



QUALCOMM RepeaterOne Technologies

Reverse Link Traffic Estimation

80-W0838-1 Rev A

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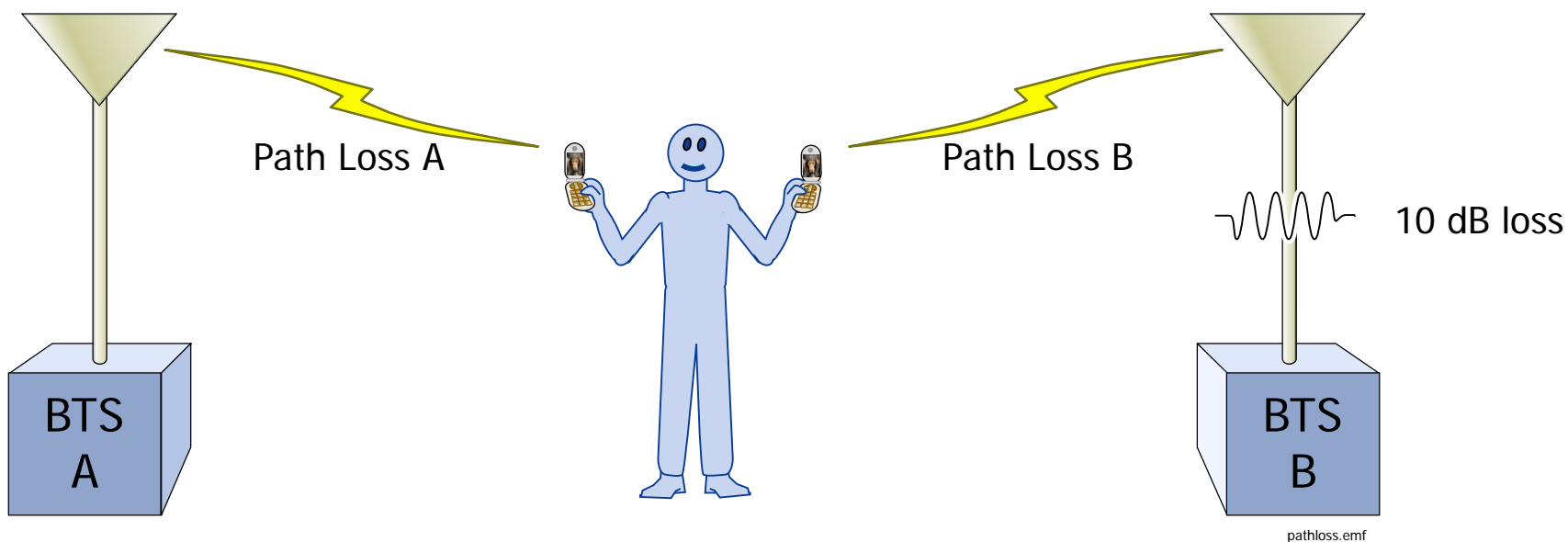
Traffic Estimation

- Desire to measure and report the traffic carried by the repeater
- Embed CSM chip in repeater and demod Reverse links
 - Expensive
 - Would only “see” activity on R-ACH
 - Long code mask for R-ACH is public
 - Long code mask for Traffic is only known to Mobile and BTS, not repeater
 - Are Access Probes one call or multiple calls?
 - No traffic duration information
- Measure Rise over Thermal in repeater Reverse Link
 - Low Cost
 - Accuracy of estimate issues when number of users is small



