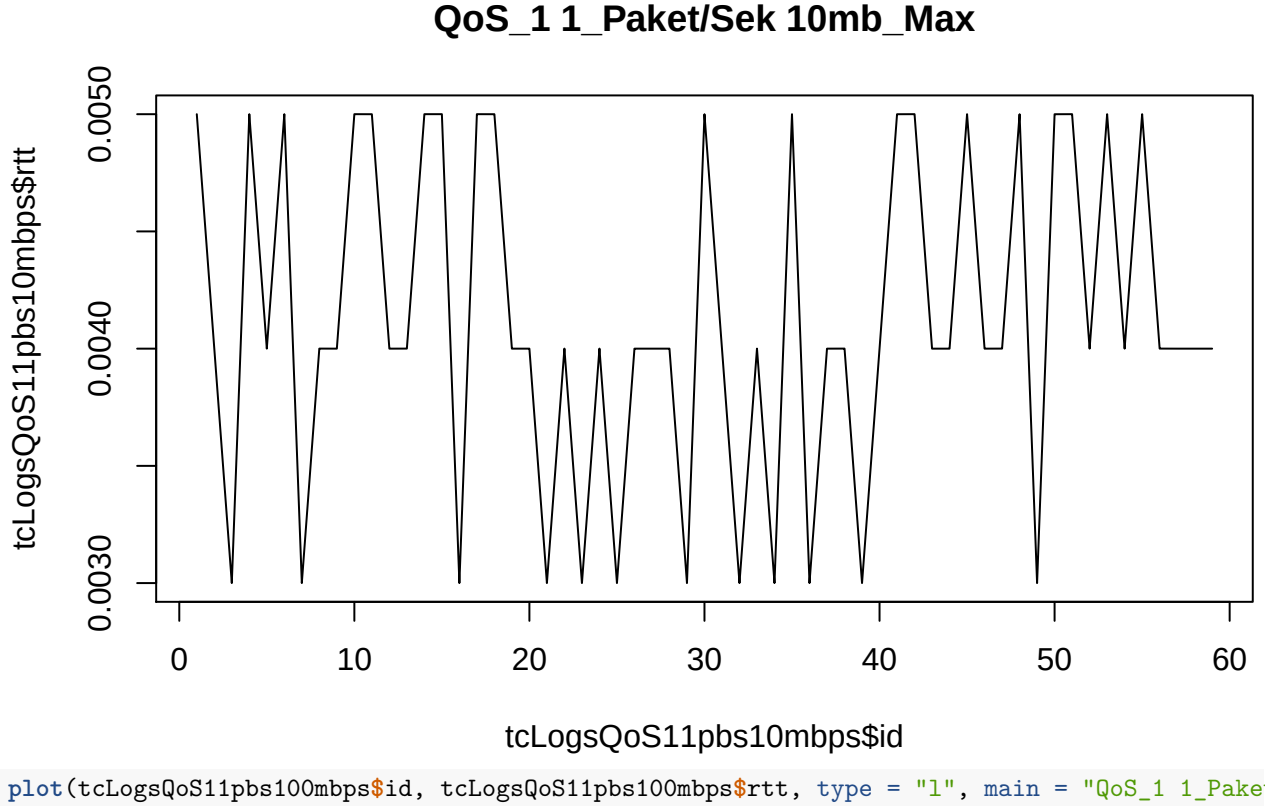
```
## QoS1_1pbs - Aufsplittung MaxDurc
tcLogsQoS11pbs10kbps<-tcLogsQoS11pbs[tcLogsQoS11pbs$MaxDurc == "10kbps",]
tcLogsQoS11pbs100kbps<-tcLogsQoS11pbs[tcLogsQoS11pbs$MaxDurc == "100kbps",]
tcLogsQoS11pbs1mbps<-tcLogsQoS11pbs[tcLogsQoS11pbs$MaxDurc == "1mbps",]
tcLogsQoS11pbs10mbps<-tcLogsQoS11pbs[tcLogsQoS11pbs$MaxDurc == "10mbps",]
tcLogsQoS11pbs100mbps<-tcLogsQoS11pbs[tcLogsQoS11pbs$MaxDurc == "100mbps",]

#plot(tcLogsQoS11pbs10kbps$id, tcLogsQoS11pbs10kbps$rtt, type = "l", main = "QoS_1 1_Paket/Sek 10kb_Max
plot(tcLogsQoS11pbs100kbps$id, tcLogsQoS11pbs100kbps$rtt, type = "b", main = "QoS_1 1_Paket/Sek 100kb_Ma
```



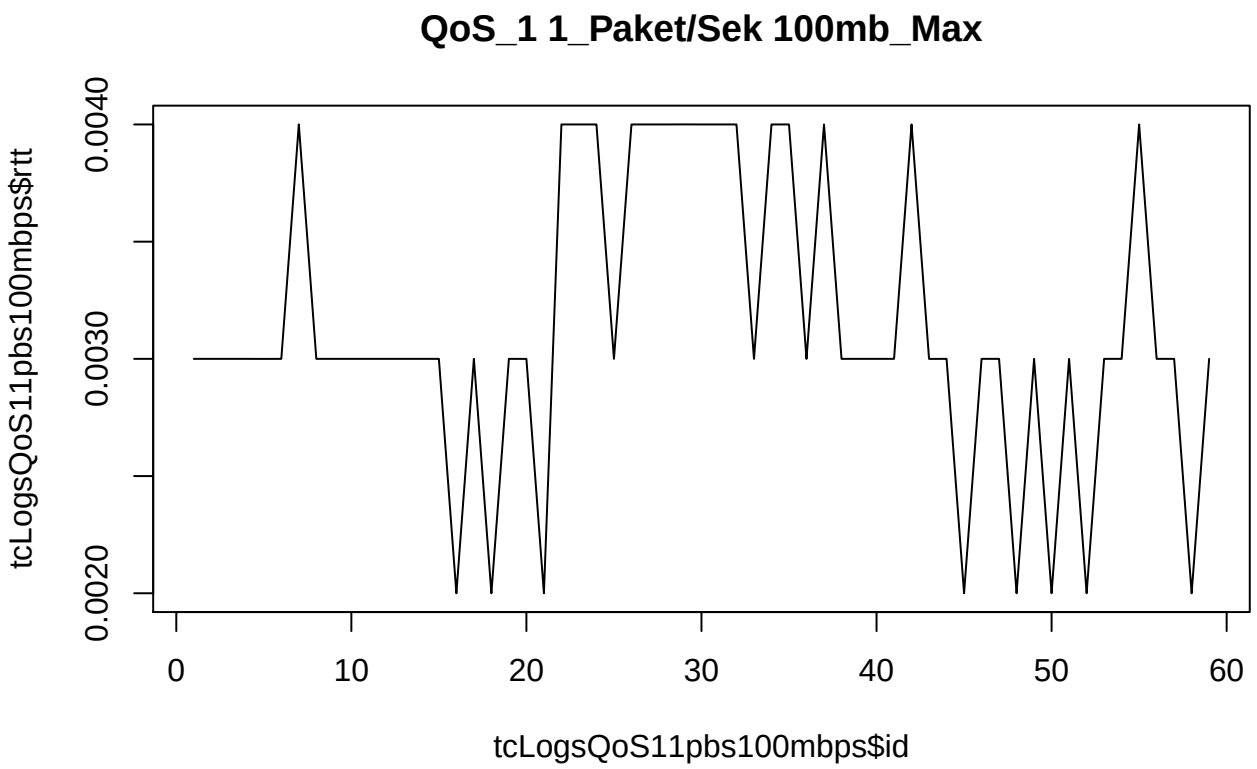

```
plot(tcLogsQoS11pbs1mbps$id, tcLogsQoS11pbs1mbps$rtt, type = "l", main = "QoS_1 1_Paket/Sek 1mb_Max")
```



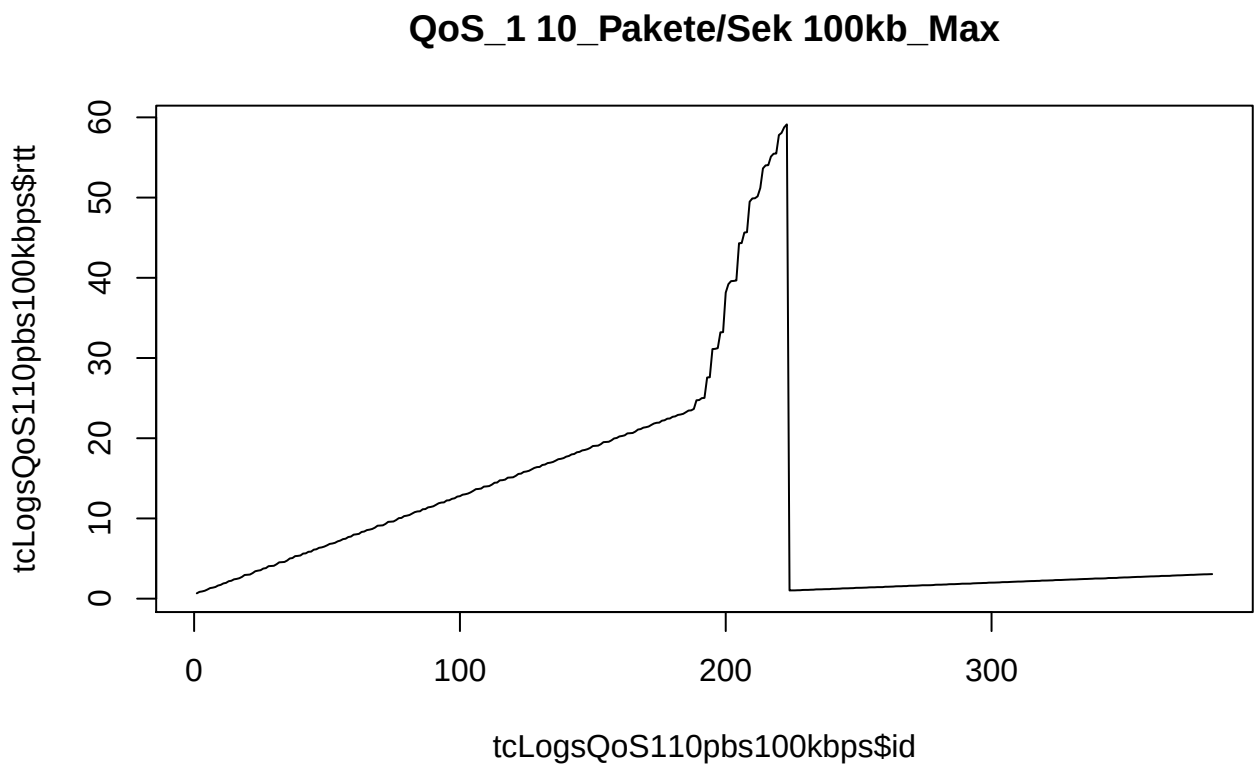

```
plot(tcLogsQoS11pbs10mbps$id, tcLogsQoS11pbs10mbps$rtt, type = "l", main = "QoS_1 1_Paket/Sek 10mb_Max"
```



