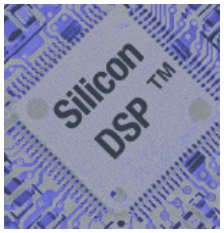
Two Ray Multipath Model



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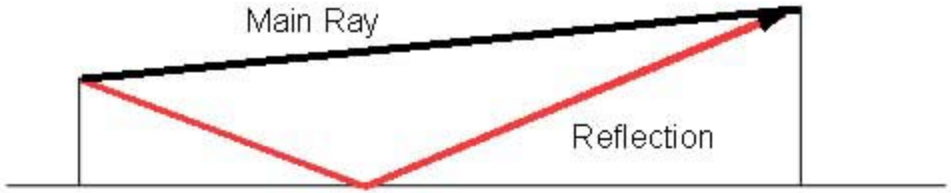
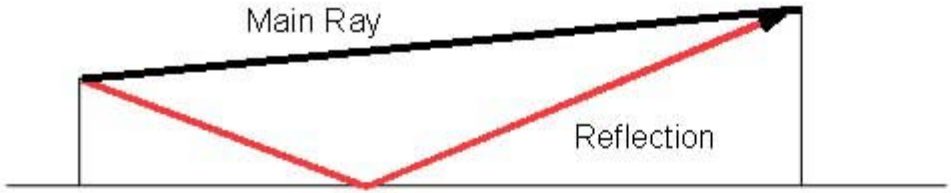
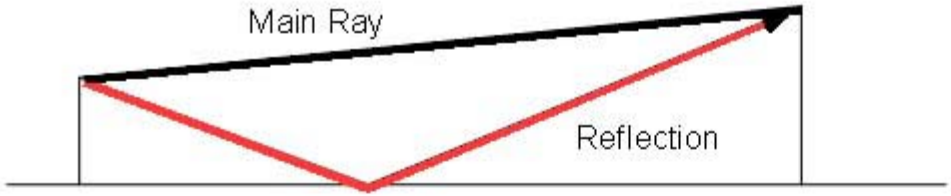


$$s(t) = \delta(t) + \alpha\delta(t - \tau_d)$$



$$s(t) = \delta(t) + \alpha\delta(t - \tau_d)$$

$$S(f) = 1 + \alpha e^{j2\pi f\tau_d}$$

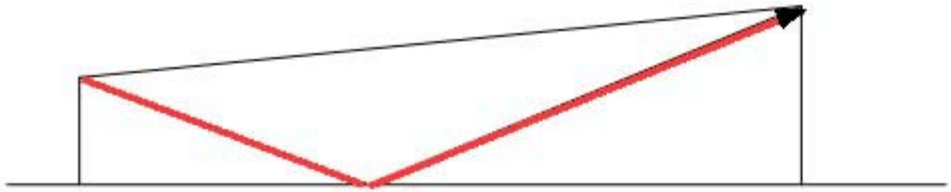


$$s(t) = \delta(t) + \alpha\delta(t - \tau_d)$$

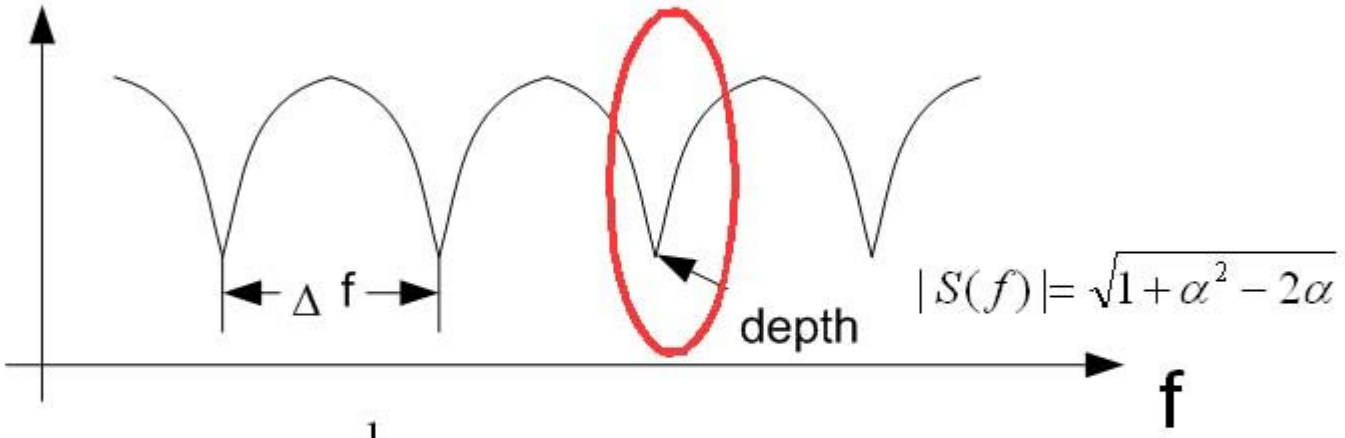
$$S(f) = 1 + \alpha e^{j2\pi f\tau_d}$$

$$S(f) = 1 + \alpha\cos(2\pi f\tau_d) + j\alpha\sin(2\pi f\tau_d)$$

$$|S(f)|^2 = 1 + \alpha^2 + 2\alpha\cos(2\pi f\tau_d)$$



Magnitude



$$|S(f)| = \sqrt{1+\alpha^2-2\alpha}$$

$$\Delta f = \frac{1}{\tau_d}$$

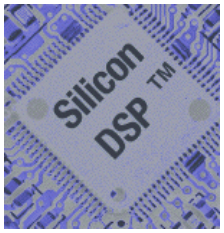
$$s(t) = \delta(t) + \alpha\delta(t-\tau_d)$$