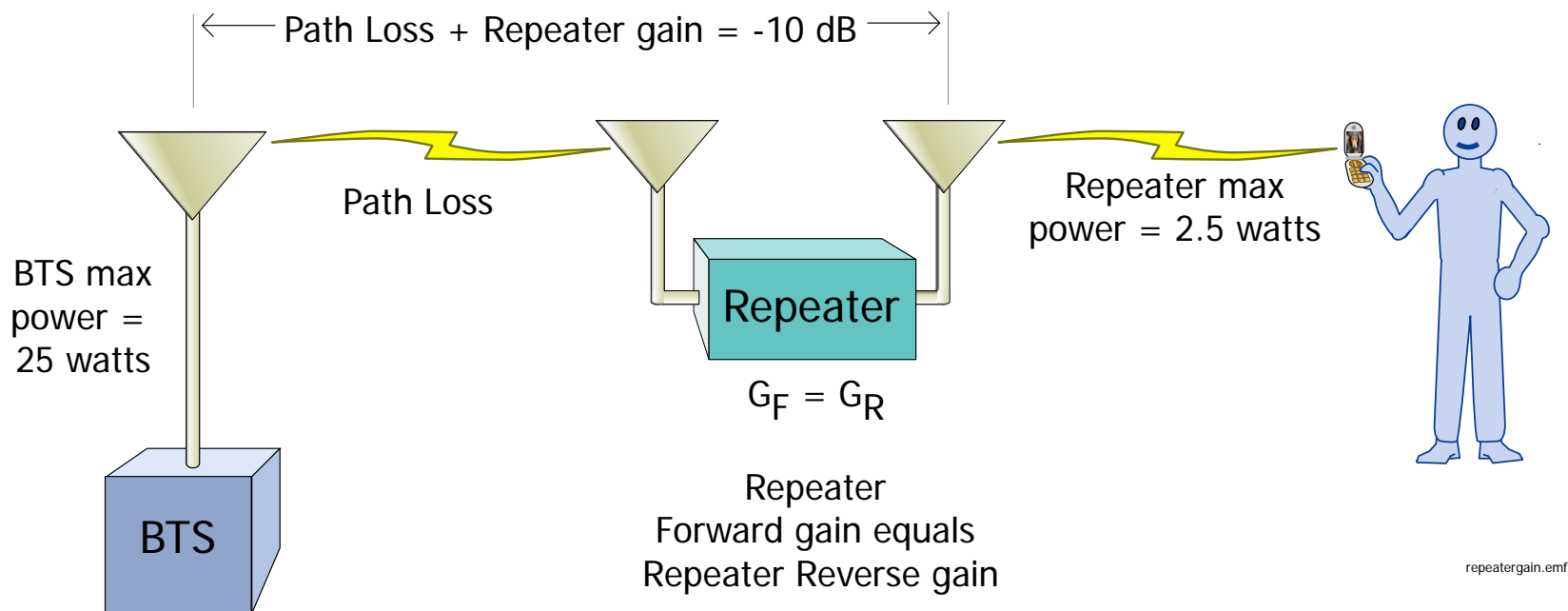
The Reverse Link Operating Point

If Path Loss A = Path Loss B, phone B has to transmit 10 dB more power for same FER





The Total Gain is less than 1





RoT Traffic Estimation

- By measuring the Reverse link Rise over Thermal (RoT) it is possible to estimate the traffic
- The output power (gain) of the repeater effects the Reverse link operating point
 - Overall gain of Path Loss + Repeater Gain is < 1
 - Typical gain is -30dB to -10dB
- RoT really estimates channel load, not number of users
 - High speed data looks like a large number of users
 - Pedestrian users show less load than mobile users
- By assuming channel conditions and call type you can estimate traffic
 - Example – RC3 / 30km/hr Mobile users require Eb/No of 5.7dB