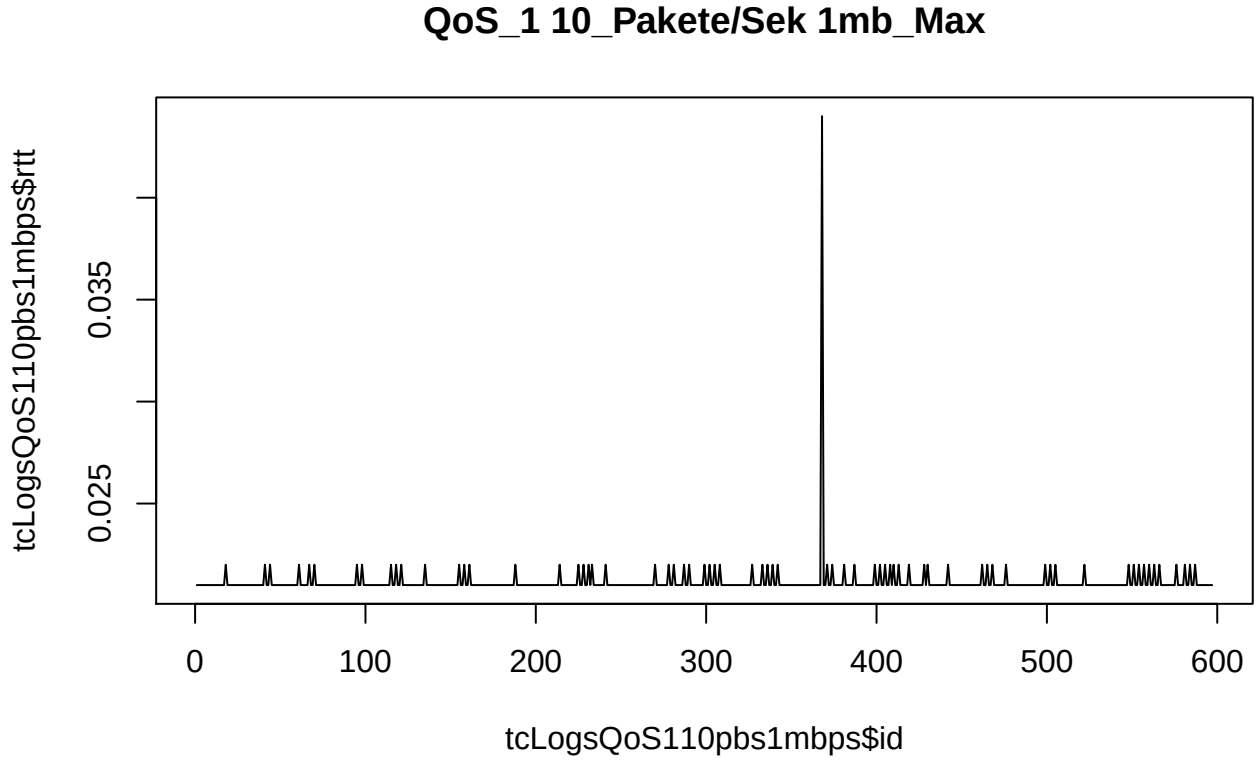

```
plot(tcLogsQoS11pbs100mbps$id, tcLogsQoS11pbs100mbps$rtt, type = "l", main = "QoS_1 1_Paket/Sek 100mb_Ma
```



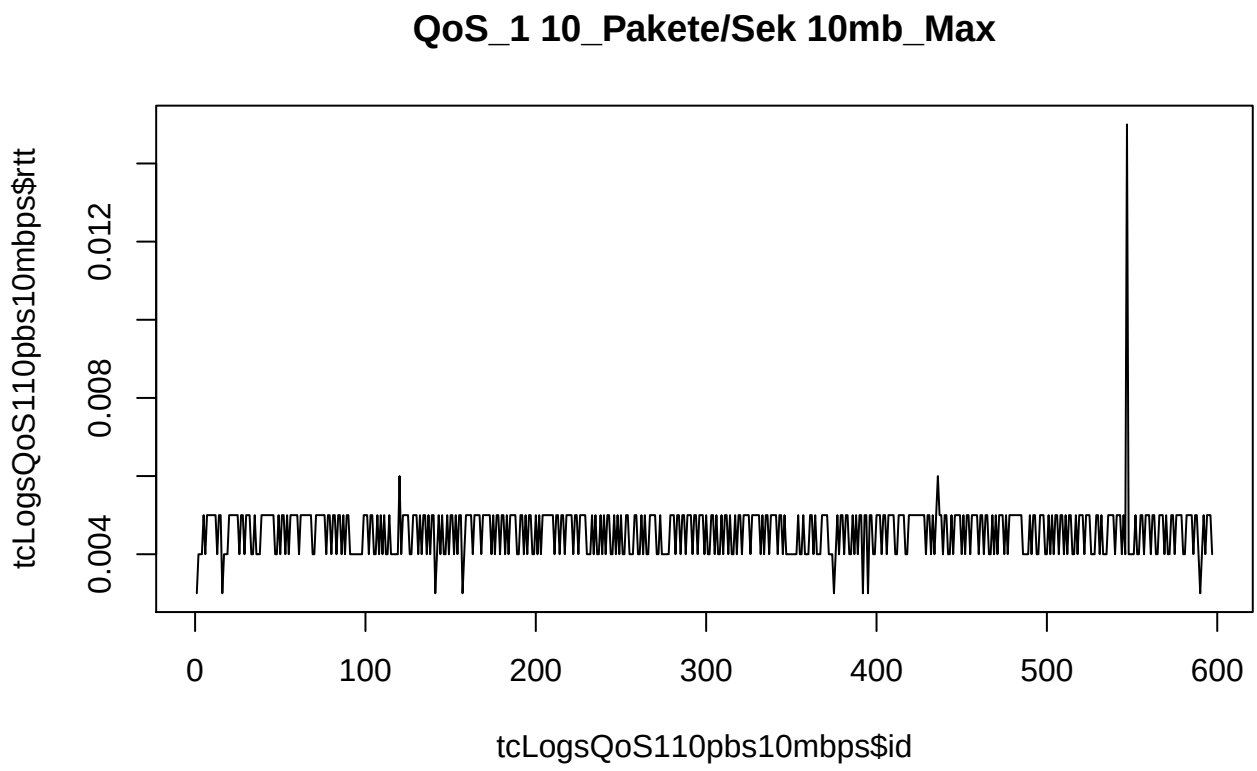

```
## QoS1_10pbs - Aufsplittung MaxDurc
tcLogsQoS110pbs10kbps<-tcLogsQoS110pbs[tcLogsQoS110pbs$MaxDurc == "10kbps",]
tcLogsQoS110pbs100kbps<-tcLogsQoS110pbs[tcLogsQoS110pbs$MaxDurc == "100kbps",]
tcLogsQoS110pbs1mbps<-tcLogsQoS110pbs[tcLogsQoS110pbs$MaxDurc == "1mbps",]
tcLogsQoS110pbs10mbps<-tcLogsQoS110pbs[tcLogsQoS110pbs$MaxDurc == "10mbps",]
tcLogsQoS110pbs100mbps<-tcLogsQoS110pbs[tcLogsQoS110pbs$MaxDurc == "100mbps",]

#plot(tcLogsQoS110pbs10kbps$id, tcLogsQoS110pbs10kbps$rtt, type = "l", main = "QoS_1 10_Pakete/Sek 10kb
plot(tcLogsQoS110pbs100kbps$id, tcLogsQoS110pbs100kbps$rtt, type = "l", main = "QoS_1 10_Pakete/Sek 100
```