$$S(f) = 1 + \alpha e^{j2\pi f\tau_d}$$

$$|S(f)|^2 = 1 + \alpha^2 + 2\alpha\cos(2\pi f\tau_d)$$

$$S(f) = 1 + \alpha\cos(2\pi f\tau_d) + j\alpha\sin(2\pi f\tau_d)$$

Multipath Fading Channel



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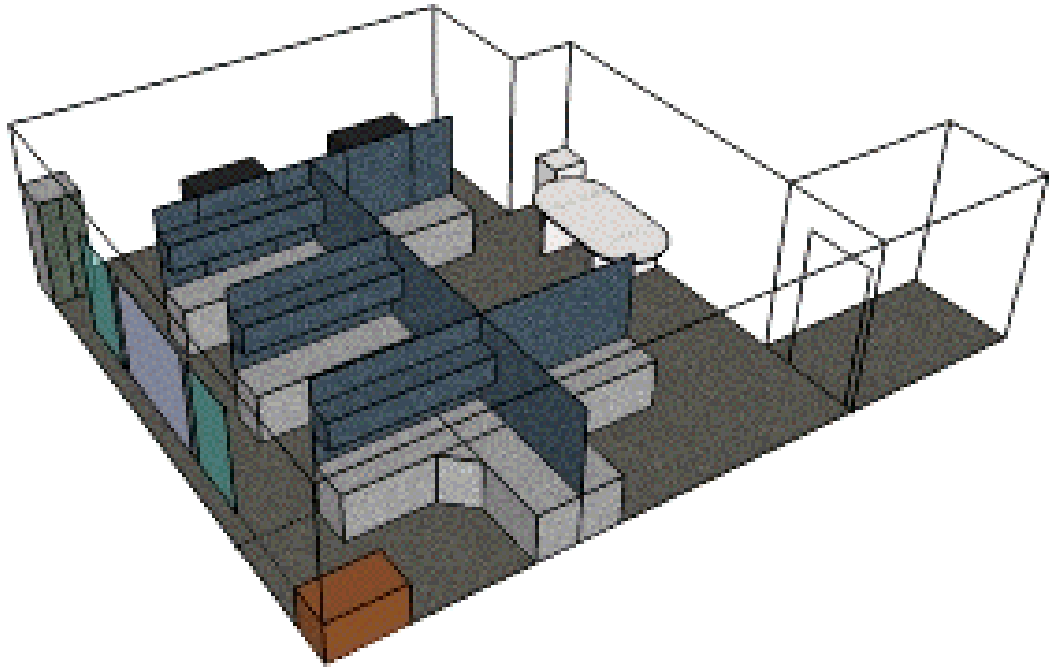
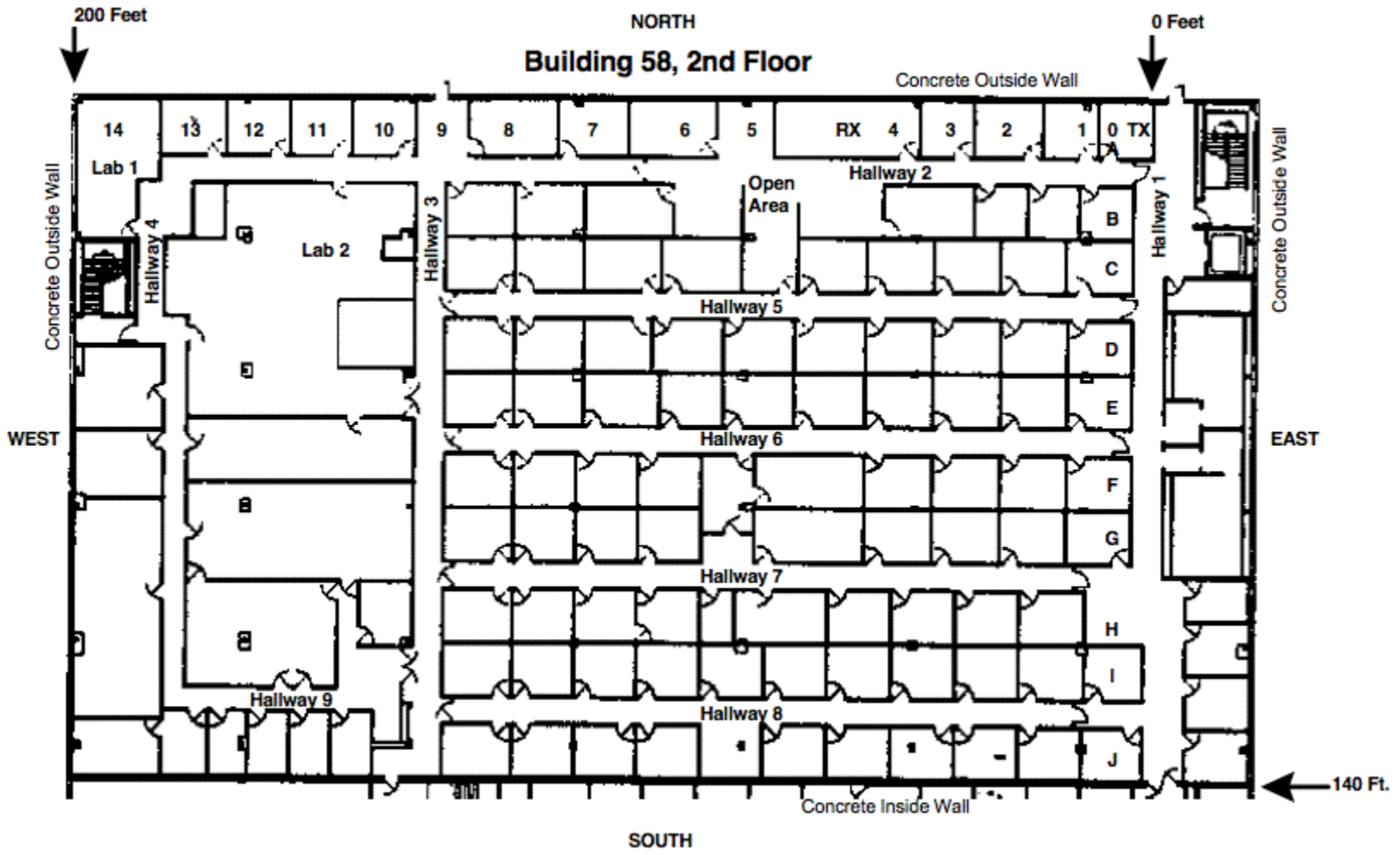
Small Office Environment