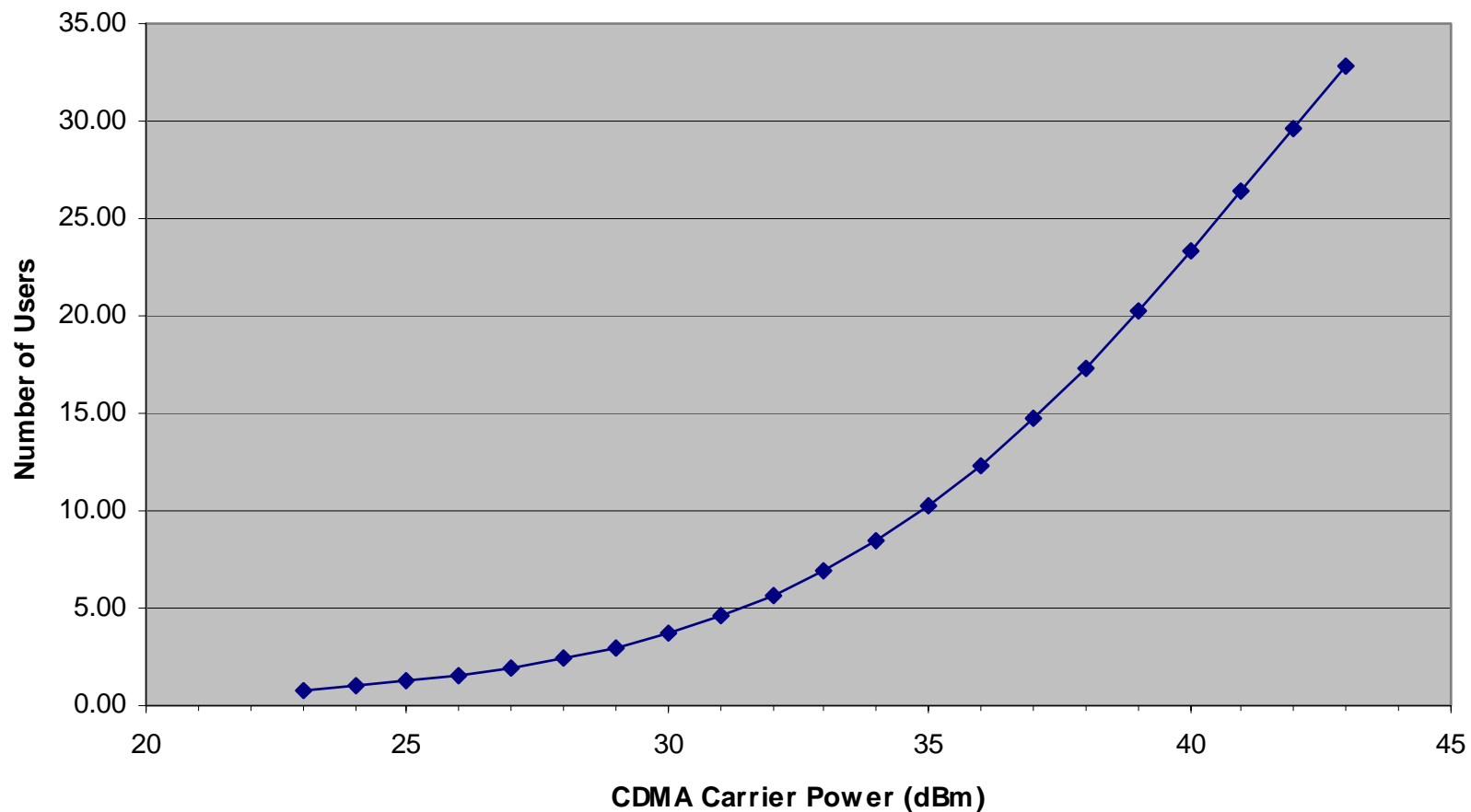
Thermal Floor

- Higher Power repeaters require more gain
 - More gain means thermal noise floor increases
 - Higher thermal noise floor “hides” the first few users of the sector
- Slide 7 shows the “floor” value (a 3dB rise) for different power repeaters
 - Note that the power is per carrier, not the maximum total output power
 - The slide assumes a RC3, 8K Voice, Mobile 30km/h environment
- Slide 8 shows the complete RoT curve for a 2 watt per carrier repeater
 - Assuming a 2dB rise is reliably detectable in the repeater, the estimate floor is 4 users under these conditions