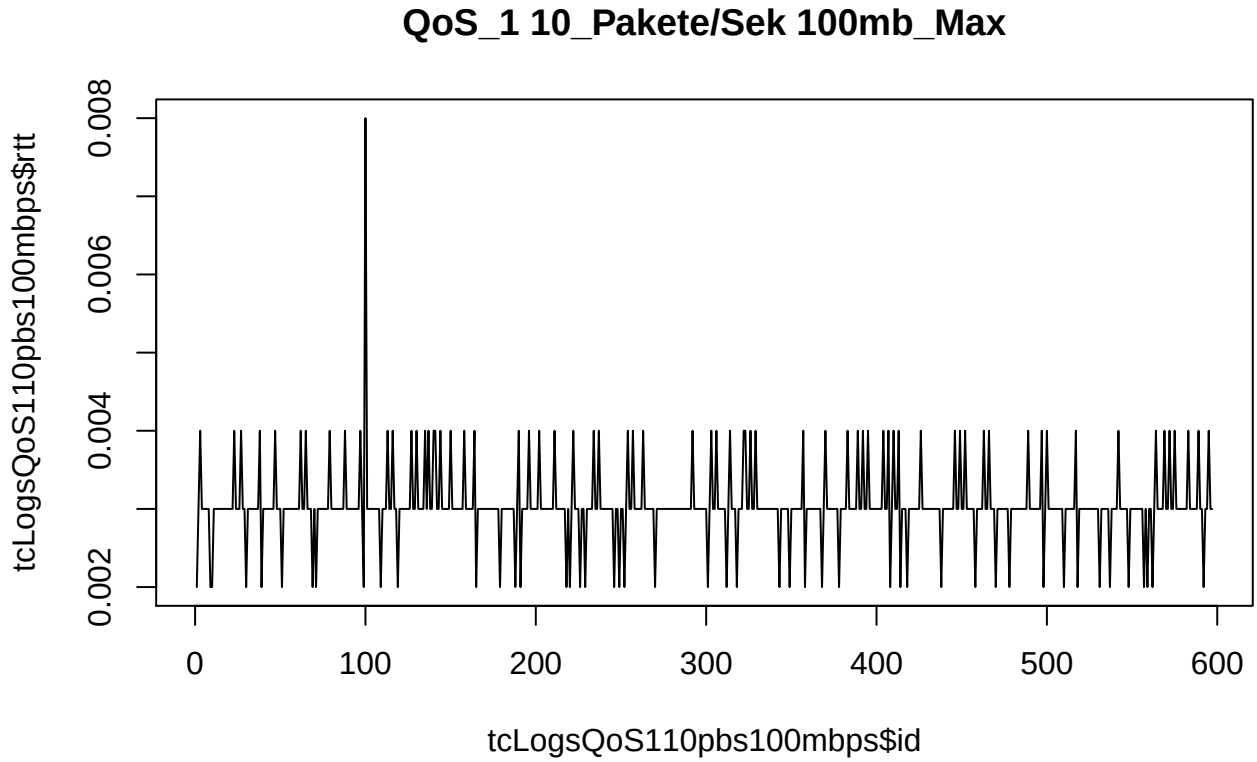

```
plot(tcLogsQoS110pbs1mbps$id, tcLogsQoS110pbs1mbps$rtt, type = "l", main = "QoS_1 10_Pakete/Sek 1mb_Max
```




```
plot(tcLogsQoS110pbs10mbps$id, tcLogsQoS110pbs10mbps$rtt, type = "l", main = "QoS_1 10_Pakete/Sek 10mb_
```

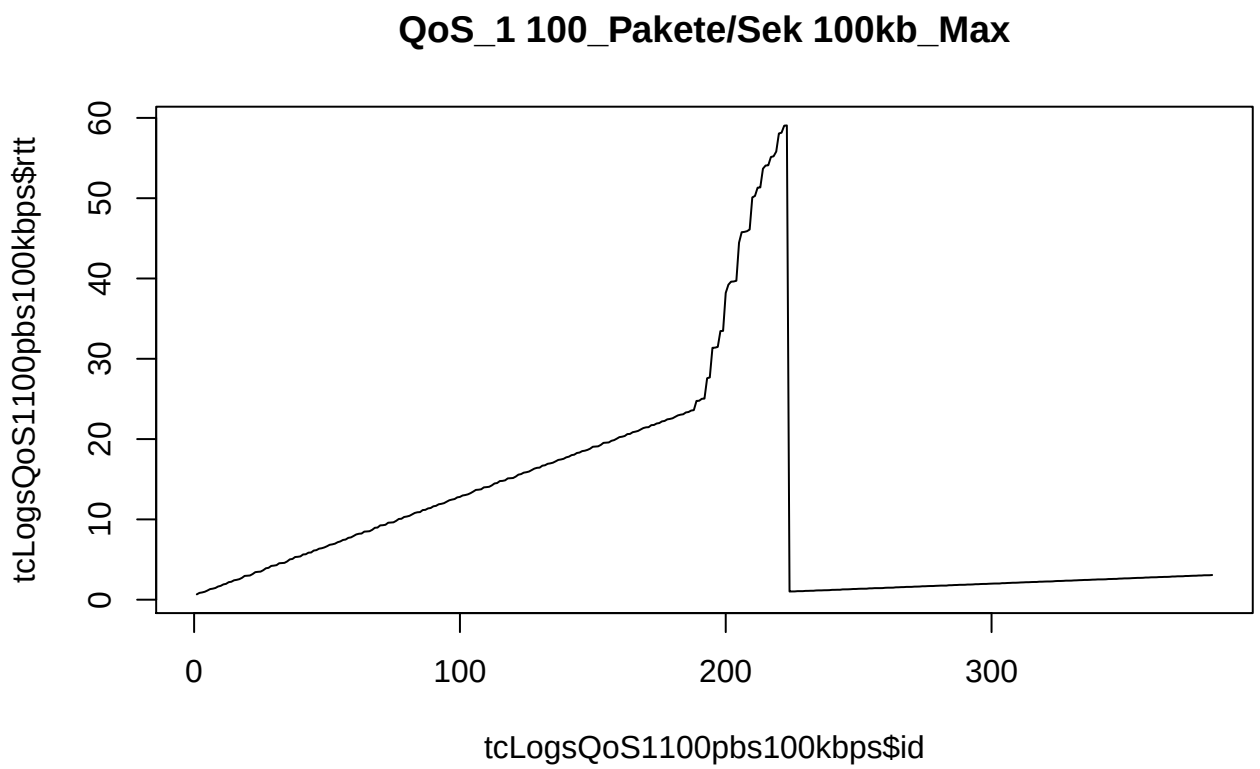



```
plot(tcLogsQoS110pbs100mbps$id, tcLogsQoS110pbs100mbps$rtt, type = "l", main = "QoS_1 10_Pakete/Sek 100m
```

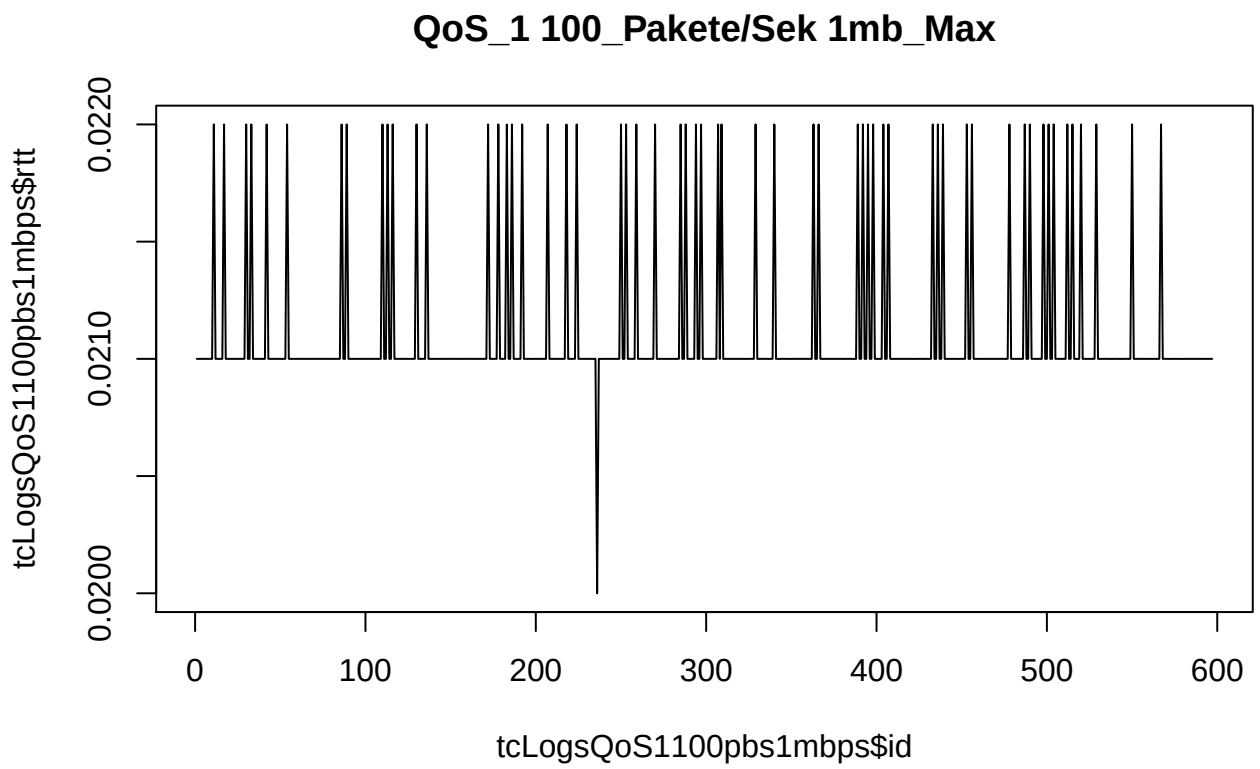



```
## QoS1_100pbs - Aufsplittung MaxDurc
tcLogsQoS1100pbs10kbps<-tcLogsQoS1100pbs[tcLogsQoS1100pbs$MaxDurc == "10kbps",]
tcLogsQoS1100pbs100kbps<-tcLogsQoS1100pbs[tcLogsQoS1100pbs$MaxDurc == "100kbps",]
tcLogsQoS1100pbs1mbps<-tcLogsQoS1100pbs[tcLogsQoS1100pbs$MaxDurc == "1mbps",]
```

