Got Match?

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Frequently Asked Questions:

1. **What is meant by "Match"?**
2. **When should I use an Antenna Tuner?**
3. **Where should I place the Antenna Tuner?**

What is meant by "Match"?

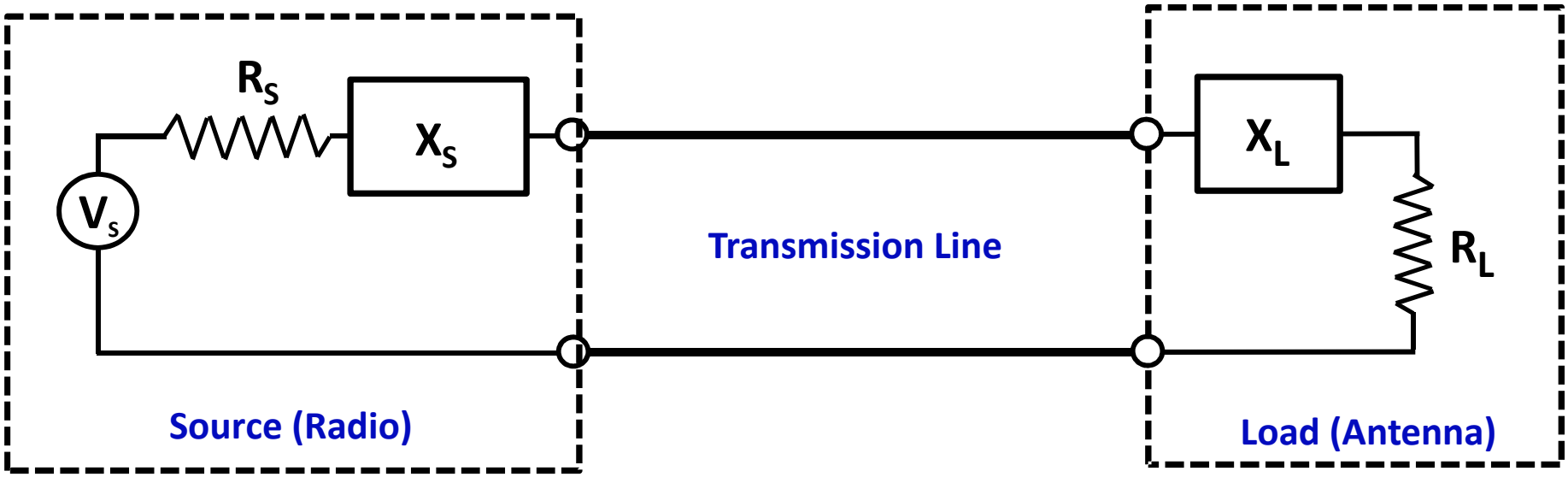
- To achieve a "Perfect Match", we need to ***simultaneously*** achieve two different types of match:
  - Z_O Match
    - Drives the selection of Source, Load, and Transmission Line ***impedances***
    - To achieve minimum loss, SWR must equal 1:1 on ***all*** transmission lines
  - Conjugate Match
    - Defines conditions for ***maximum power transfer*** from Source to Load
    - This is usually what is meant when the term "Match" is used

Good reference: "Reflections III" by Walter Maxwell (W2DU)

Why Do We Want a "Perfect Match"