3dB RoT vs. CDMA Carrier Power

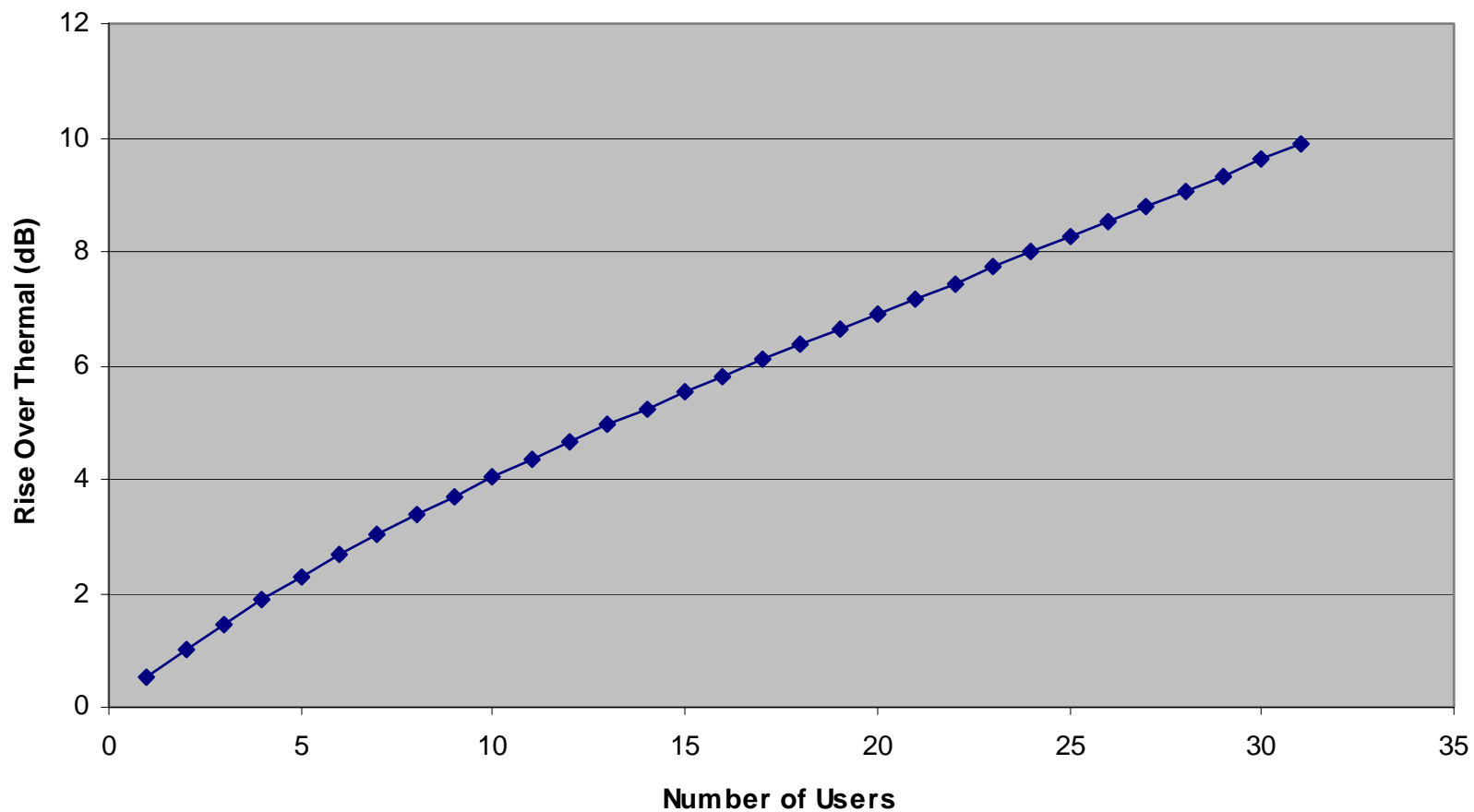
Number of Users for 3 dB ROT
RC3: 30 km/h, 1path, Eb/No=5.7 dB