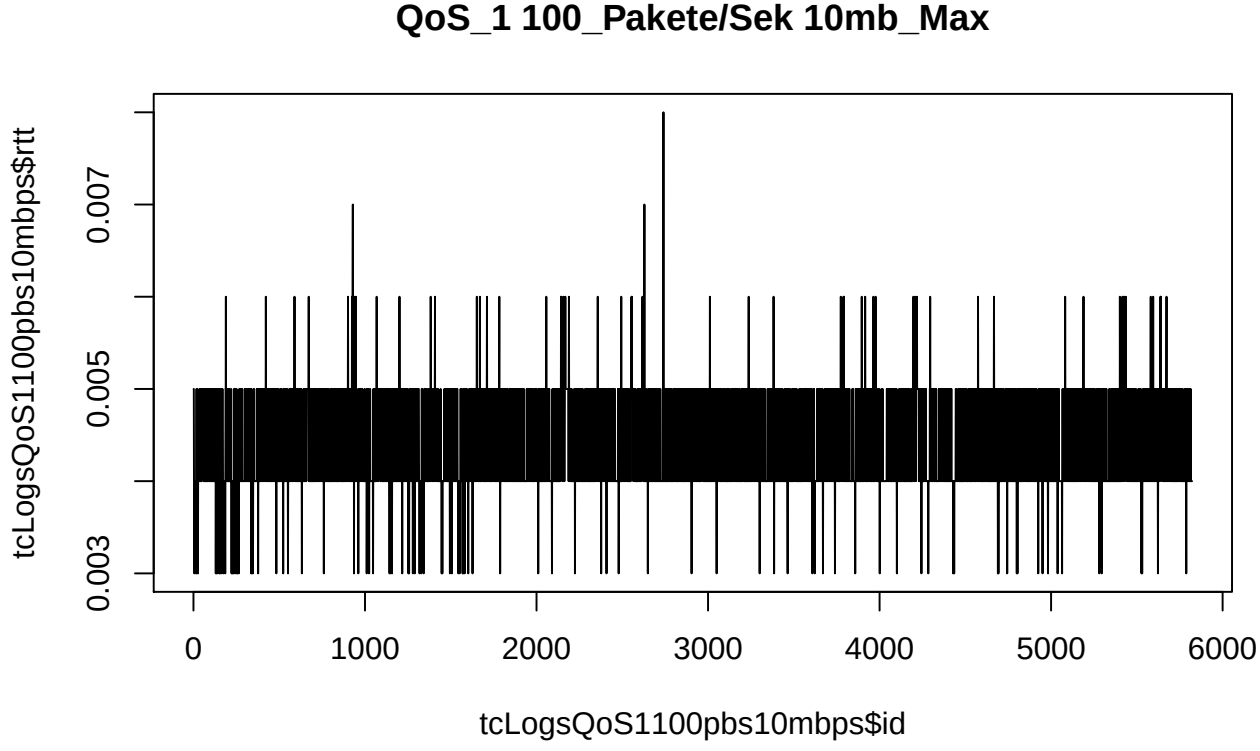
```
tcLogsQoS1100pbs10mbps<-tcLogsQoS1100pbs[tcLogsQoS1100pbs$MaxDurc == "10mbps",]
tcLogsQoS1100pbs100mbps<-tcLogsQoS1100pbs[tcLogsQoS1100pbs$MaxDurc == "100mbps",]

#plot(tcLogsQoS1100pbs10kbps$id, tcLogsQoS1100pbs10kbps$rtt, type = "l", main = "QoS_1 100_Pakete/Sek 1
plot(tcLogsQoS1100pbs100kbps$id, tcLogsQoS1100pbs100kbps$rtt, type = "l", main = "QoS_1 100_Pakete/Sek
```



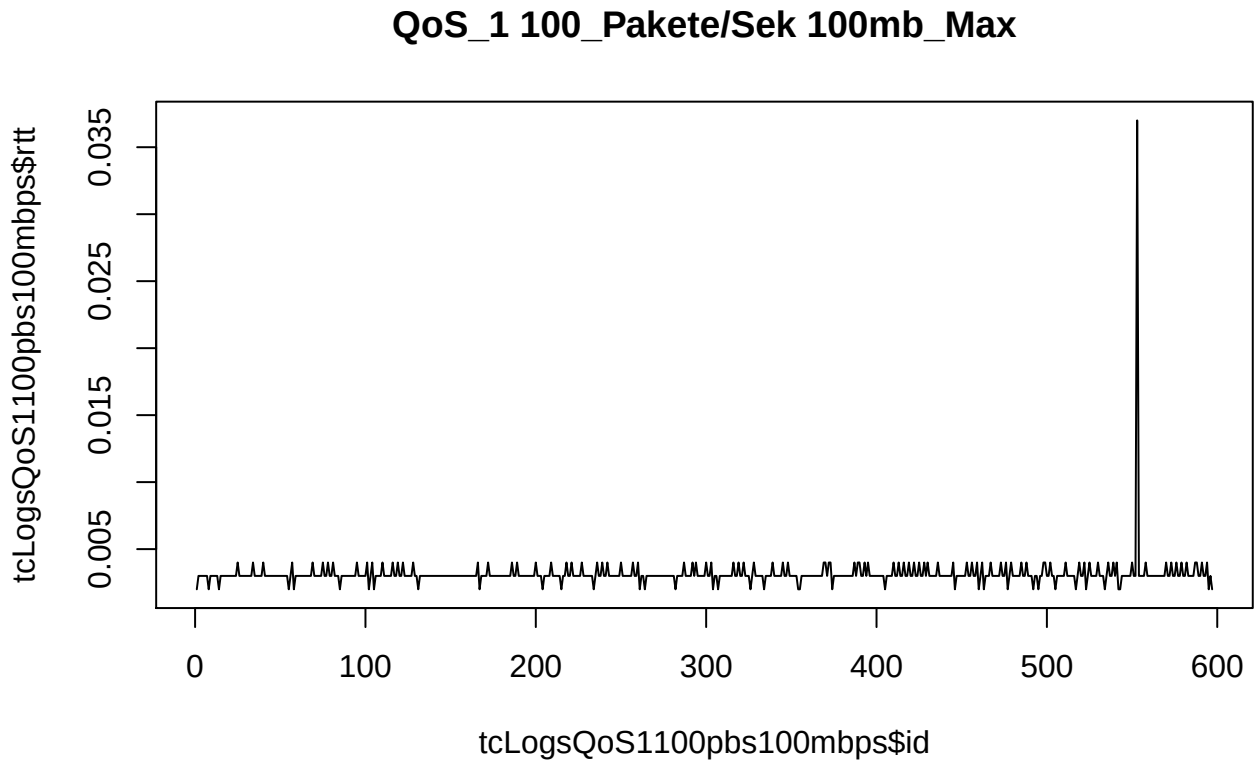

```
plot(tcLogsQoS1100pbs1mbps$id, tcLogsQoS1100pbs1mbps$rtt, type = "l", main = "QoS_1 100_Pakete/Sek 1mb_
```



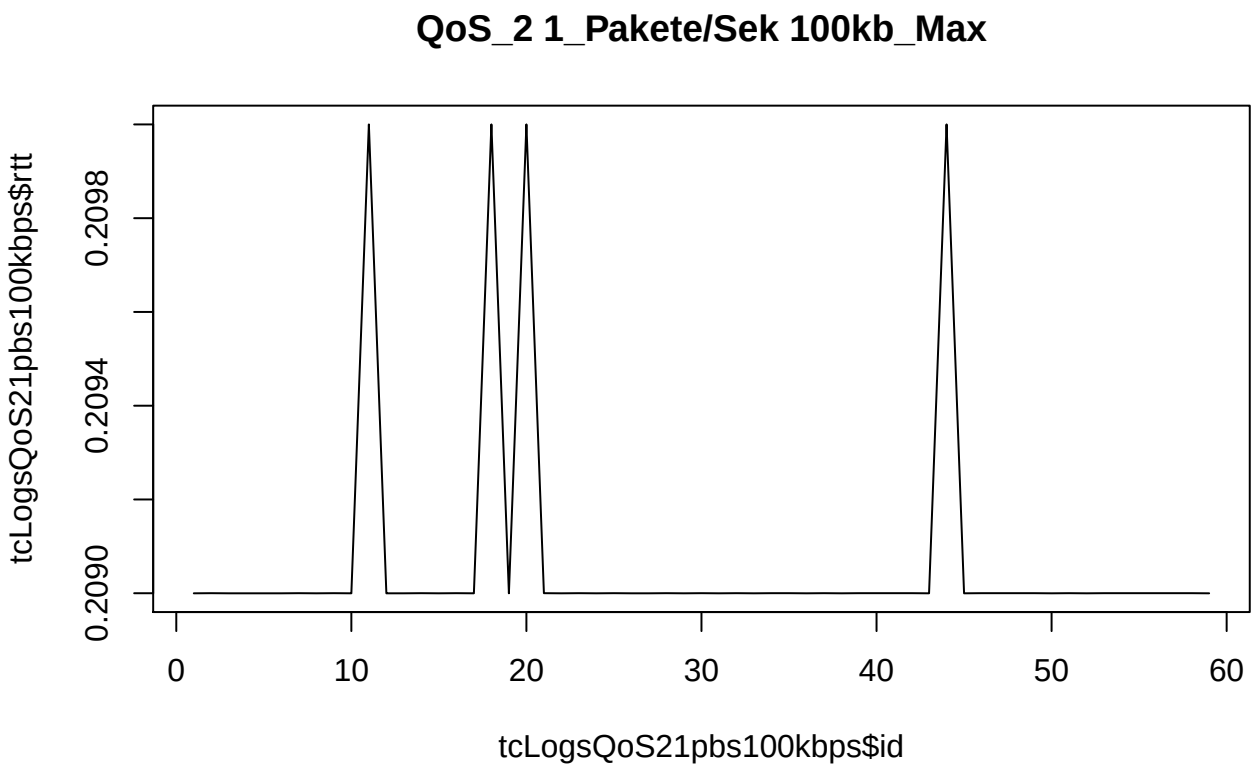

```
plot(tcLogsQoS1100pbs10mbps$id, tcLogsQoS1100pbs10mbps$rtt, type = "l", main = "QoS_1 100_Pakete/Sek 10
```



