VPI University Program

Photonics Curriculum Version 7.0

Lecture Series

Introduction to Fiber-Optic Communications II

FOC2

Module Prerequisites

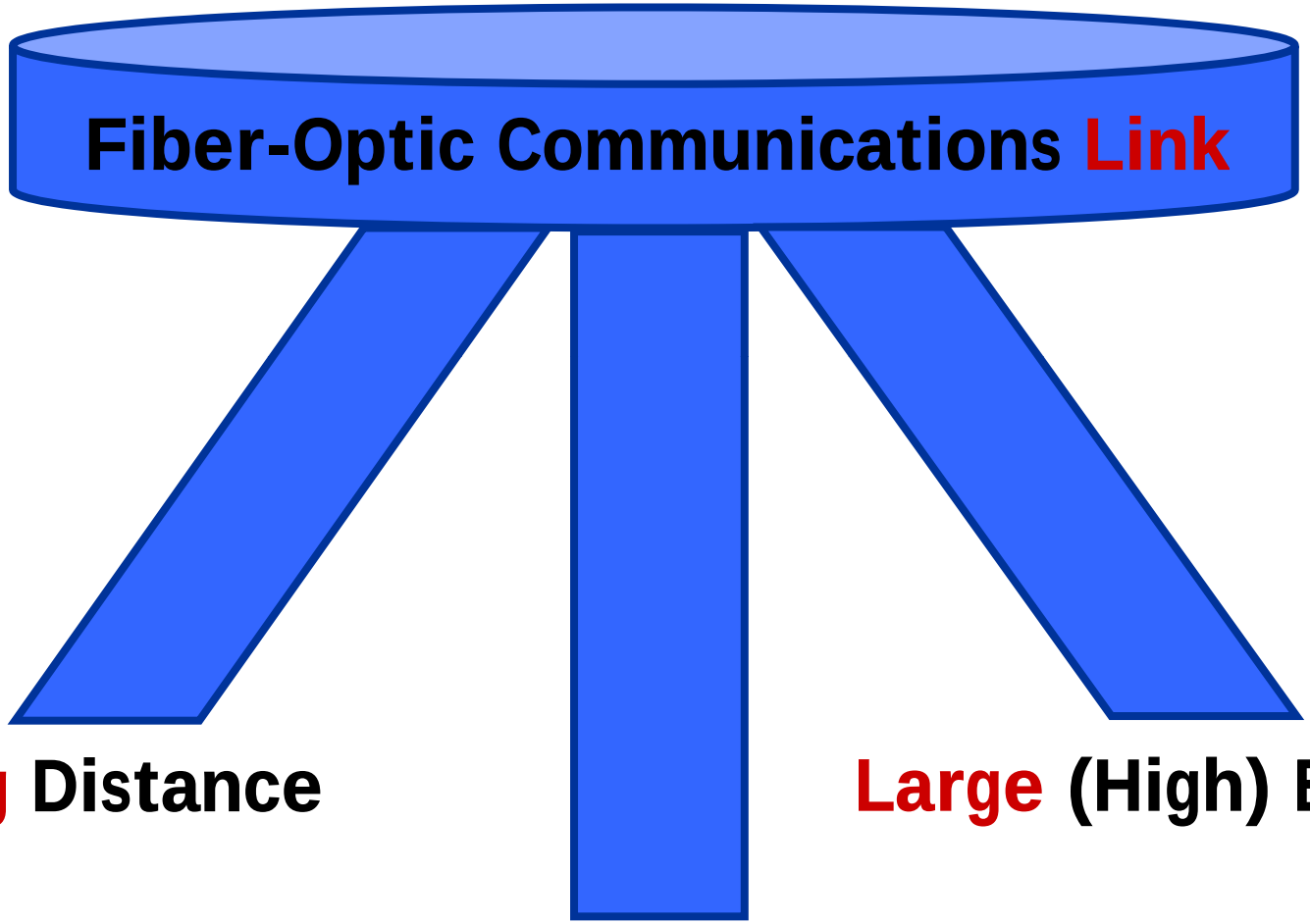
- **Introduction to Fiber-Optic Communications I**
- **Should have worked through the *User's Manual* of *VPItransmissionMaker*/*VPIcomponentMaker* before starting this unit (to understand how to handle the software).**