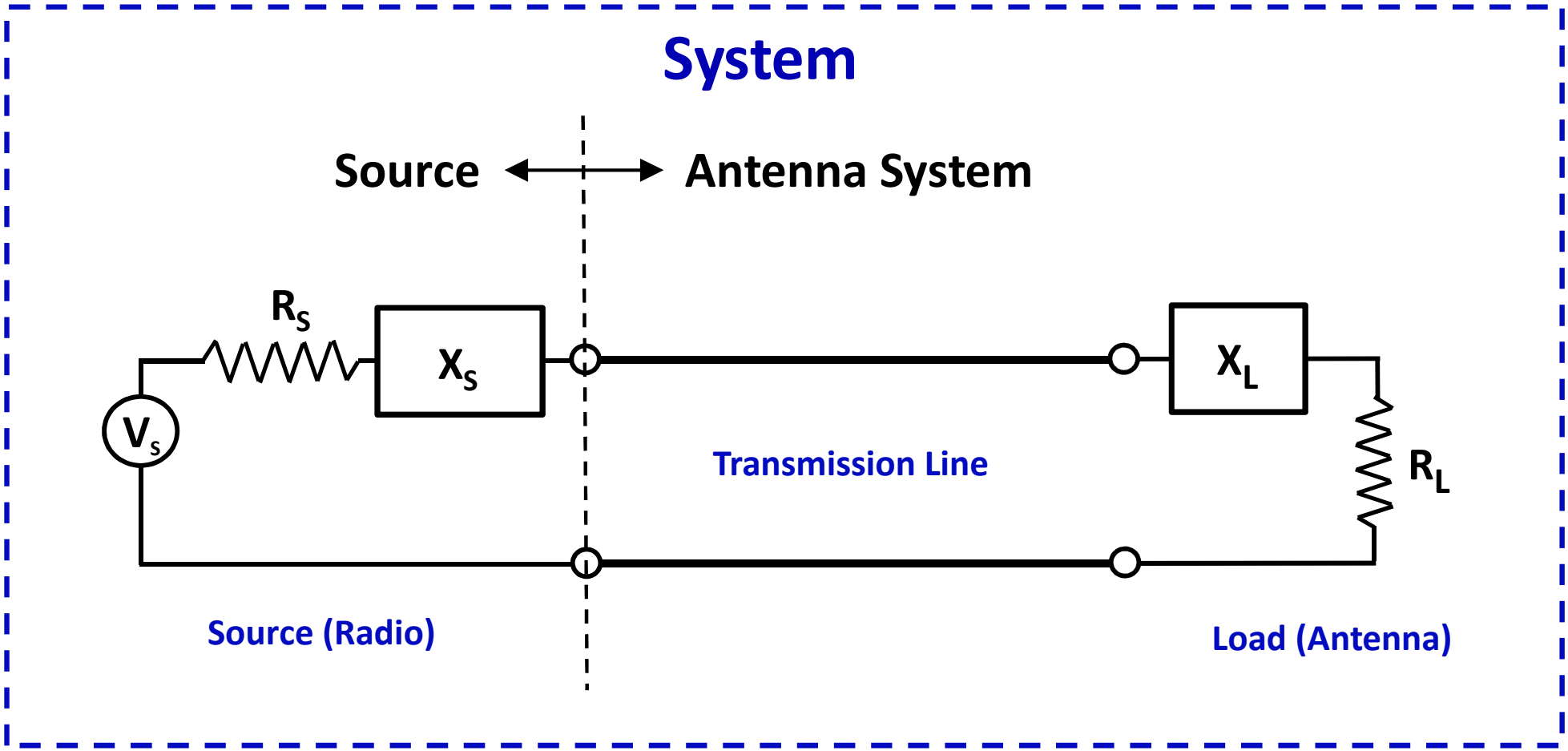
A "Perfect Match" results in the:

1) **Maximum Available Power being generated by the Source**
2) **Maximum Available Power being absorbed by the Load**
3) **SWR = 1.0:1 at any point in the "Antenna System"**
4) **Wider operating bandwidth**
5) **"*System*" (*not the antenna*) being tuned to resonance**