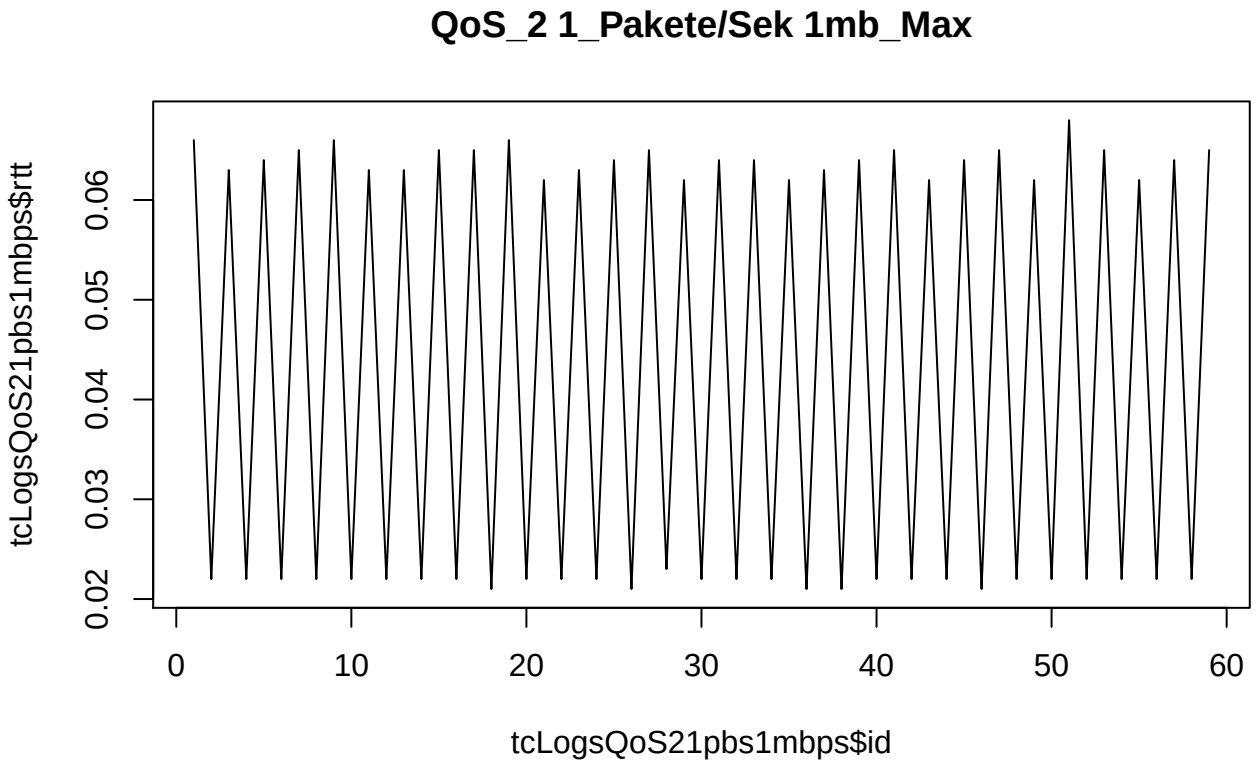

```
plot(tcLogsQoS1100pbs100mbps$id, tcLogsQoS1100pbs100mbps$rtt, type = "l", main = "QoS_1 100_Pakete/Sek
```



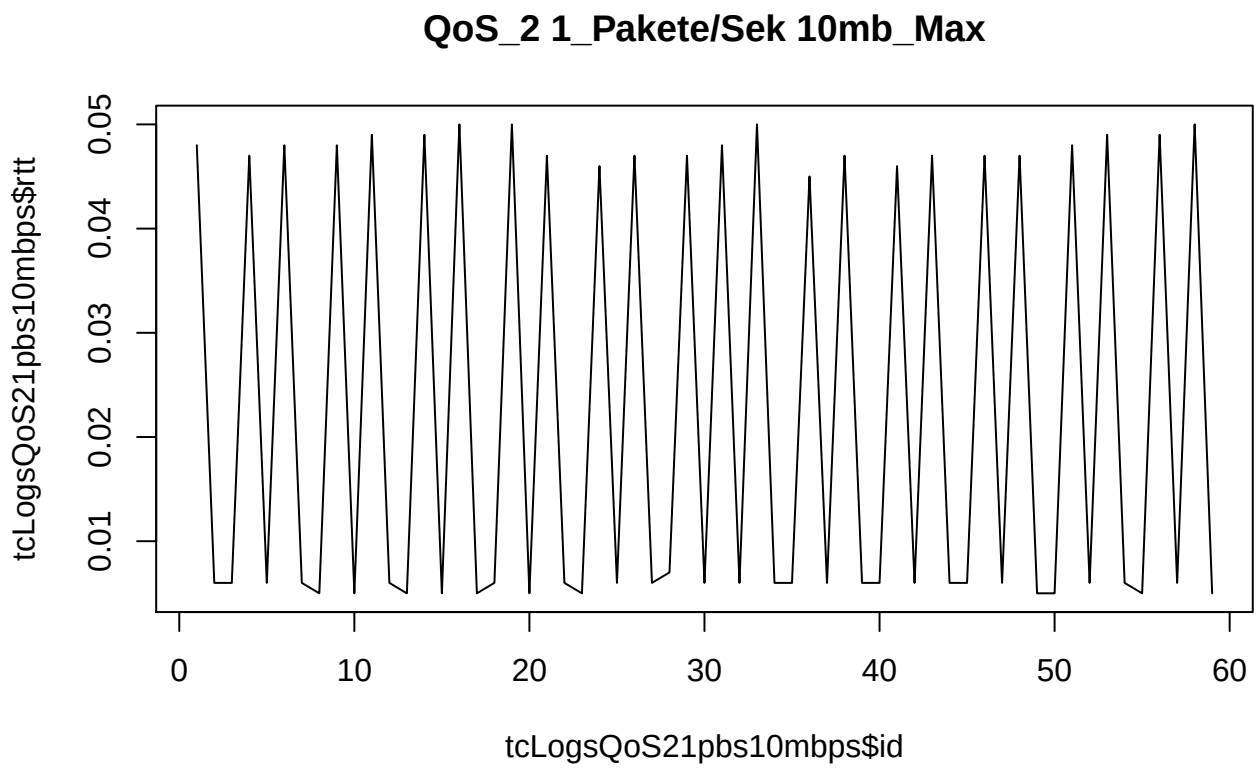

```
## QoS2_1pbs - Aufsplittung MaxDurc
tcLogsQoS21pbs10kbps<-tcLogsQoS21pbs[tcLogsQoS21pbs$MaxDurc == "10kbps", ]
tcLogsQoS21pbs100kbps<-tcLogsQoS21pbs[tcLogsQoS21pbs$MaxDurc == "100kbps", ]
tcLogsQoS21pbs1mbps<-tcLogsQoS21pbs[tcLogsQoS21pbs$MaxDurc == "1mbps", ]
tcLogsQoS21pbs10mbps<-tcLogsQoS21pbs[tcLogsQoS21pbs$MaxDurc == "10mbps", ]
tcLogsQoS21pbs100mbps<-tcLogsQoS21pbs[tcLogsQoS21pbs$MaxDurc == "100mbps", ]

#plot(tcLogsQoS21pbs10kbps$id, tcLogsQoS21pbs10kbps$rtt, type = "l", main = "QoS_2 1_Pakete/Sek 10kb_Ma
plot(tcLogsQoS21pbs100kbps$id, tcLogsQoS21pbs100kbps$rtt, type = "l", main = "QoS_2 1_Pakete/Sek 100kb_
```