Module Objectives

Fiber-Optic Communication Systems

- **Design Issues**
- **Design Constraints**
- **Link Power Budget**

Design Goals

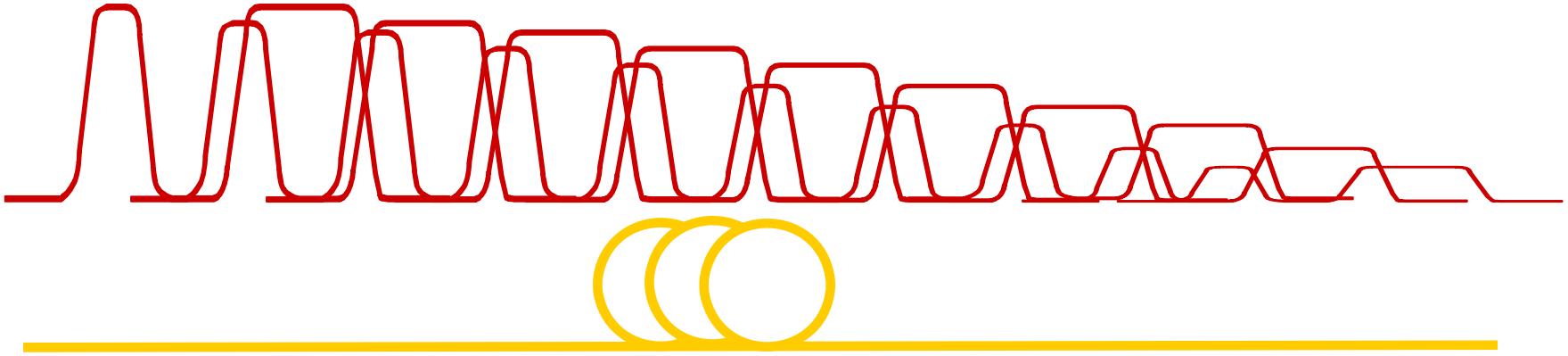


Low BER (ideally zero)

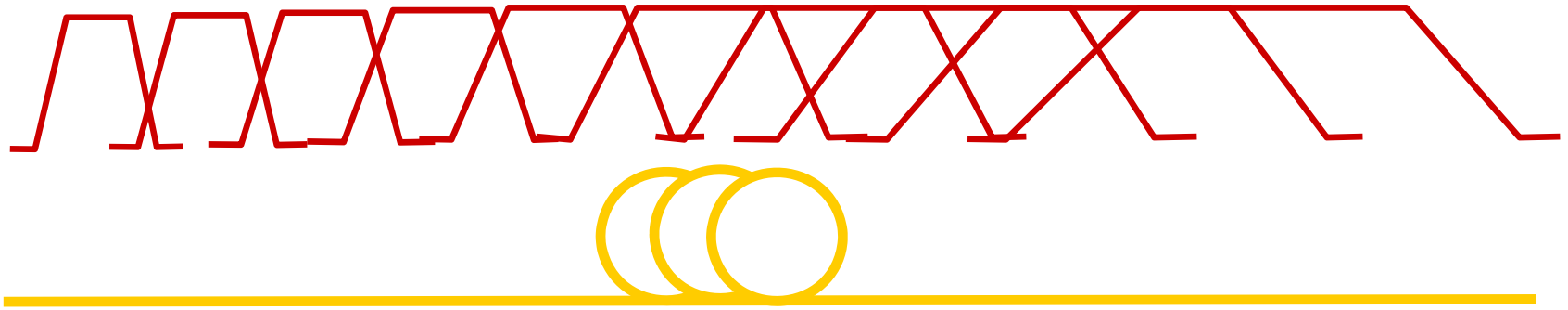
10^{-9} or less in practice

Design Constraints

- **Fiber loss**

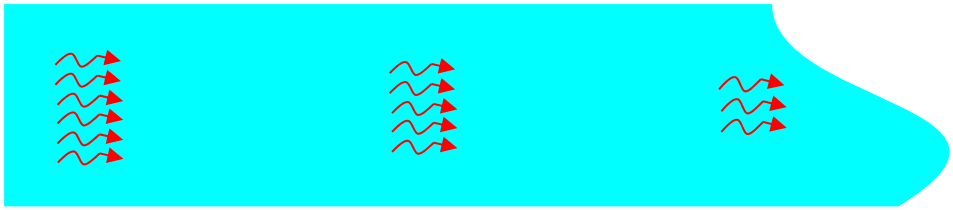


- **Pulse spreading**

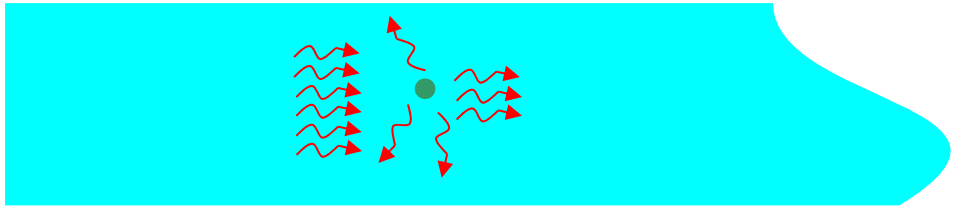


What causes fiber loss?