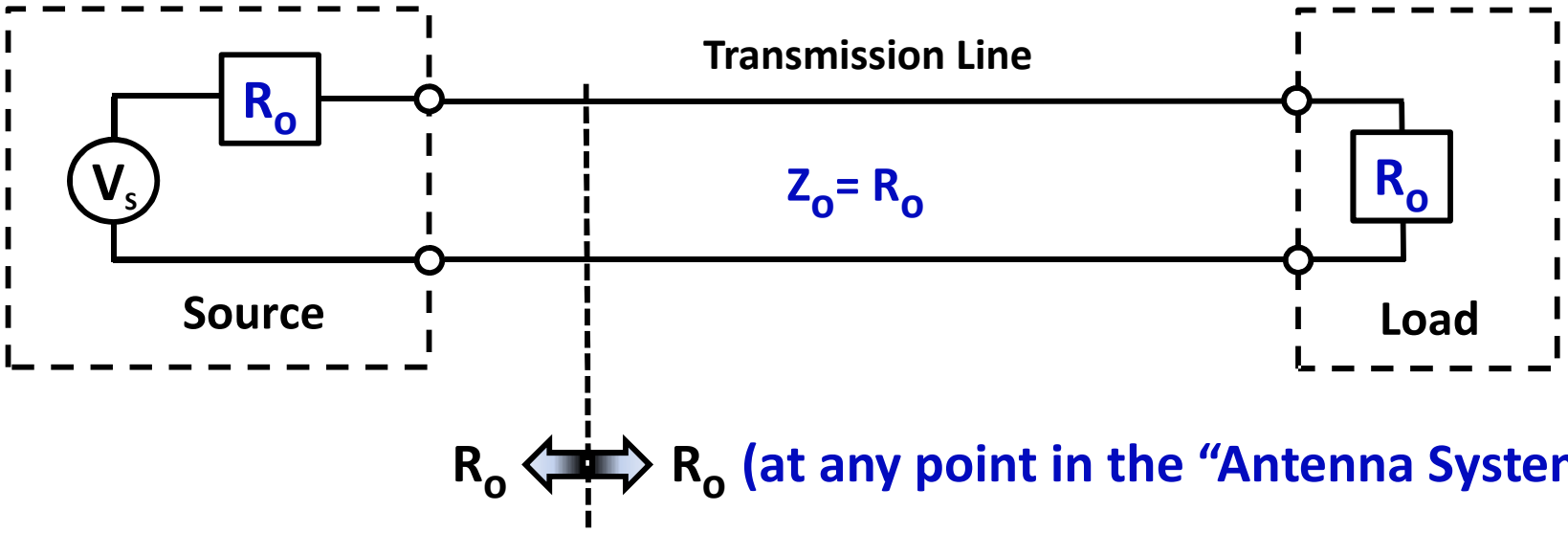
What Is Meant By "Antenna System"?

- The "System" includes all hardware from the the Source, *thru* the Load



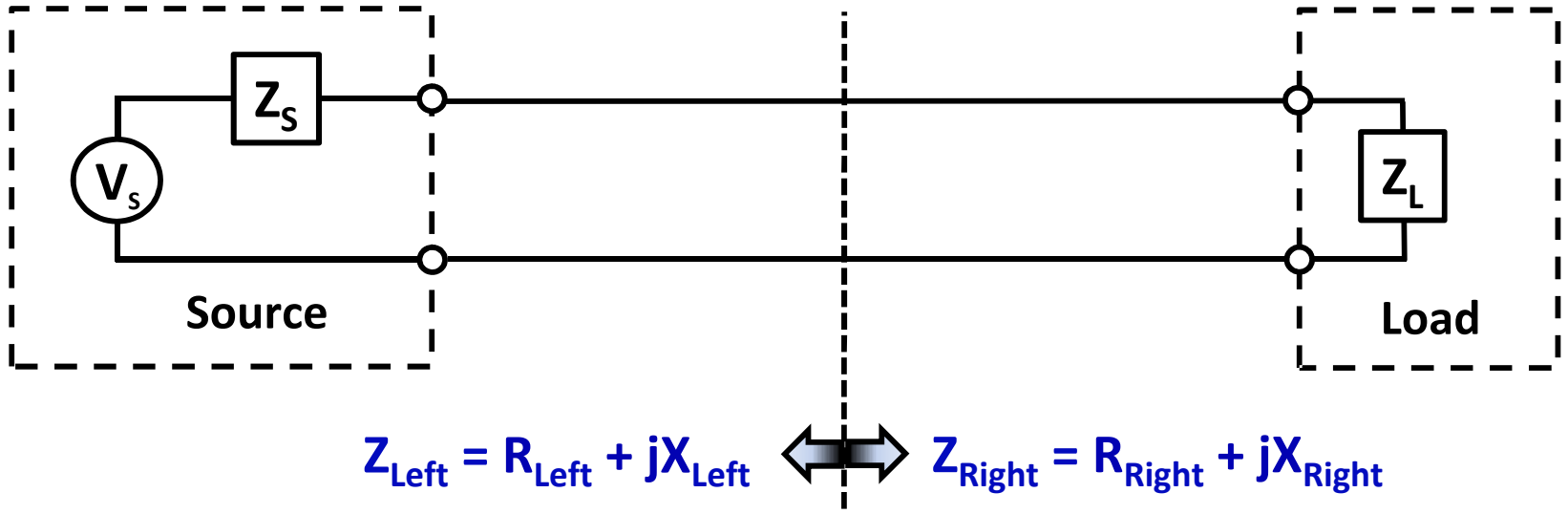
What is a "Z_o Match"?