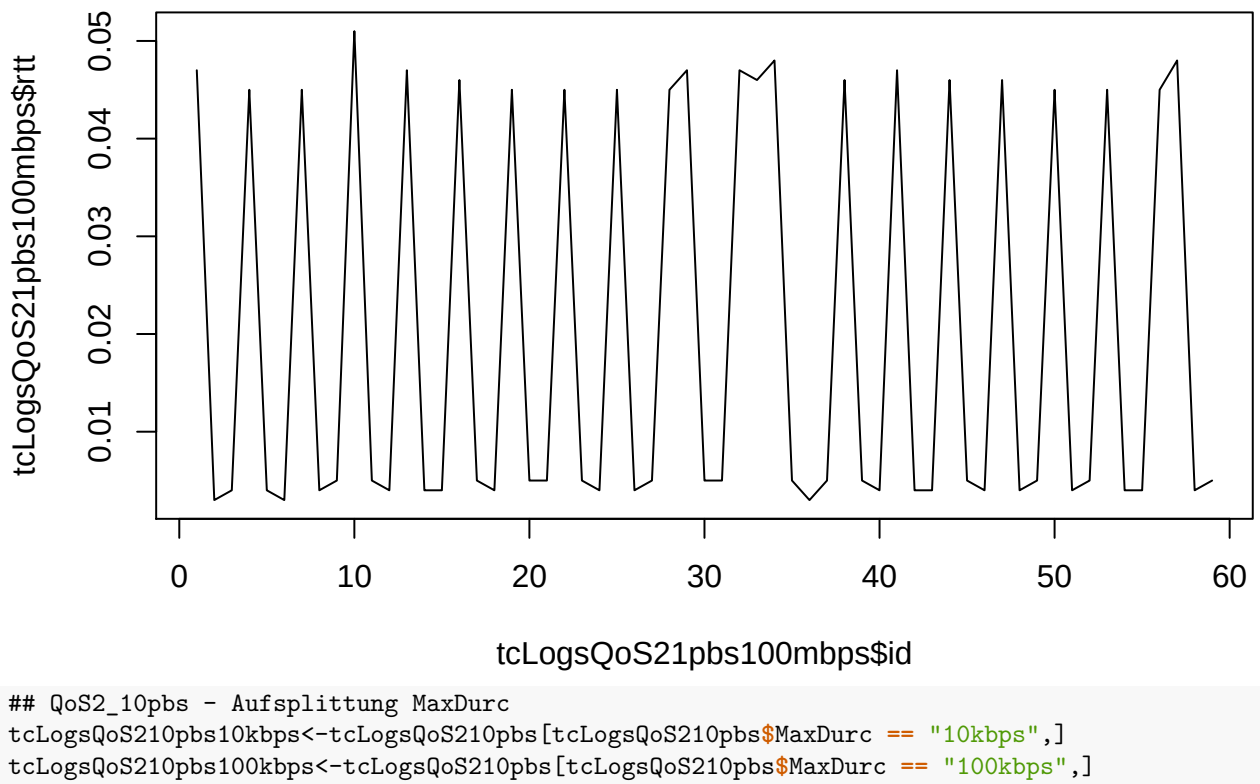

```
plot(tcLogsQoS21pbs1mbps$id, tcLogsQoS21pbs1mbps$rtt, type = "l", main = "QoS_2 1_Pakete/Sek 1mb_Max")
```




```
plot(tcLogsQoS21pbs10mbps$id, tcLogsQoS21pbs10mbps$rtt, type = "l", main = "QoS_2 1_Pakete/Sek 10mb_Max
```

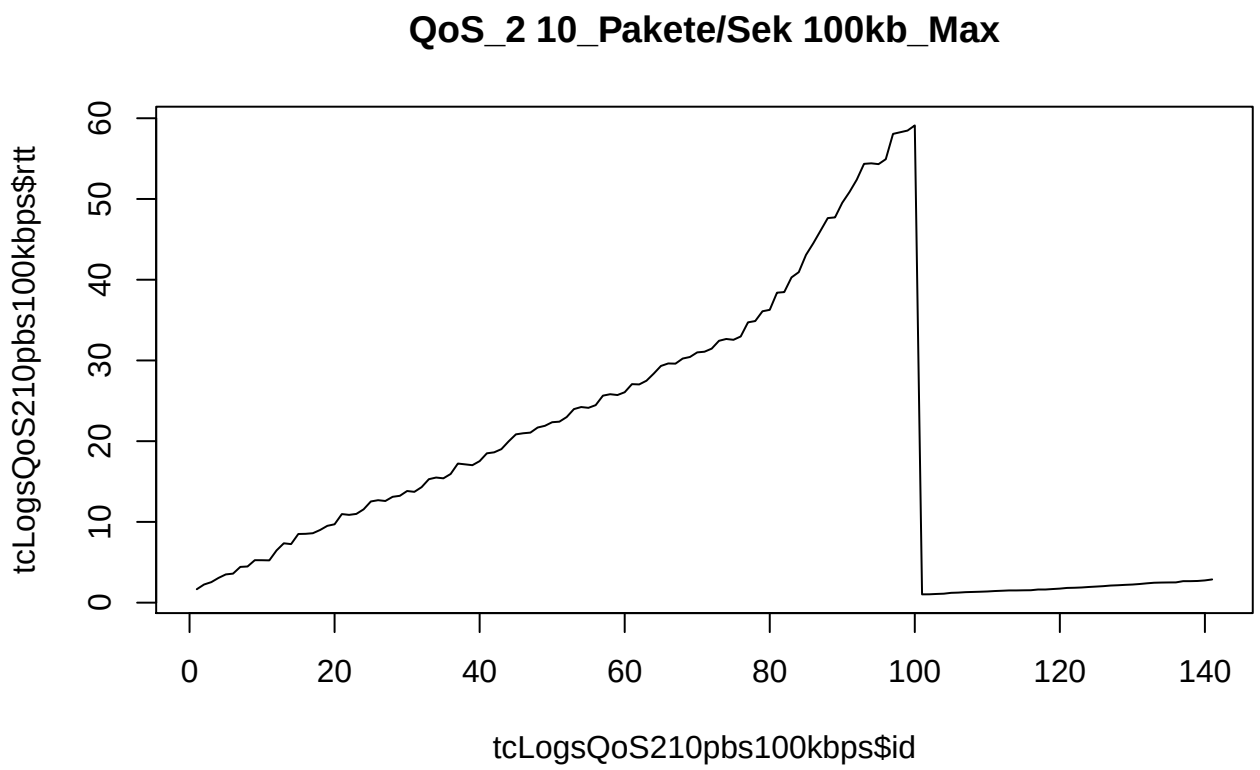



```
plot(tcLogsQoS21pbs100mbps$id, tcLogsQoS21pbs100mbps$rtt, type = "l", main = "QoS_2 1_Pakete/Sek 100mb_
```

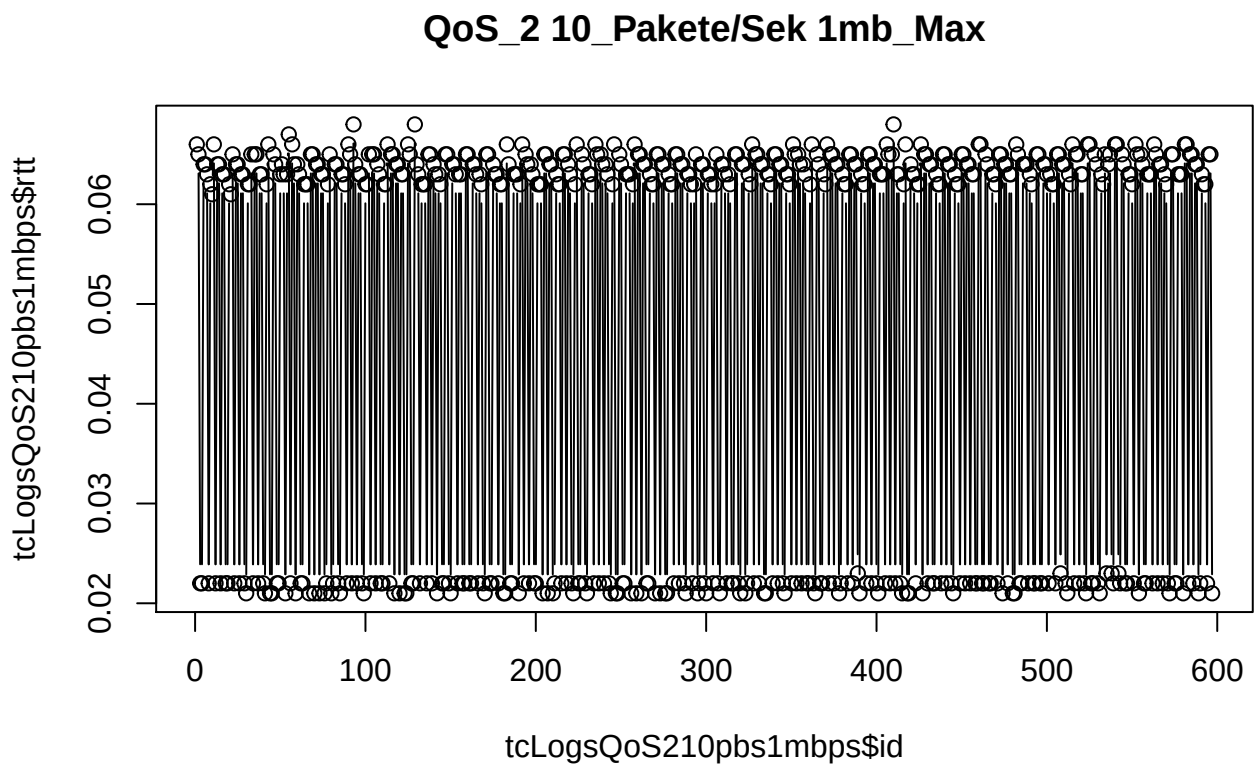



```
## QoS2_10pbs - Aufsplittung MaxDurc
tcLogsQoS210pbs10kbps<-tcLogsQoS210pbs[tcLogsQoS210pbs$MaxDurc == "10kbps",]
tcLogsQoS210pbs100kbps<-tcLogsQoS210pbs[tcLogsQoS210pbs$MaxDurc == "100kbps",]
tcLogsQoS210pbs1mbps<-tcLogsQoS210pbs[tcLogsQoS210pbs$MaxDurc == "1mbps",]
```