2 Watt per Carrier Example

Repeater Output Power for 2W CDMA Carrier
RC3: 30 km/h, 1 path, Eb/No=5.7 dB





RoT Comparison

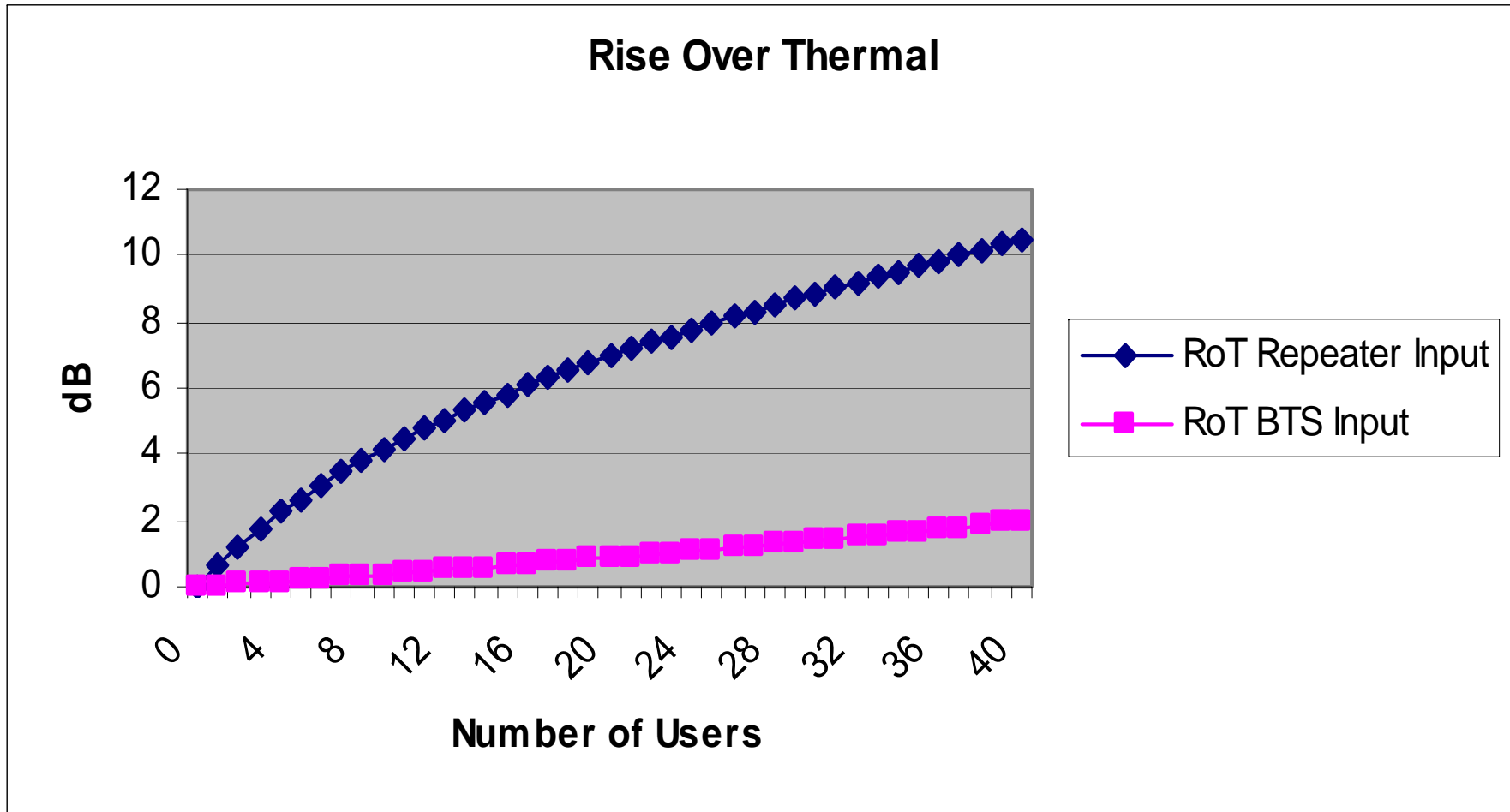


Chart Assumptions: AWGN, Isolated sector, 25Watt BTS, 2.5W Repeater, $N_{BTS} = N_R = 4\text{dB}$