- **Z_o = Characteristic Impedance of a Transmission Line**
  - **Z_o =** $R_o + jX_o$ **= R_o +** $j\tilde{0}$ **= R_o** (for most Ham applications)
- **"Z_o Match"** is achieved when the impedance seen by a transmission line, ***at each end of the line***, is equal to the impedance of the line (**Z_o**):
  - Simply stated: **$Z_S = Z_L = Z_o \cong R_o$**
  - For cases where there is no reactance:
    - **Z_o Match = Perfect Match**
    - **No need for an Antenna Tuner**



What is a "Conjugate Match"?

- Two conditions must be met (**at any point in the "System"**)
  - **1) $R_{Left} = R_{Right}$**
  - **2) *Net* Reactance in the "System" = 0**
    - **$jX_{Left} = -jX_{Right}$**
    - **"System" is resonant**

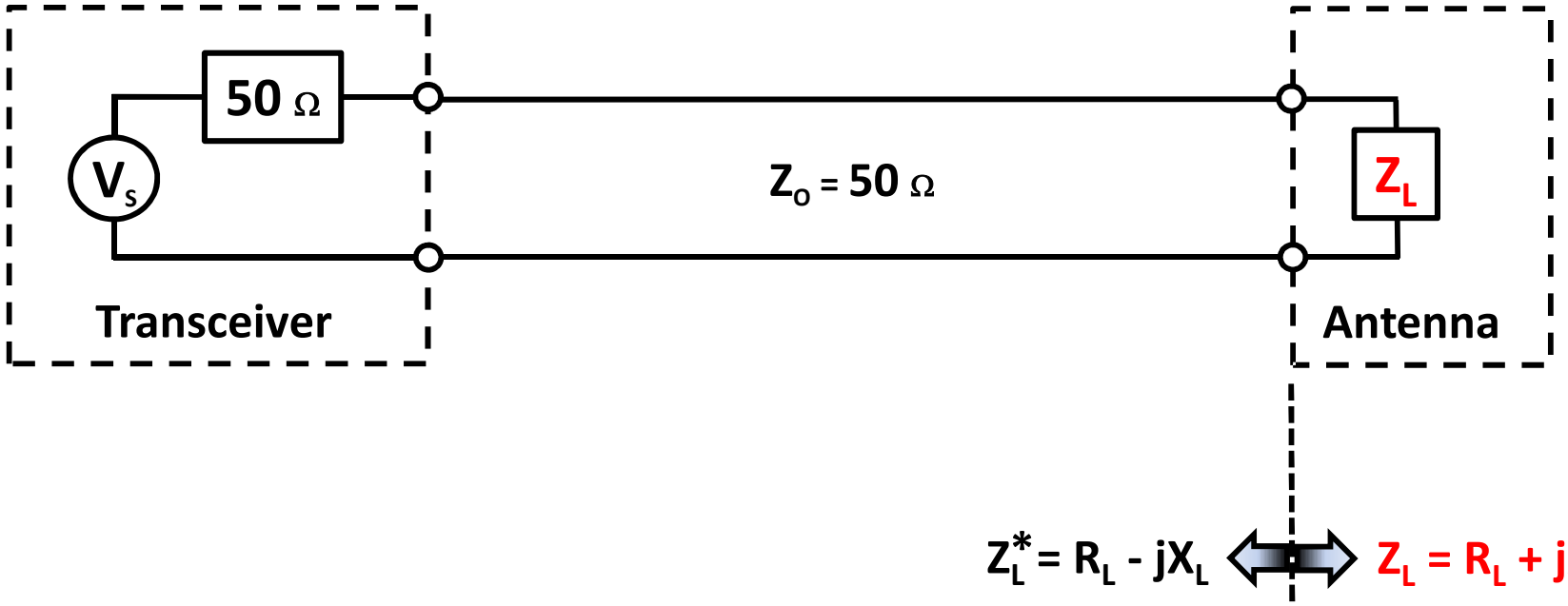


Note:

1. **"Conjugate Match" is independent of the Transmission Line**
2. **For cases where there is no Transmission Line:**
   - **Conjugate Match equals a Perfect Match**

How To Achieve A "Conjugate Match"?