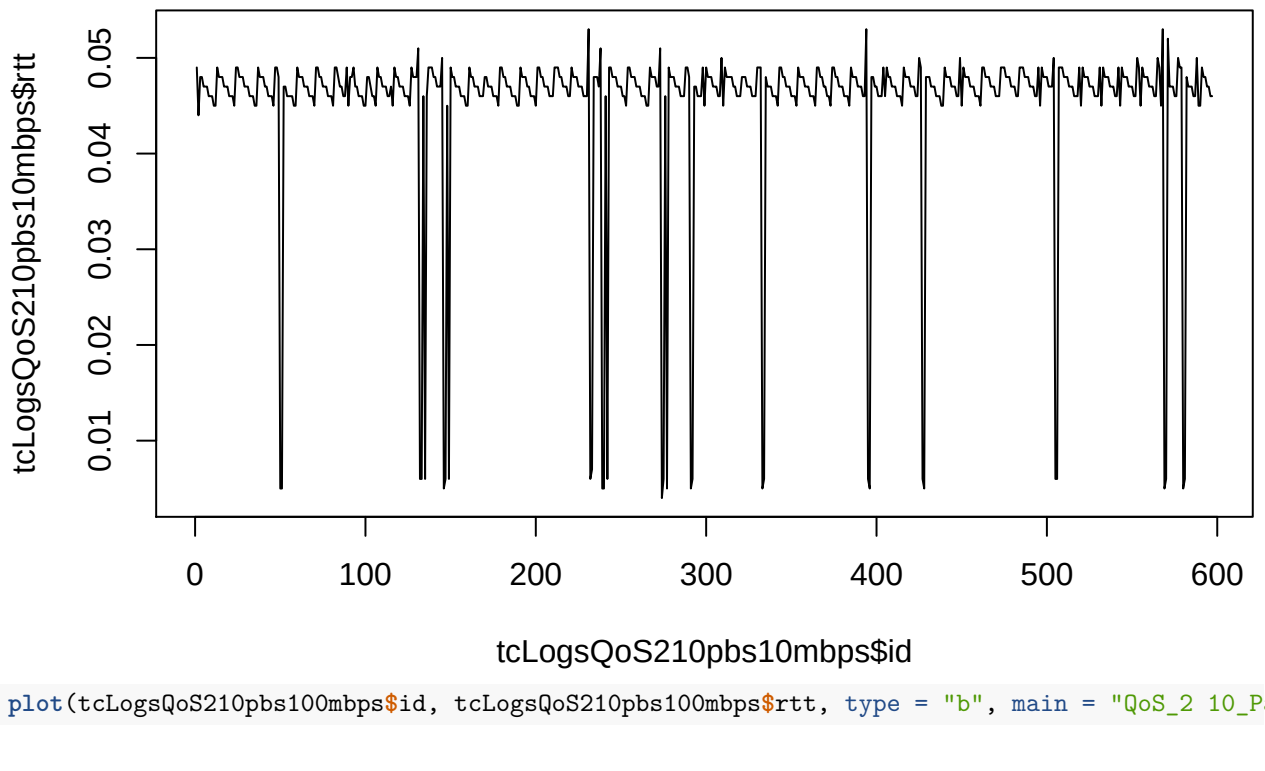
```
tcLogsQoS210pbs10mbps<-tcLogsQoS210pbs[tcLogsQoS210pbs$MaxDurc == "10mbps",]
tcLogsQoS210pbs100mbps<-tcLogsQoS210pbs[tcLogsQoS210pbs$MaxDurc == "100mbps",]

#plot(tcLogsQoS210pbs10kbps$id, tcLogsQoS210pbs10kbps$rtt, type = "l", main = "QoS_2 10_Pakete/Sek 10kb
plot(tcLogsQoS210pbs100kbps$id, tcLogsQoS210pbs100kbps$rtt, type = "l", main = "QoS_2 10_Pakete/Sek 100
```



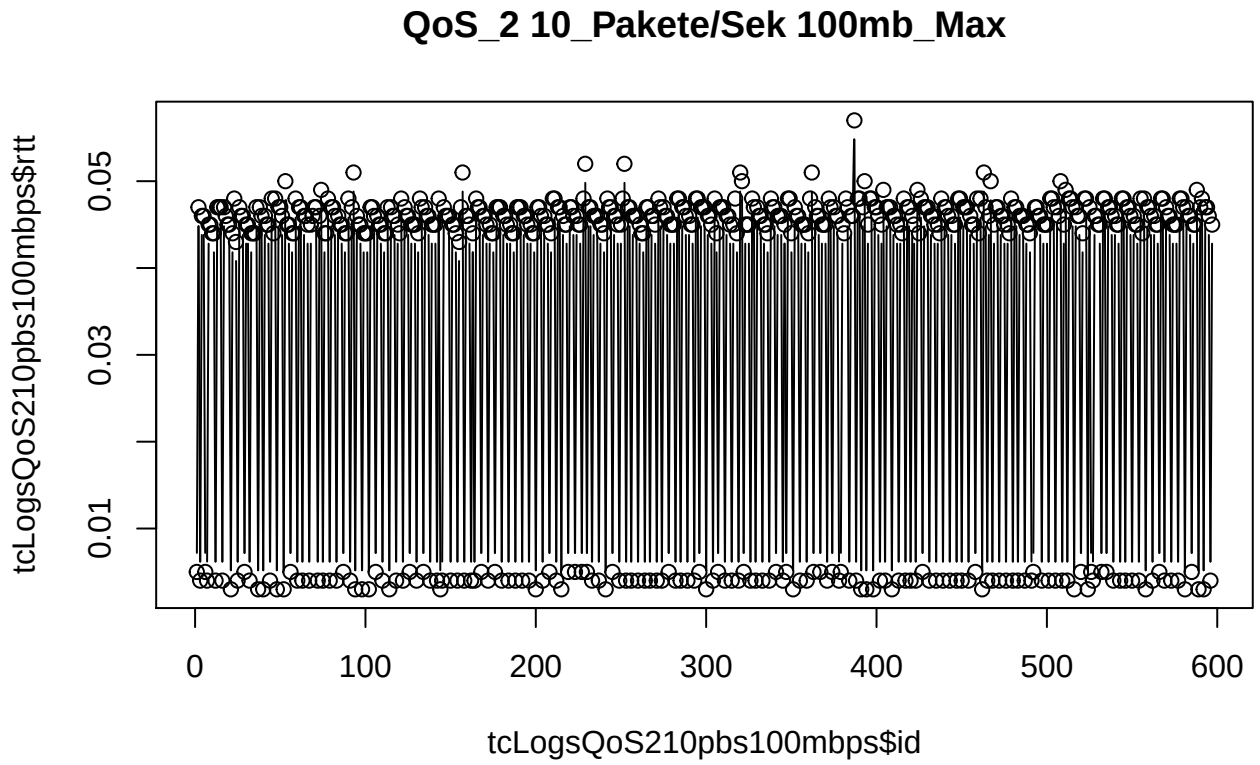

```
plot(tcLogsQoS210pbs1mbps$id, tcLogsQoS210pbs1mbps$rtt, type = "b", main = "QoS_2 10_Pakete/Sek 1mb_Max
```



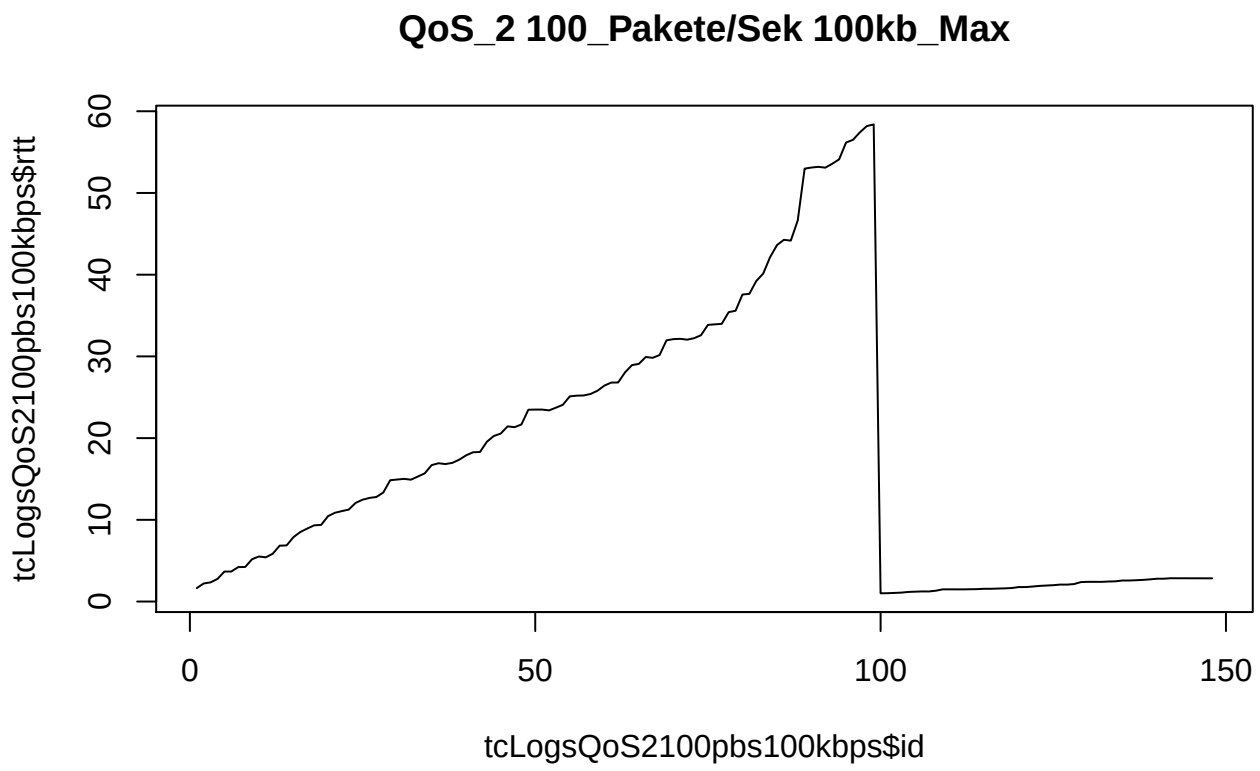

```
plot(tcLogsQoS210pbs10mbps$id, tcLogsQoS210pbs10mbps$rtt, type = "l", main = "QoS_2 10_Pakete/Sek 10mb_
```