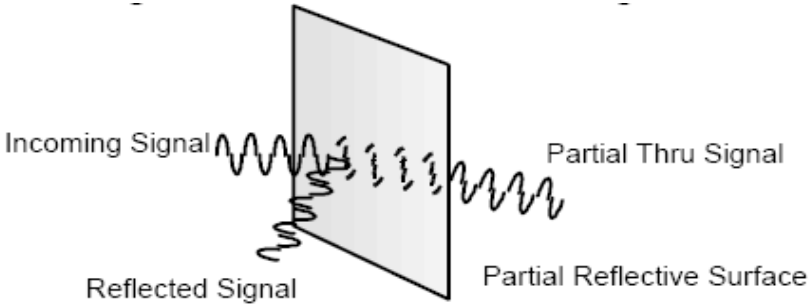
Google Images

Large Office Environment

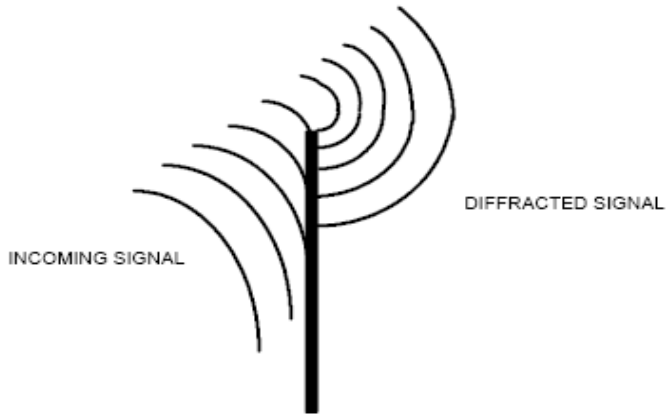


Indoor Radio WLAN Performance
Part II: Range Performance in a Dense Office Environment

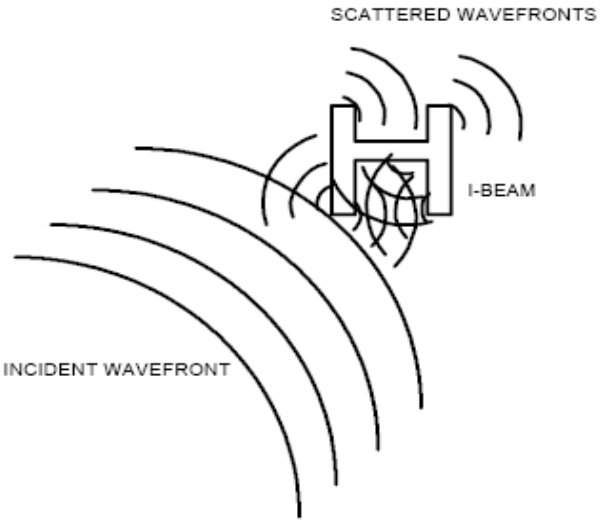
John C. Stein
Intersil Corporation, 2401 Palm Bay, Florida 32905



Reflection and Pass Thru



Diffraction



Scattering

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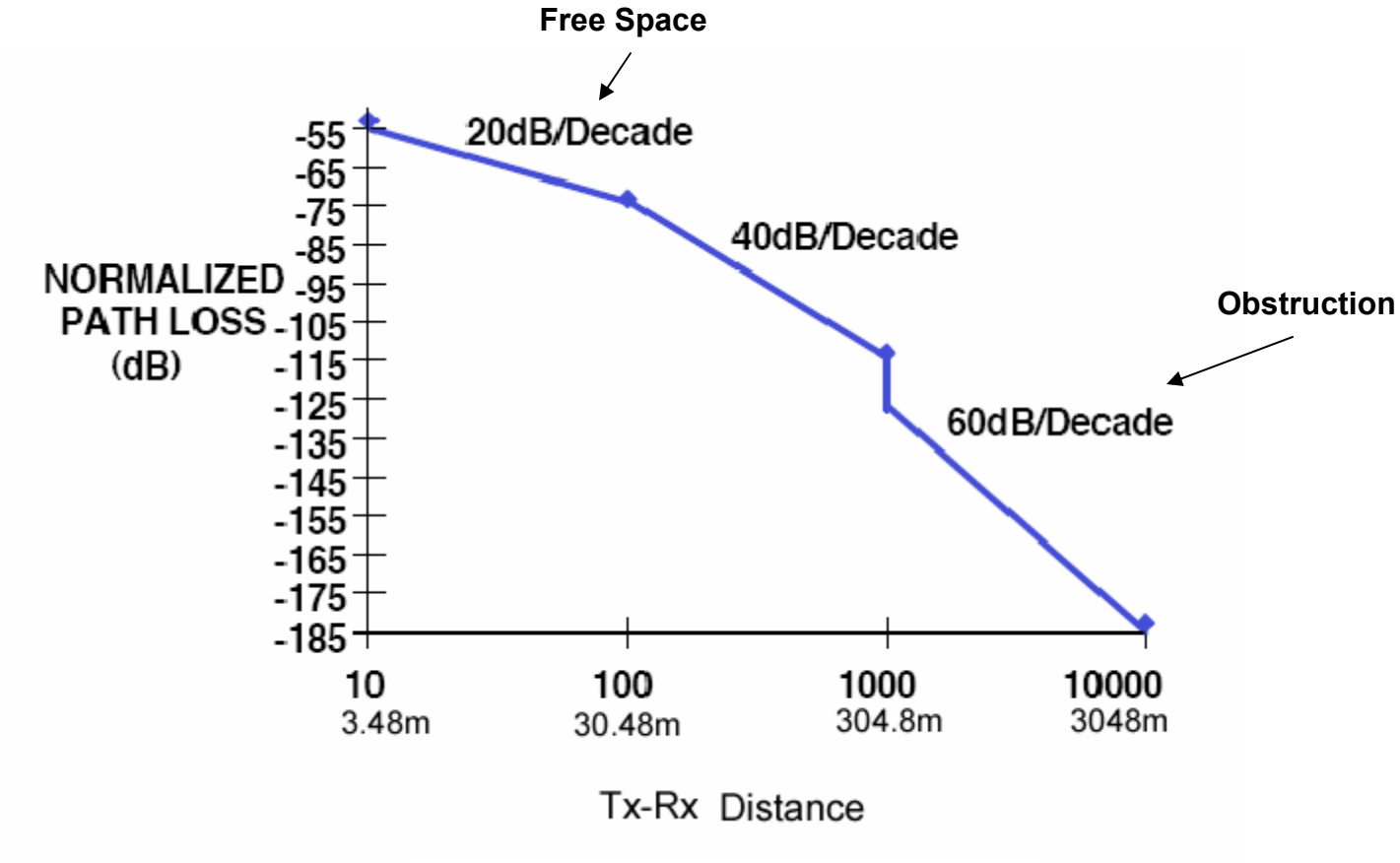
John C. Stein
Intersil Corporation, 2401 Palm Bay, Florida 32905

$$\text{free space loss} = \left(\frac{4\pi d}{\lambda}\right)^2 = \left(\frac{4\pi df}{c}\right)^2$$