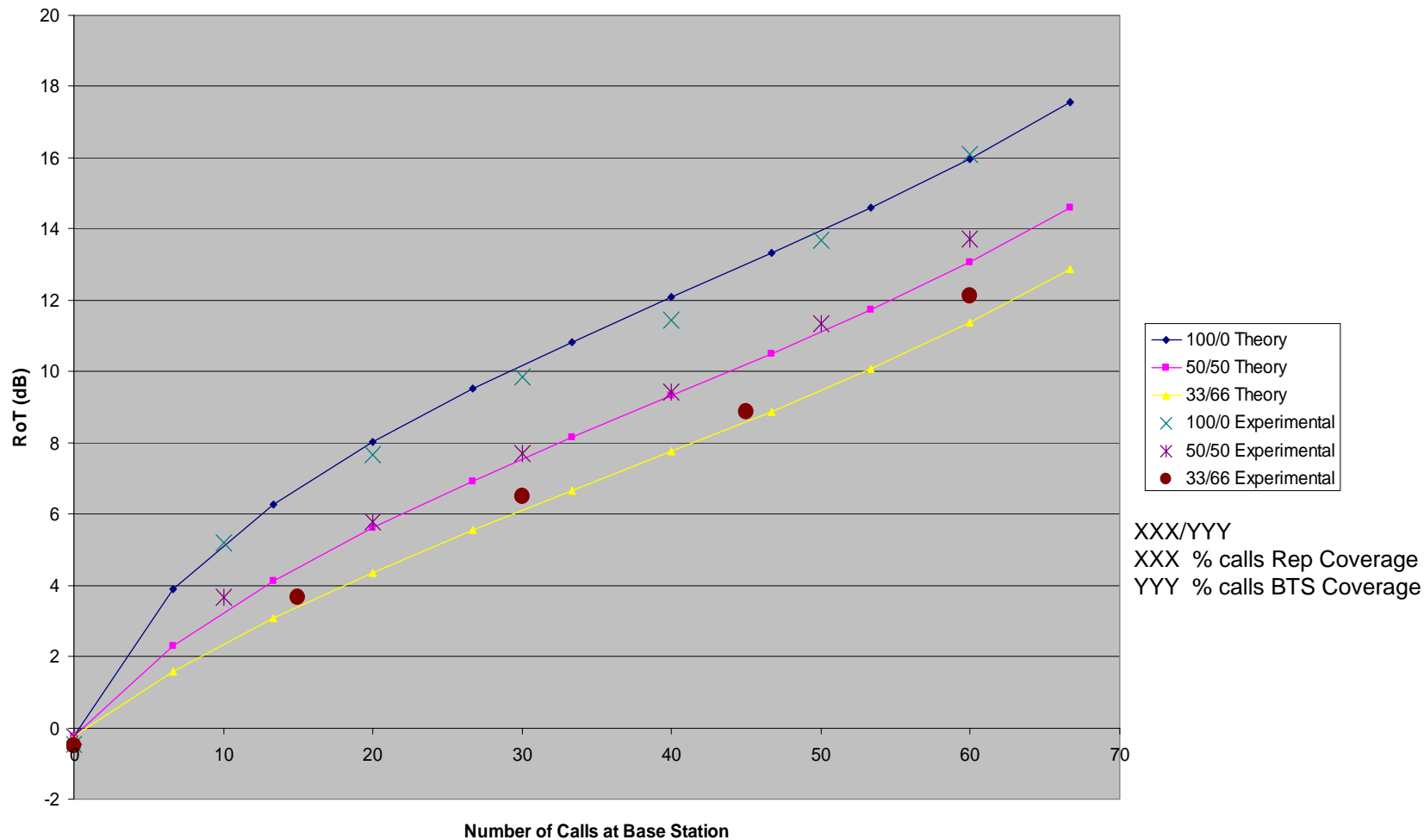
Repeater/BTS Load Curves

- Repeater RoT changes slightly as a fraction of BTS load. Different curves are required for different BTS loads.
- For BTS loads up to 50% of call Blocking, little difference in RoT curves
- Knowing the Number of Calls at the BTS, you can back out the true repeater load.