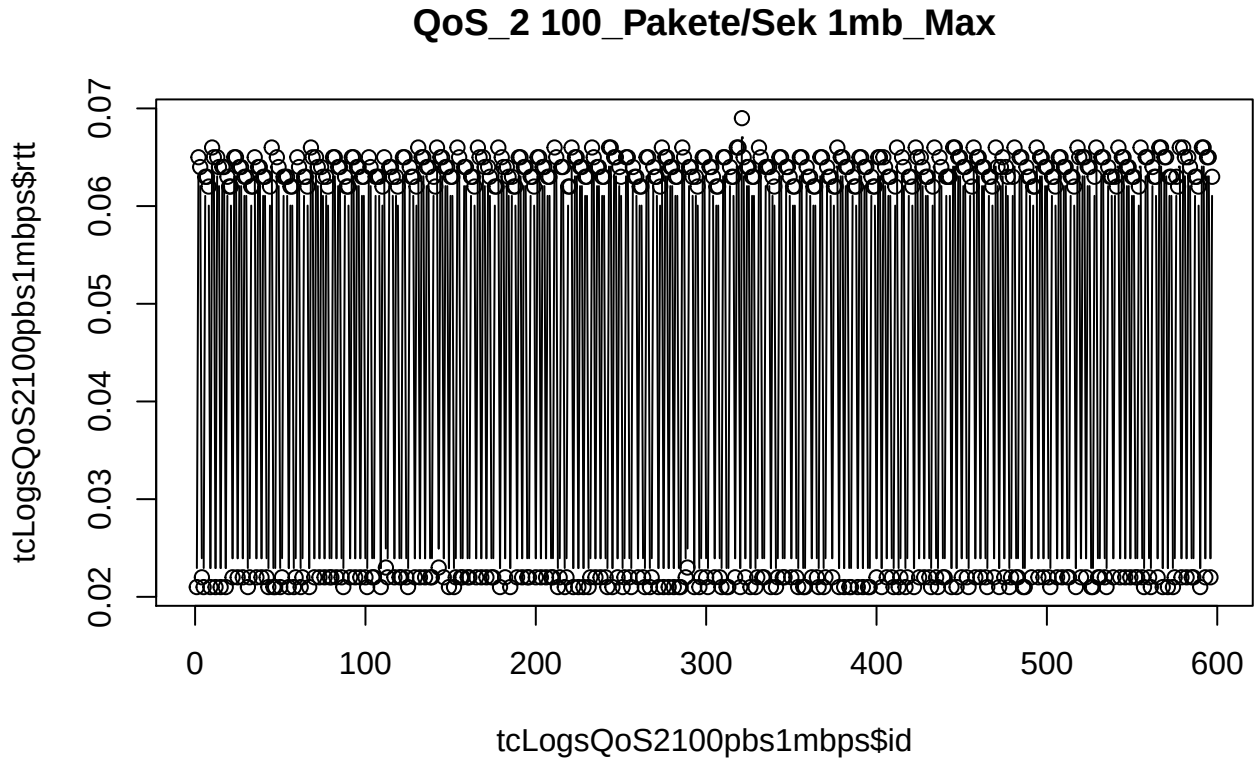

```
plot(tcLogsQoS210pbs100mbps$id, tcLogsQoS210pbs100mbps$rtt, type = "b", main = "QoS_2 10_Pakete/Sek 100m
```



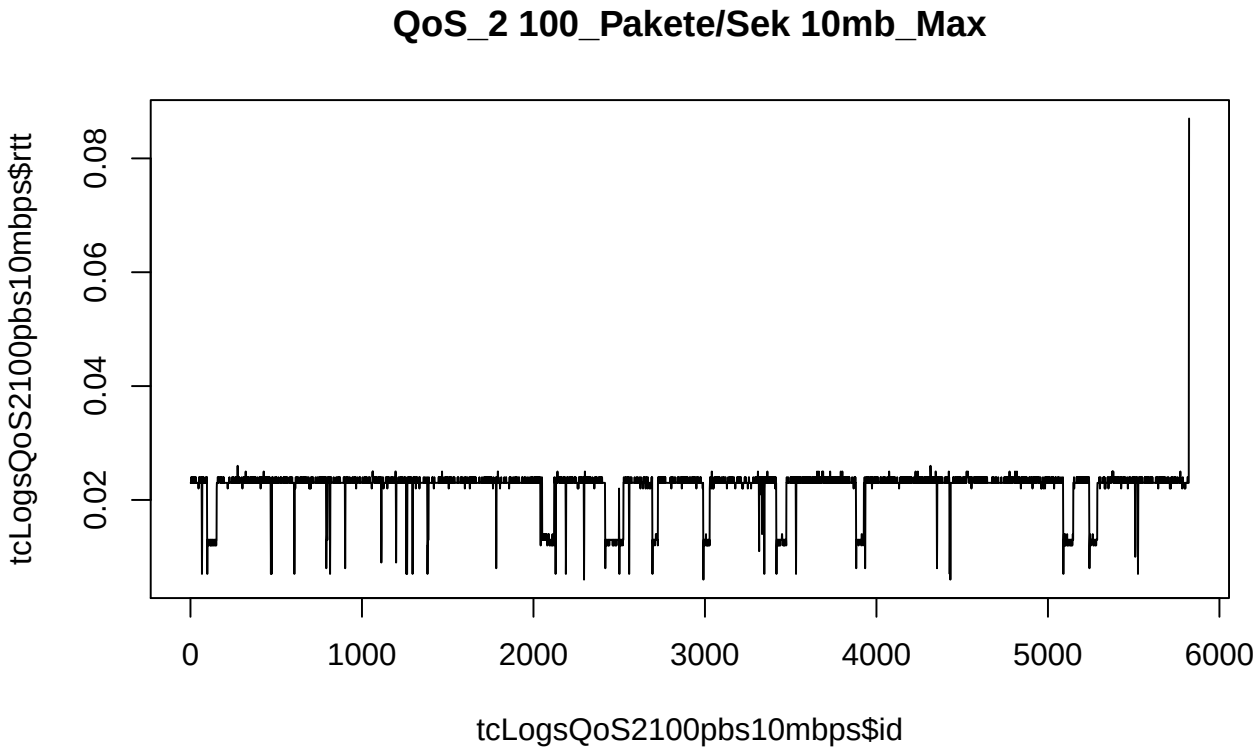

```
## QoS2_100pbs - Aufsplittung MaxDurc
tcLogsQoS2100pbs10kbps<-tcLogsQoS2100pbs[tcLogsQoS2100pbs$MaxDurc == "10kbps",]
tcLogsQoS2100pbs100kbps<-tcLogsQoS2100pbs[tcLogsQoS2100pbs$MaxDurc == "100kbps",]
tcLogsQoS2100pbs1mbps<-tcLogsQoS2100pbs[tcLogsQoS2100pbs$MaxDurc == "1mbps",]
tcLogsQoS2100pbs10mbps<-tcLogsQoS2100pbs[tcLogsQoS2100pbs$MaxDurc == "10mbps",]
tcLogsQoS2100pbs100mbps<-tcLogsQoS2100pbs[tcLogsQoS2100pbs$MaxDurc == "100mbps",]

#plot(tcLogsQoS2100pbs10kbps$id, tcLogsQoS2100pbs10kbps$rtt, type = "l", main = "QoS_2 100_Pakete/Sek 1
plot(tcLogsQoS2100pbs100kbps$id, tcLogsQoS2100pbs100kbps$rtt, type = "l", main = "QoS_2 100_Pakete/Sek
```




```
plot(tcLogsQoS2100pbs1mbps$id, tcLogsQoS2100pbs1mbps$rtt, type = "b", main = "QoS_2 100_Pakete/Sek 1mb_
```




```
plot(tcLogsQoS2100pbs10mbps$id, tcLogsQoS2100pbs10mbps$rtt, type = "l", main = "QoS_2 100_Pakete/Sek 10
```




```
plot(tcLogsQoS2100pbs100mbps$id, tcLogsQoS2100pbs100mbps$rtt, type = "b", main = "QoS_2 100_Pakete/Sek
```