d in meters

f in GHz

$$\text{FSL(dB)} \approx 20log_{10}(d) + 20log_{10}(f) + 32.45$$



2.4GHz Typical Path Loss

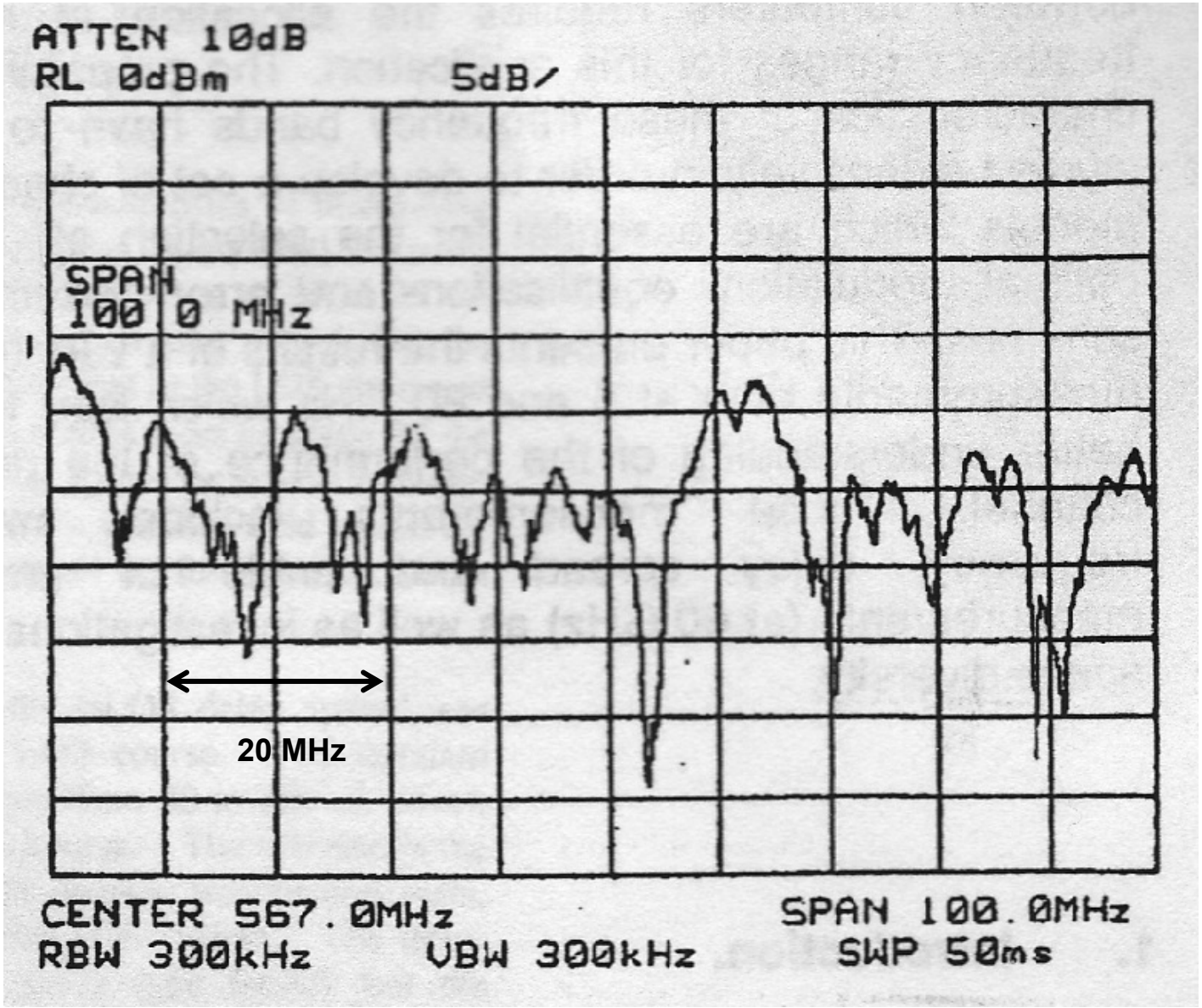
Indoor Radio WLAN Performance
Part II: Range Performance in a Dense Office Environment

John C. Stein
Intersil Corporation, 2401 Palm Bay, Florida 32905

Theodore S. Rappaport, *Wireless Communications Principles and Practice*, IEEE Press/Prentice Hall PTR, Upper Saddle River, New Jersey, 1996

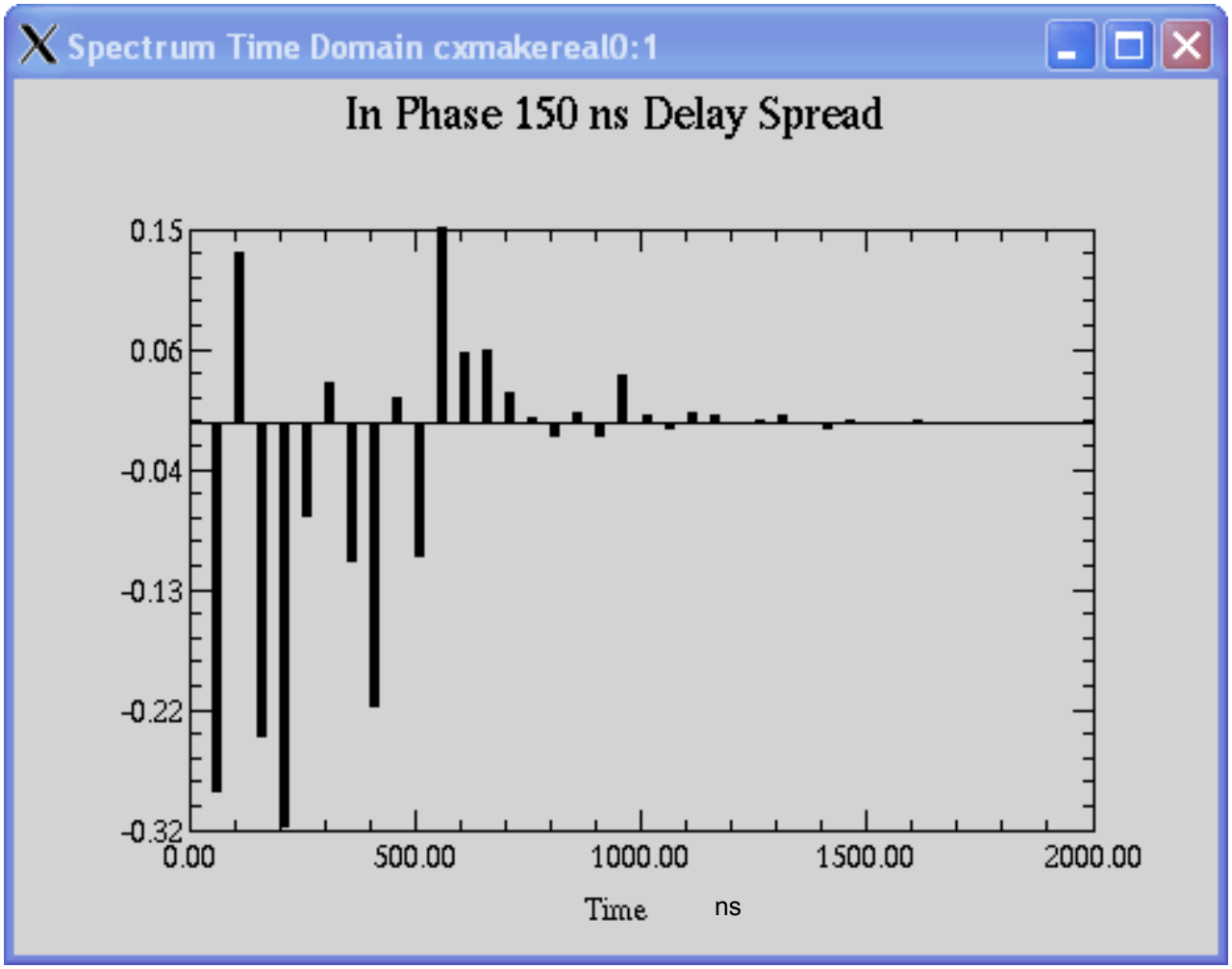
A. Santamaria Lopez-Hernandez (Editors), *Wireless LAN Systems*, Artech House, 685 Canton Street, Norwood, MA 02062