RoT vs BTS Call Load

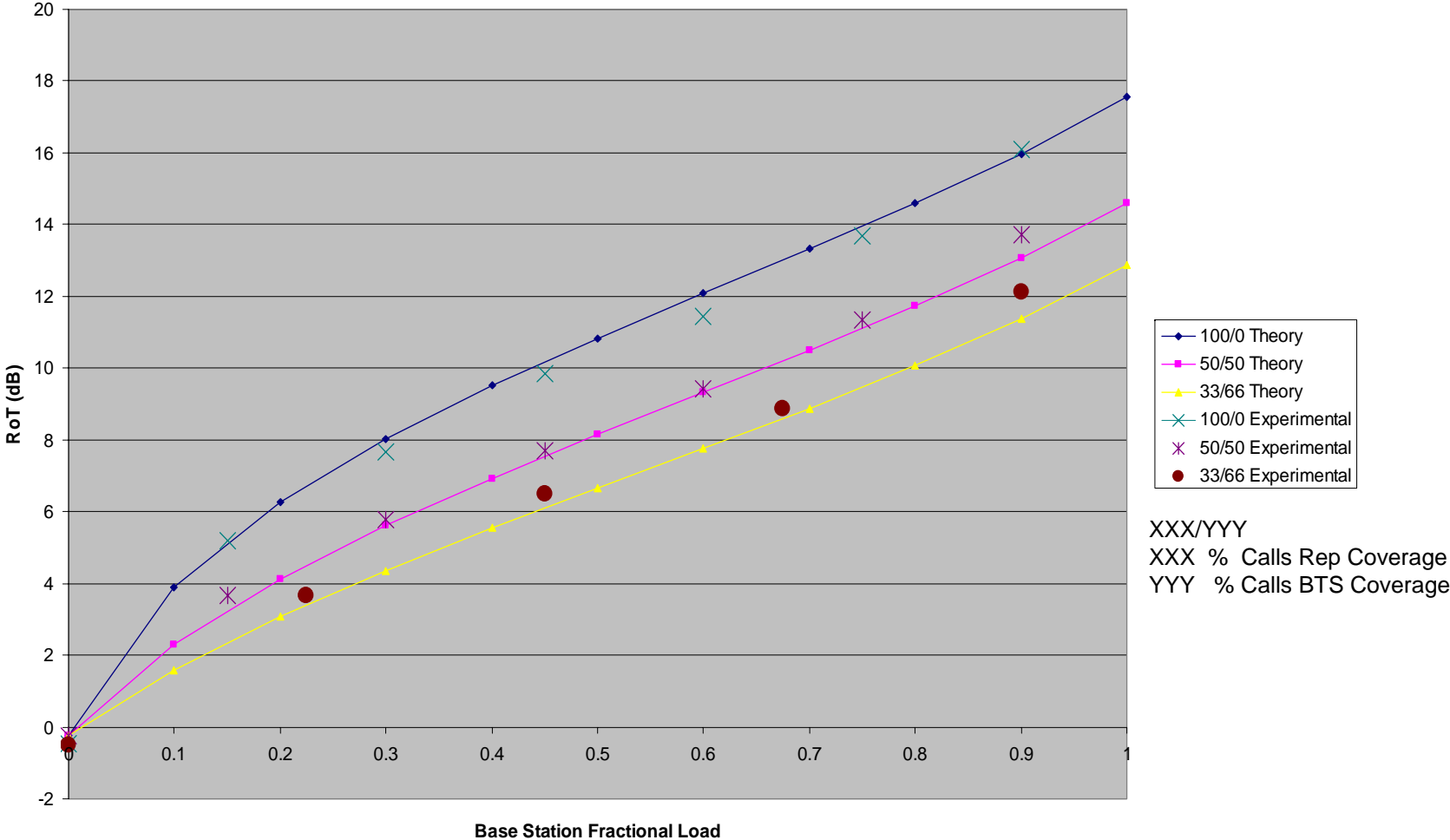
RoT vs. BTS Call Load





RoT vs BTS Load

RoT vs. BTS Load for Various Repeater Loads





RoT Summary

- RoT measures Channel Loading , not individual users
 - Can infer number of users
 - How to count one high speed Data user?
 - Really better to understand the impact to channel loading and measure “call equivalents”
- RoT is low cost and simple
- Estimate floor depends on repeater power
 - Less useful for large outdoor repeaters
 - Accurate for low power repeaters
- Protected by IPR
- See WWW.RepeaterOne.com for more information