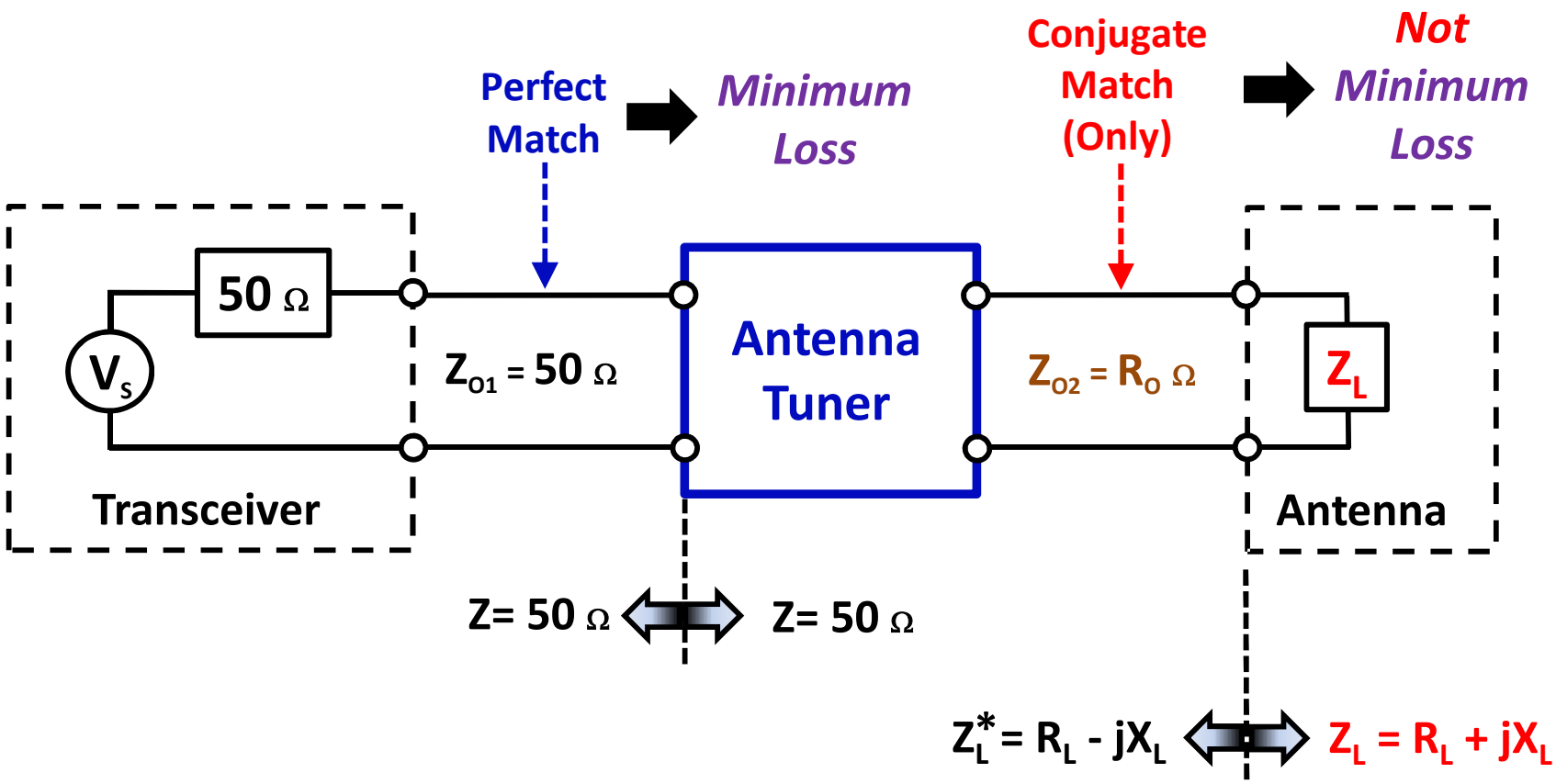
- **Typically:**
  - $Z_S = Z_O = 50\ \Omega$ (not required) **and,**
  - $Z_L = R_L + jX_L \neq 50 + j\square\ \Omega$



* => Conjugate

How To Achieve A "Conjugate Match"?