Measured Channel 5GHz

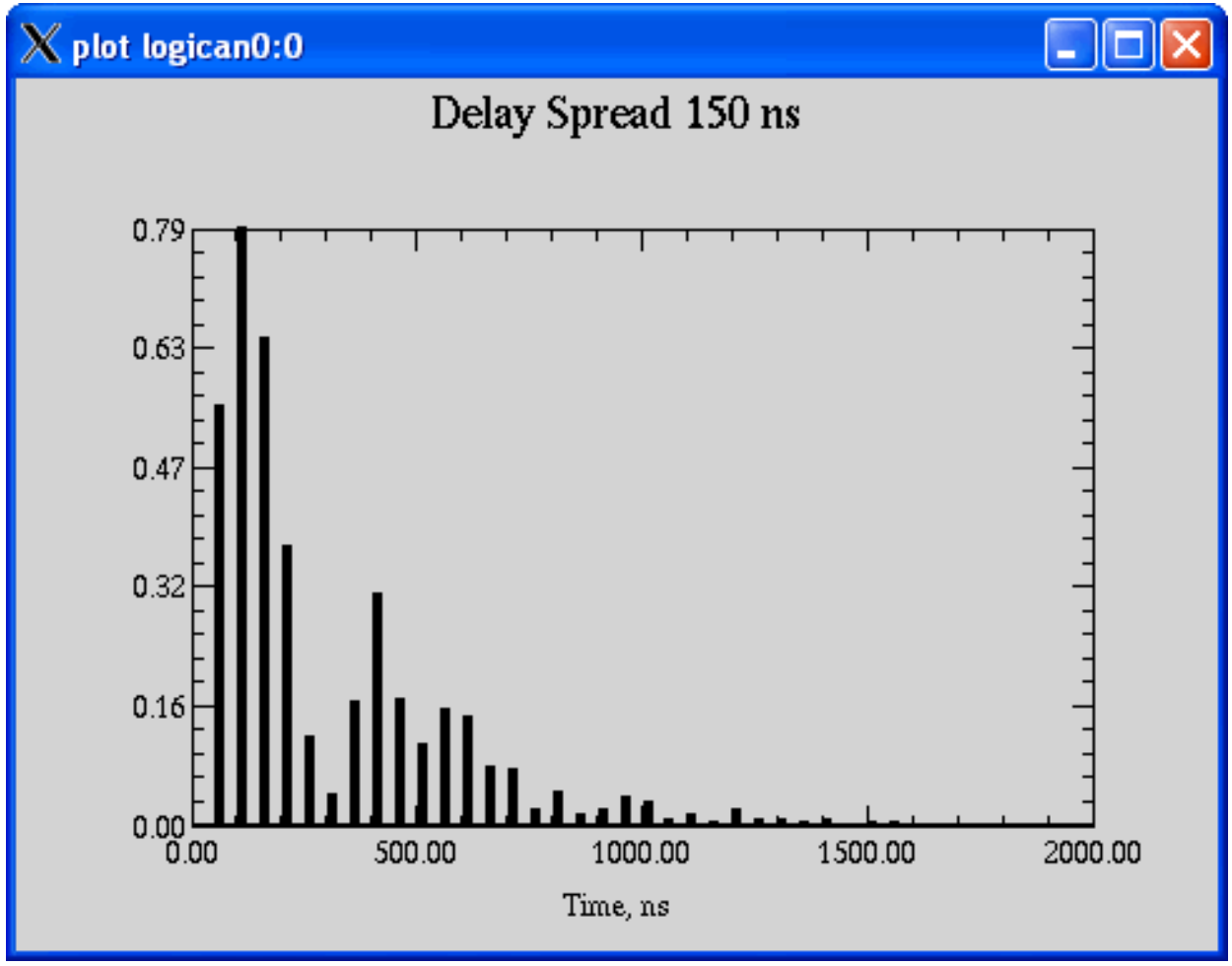


Ref: Indoor and Outdoor Propagation Measurements at 5 and 60 GHz for Radio LAN Application, A. Plattner, N. Prediger, W Herzig, Deutsche Aerospace ULM, Germany, 1993 IEEE MTT-S Digest

Multipath Impulse Response In-Phase



Power Delay Profile



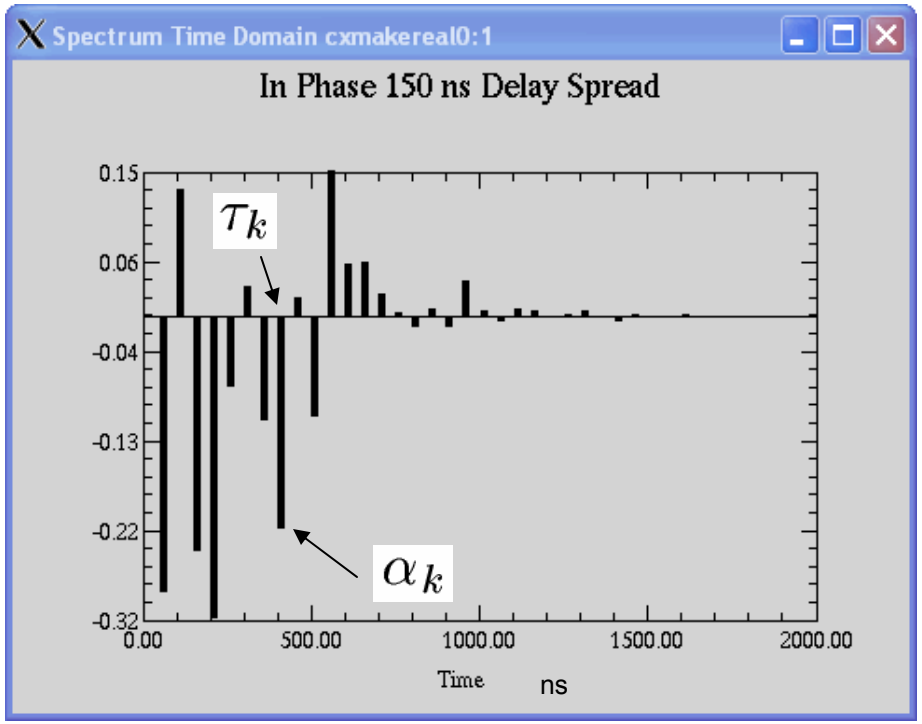
Mean Excess Delay

$$\overline{\tau} = \frac{\sum_k \alpha_k^2 \tau_k}{\sum_k \alpha_k^2}$$

RMS Delay Spread

$$\sigma_\tau = \sqrt{\overline{\tau^2} - (\overline{\tau})^2}$$

$$\overline{\tau^2} = \frac{\sum_k \alpha_k^2 \tau_k^2}{\sum_k \alpha_k^2}$$

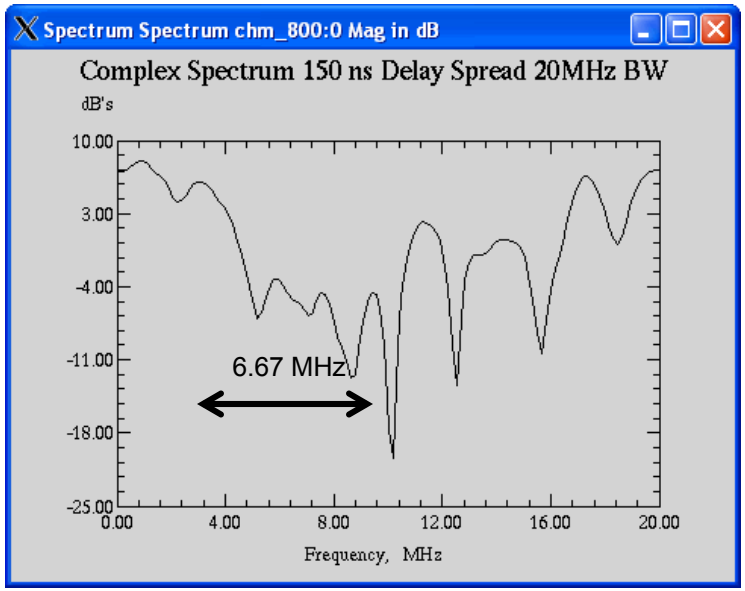


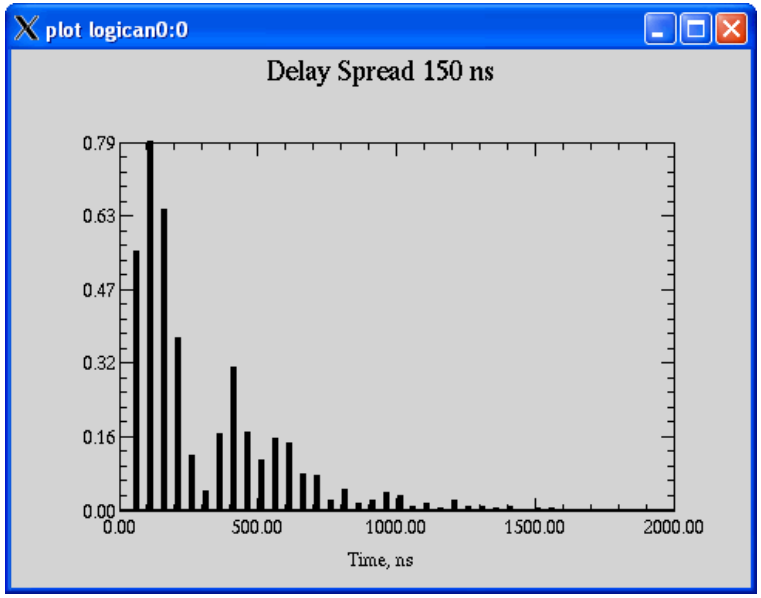
Coherence Bandwidth

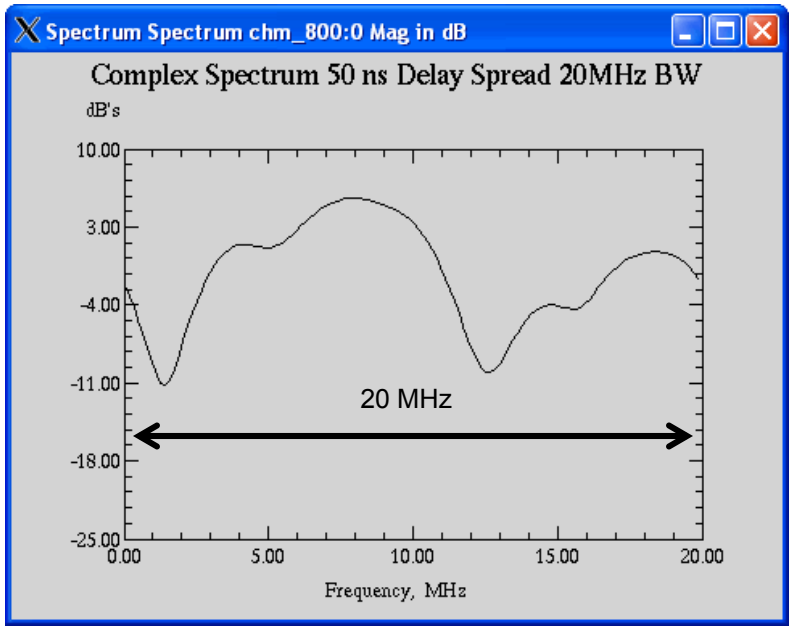
σ_τ RMS Delay Spread

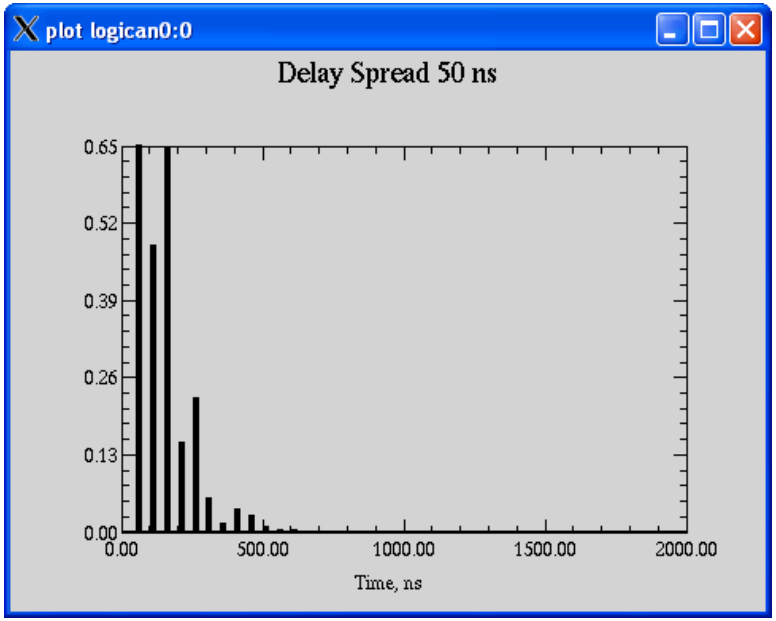
$$B_c = \frac{1}{\beta}\frac{1}{\sigma_\tau}$$