Use an Antenna (System) Tuner:

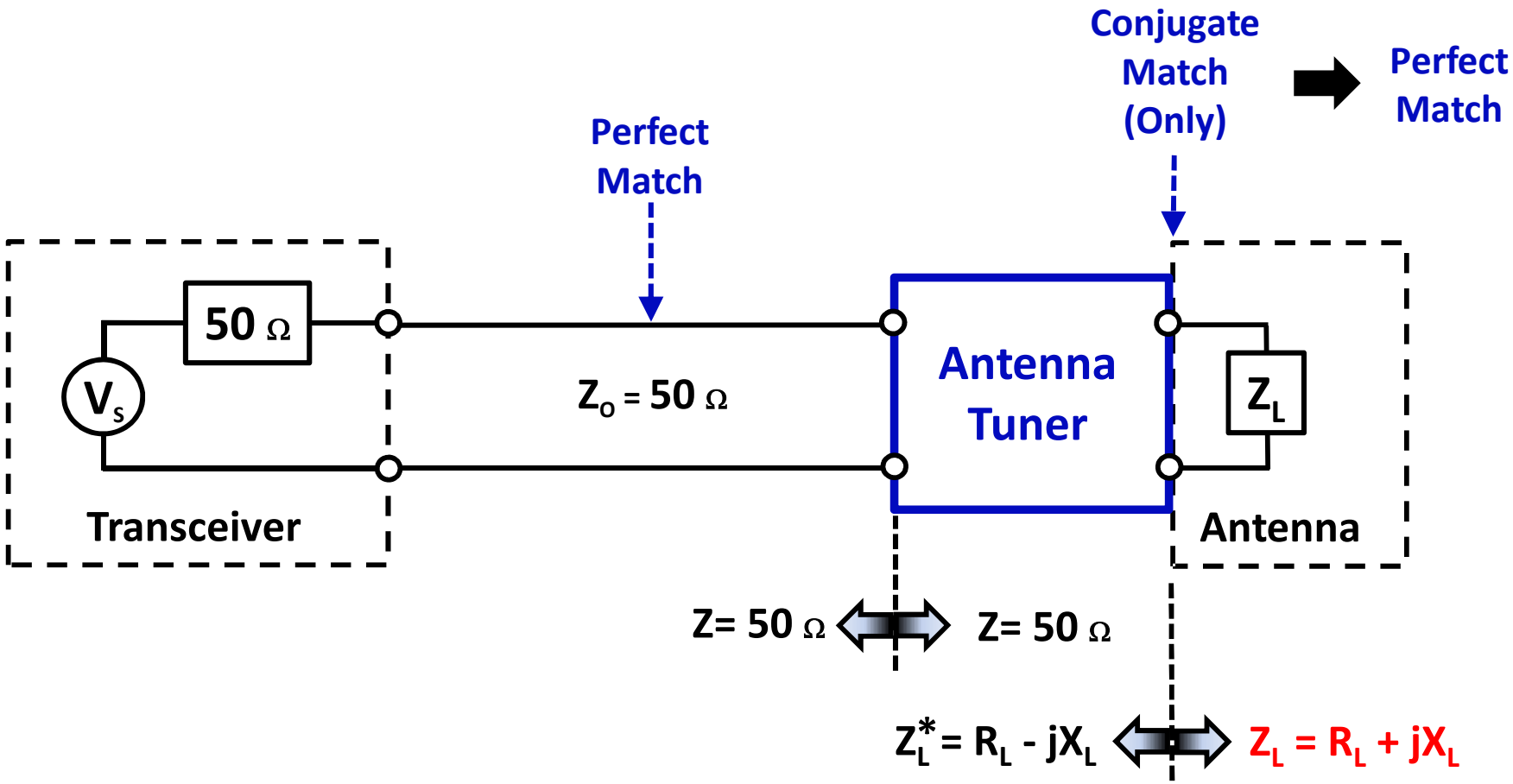


- Note: the "System" (not the antenna) has been "tuned" to resonance

How To Achieve Minimum System Loss?

Place the Antenna (System) Tuner at the Load:

- We now have a "Perfect Match" at all points in the "Antenna System"



Answers to "When" & "Where"

When:

1. **The *NET* "System" loss can be reduced by more than the insertion loss of an Antenna Tuner**
2. **The SWR of the Load is high enough to cause the transmitter output power to be reduced because the SWR protection circuit is being activated**
    - Usually between 1.5:1 and 2.0:1
3. **Increased operating bandwidth is needed**

Where:

- **As close to the antenna as possible, *or***
- **Where convenient, *and* use low loss transmission line between the antenna and the tuner**