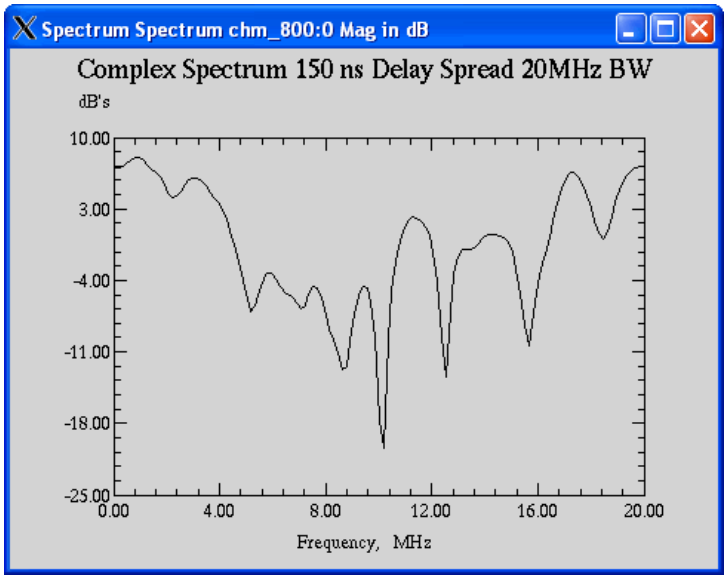
$$\beta = 5$$

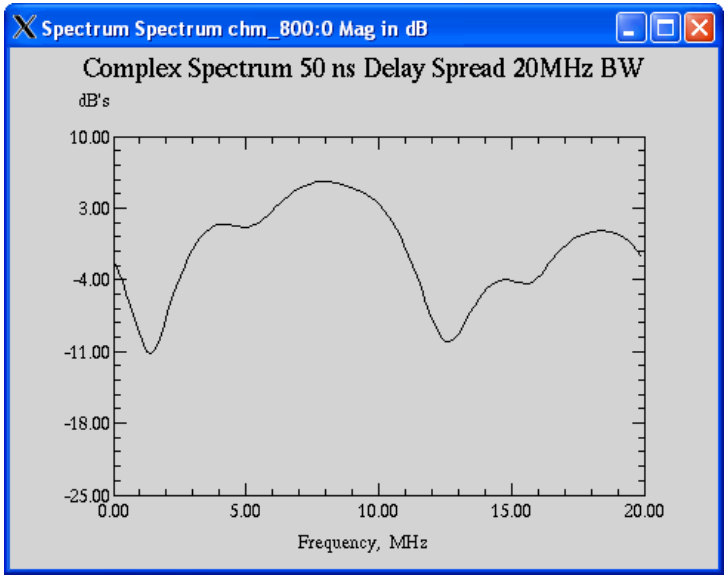


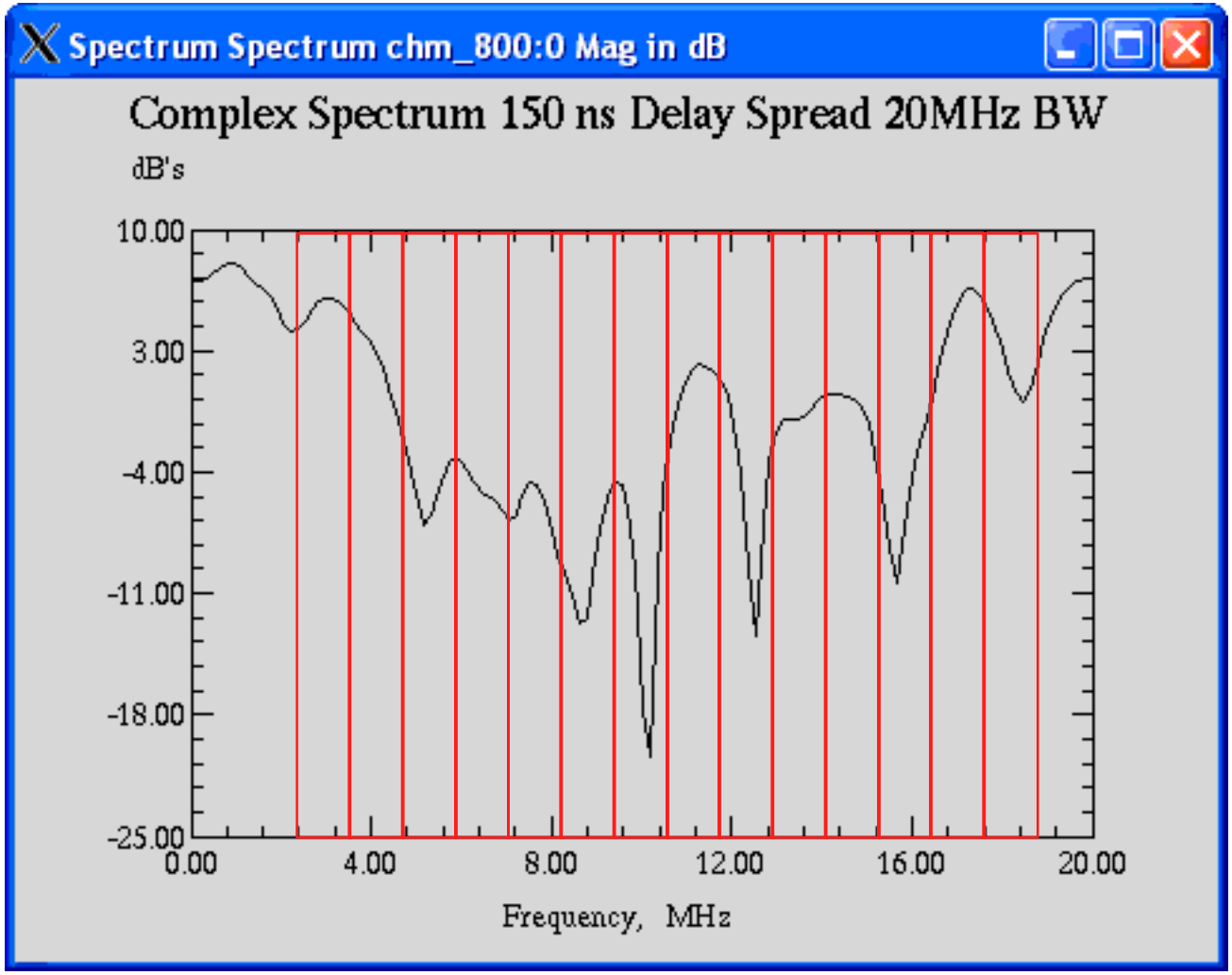


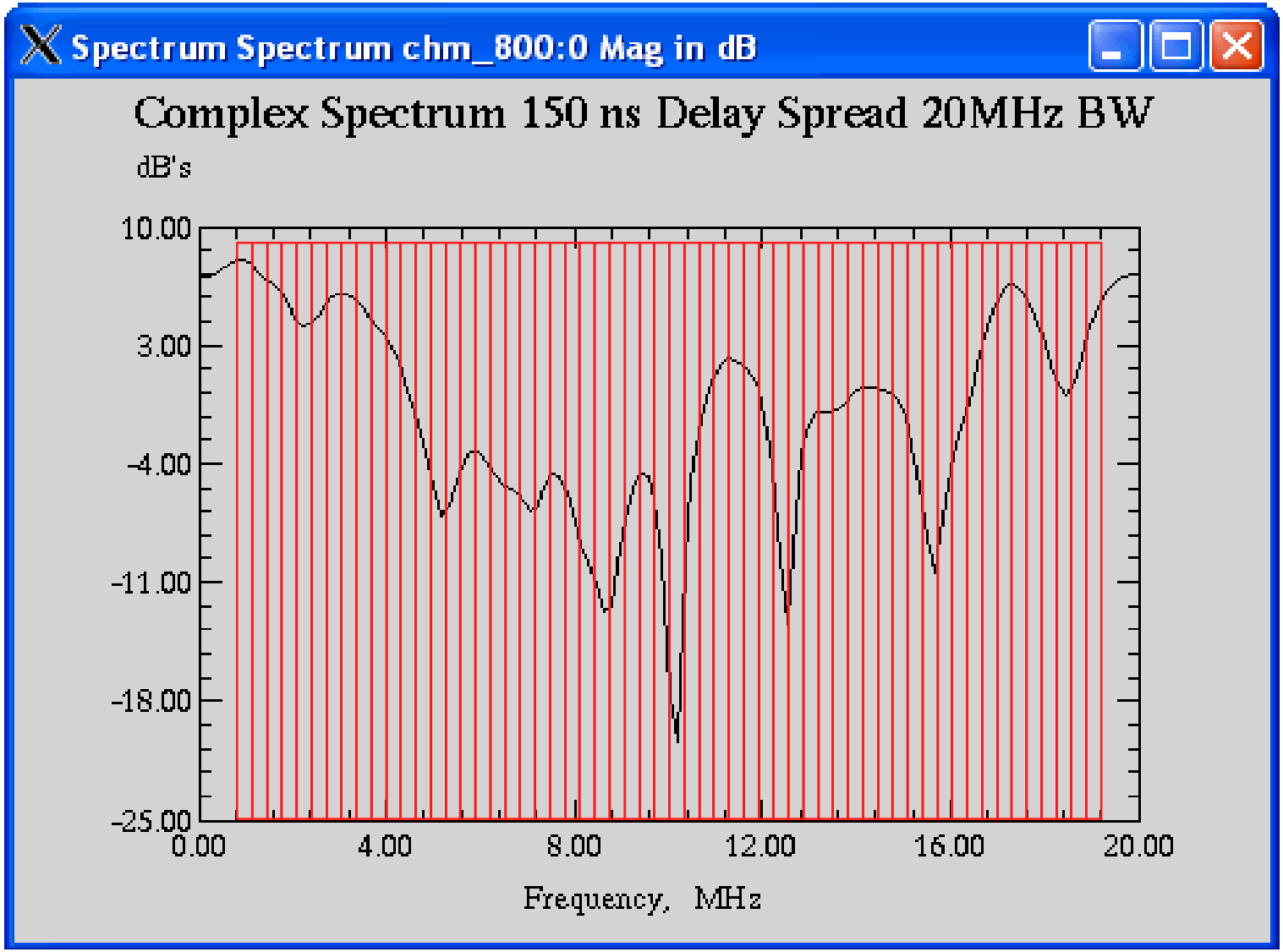












Carrier Spacing 312.5 kHz