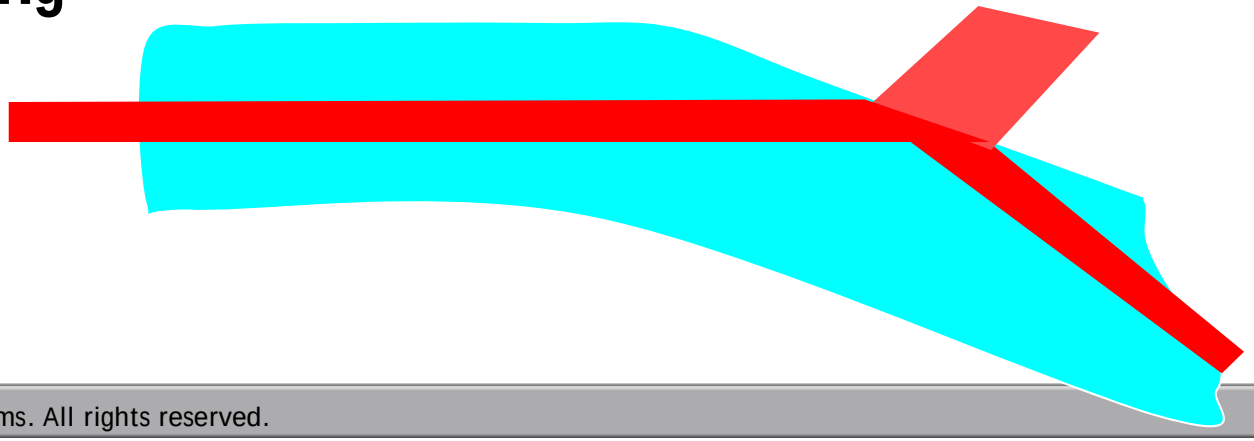
- **Absorption**



- **Scattering**

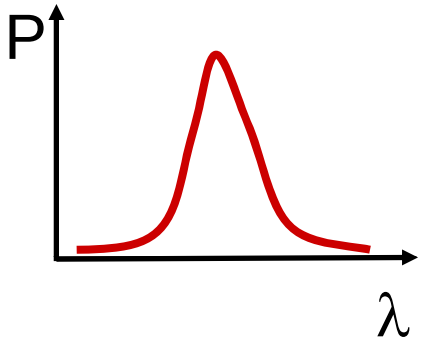


- **Bending**

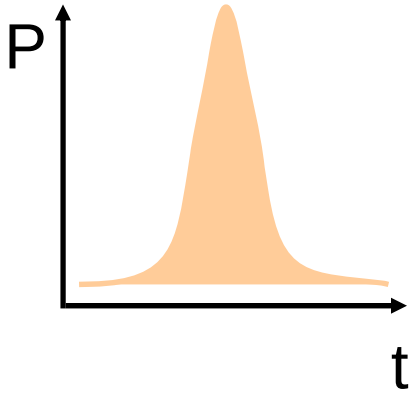


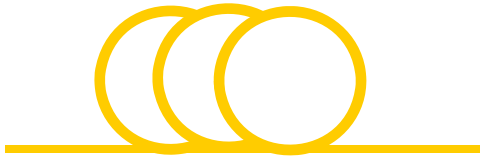
What causes pulse spreading?

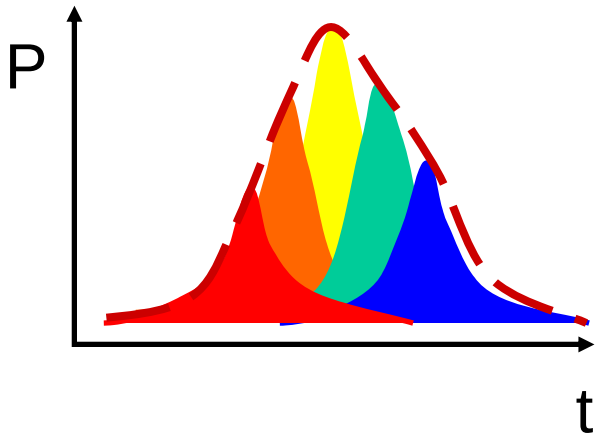
spectrum of pulses:



- **Different wavelengths travel at different speeds in fiber**



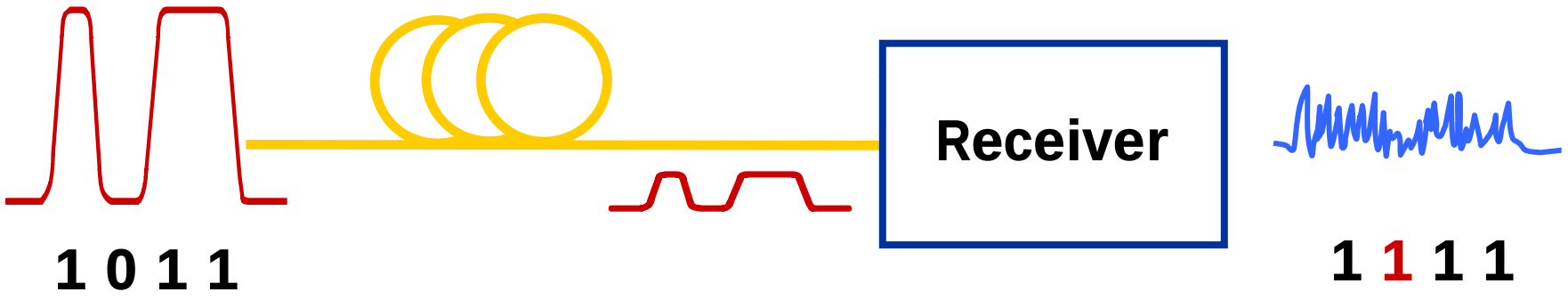




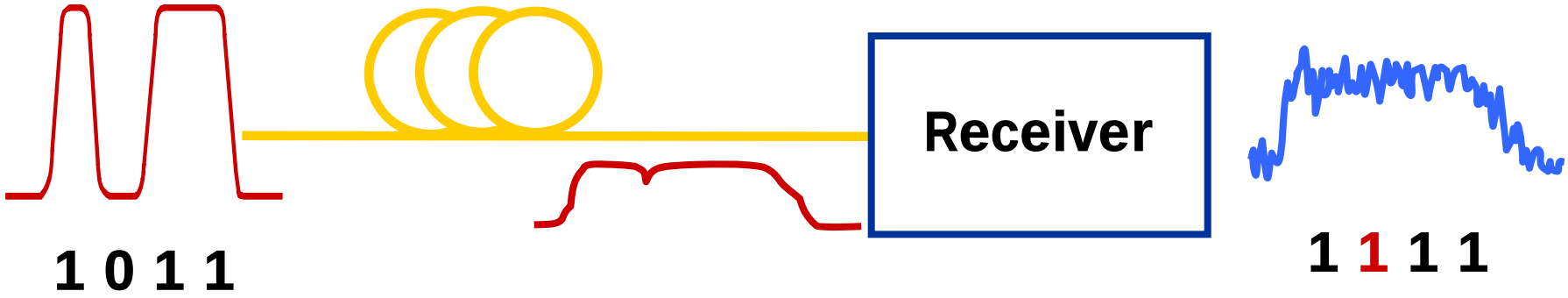
Design Constraints

Transmission distance is limited by:

Loss



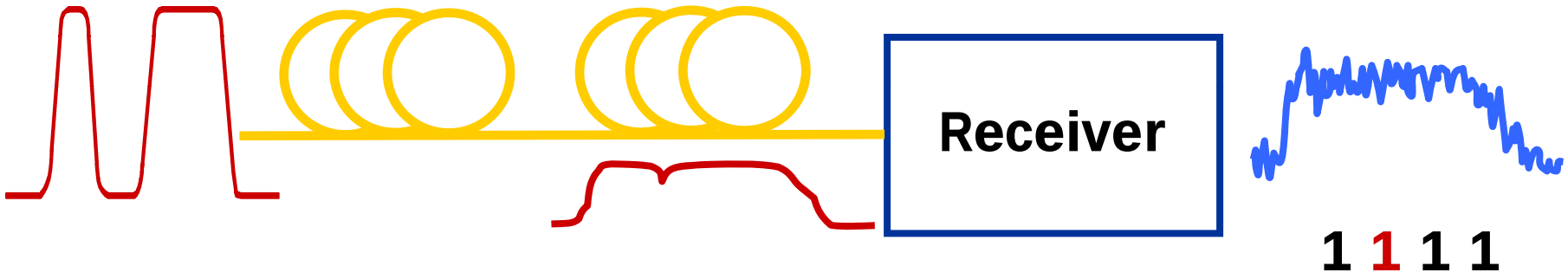
Spreading



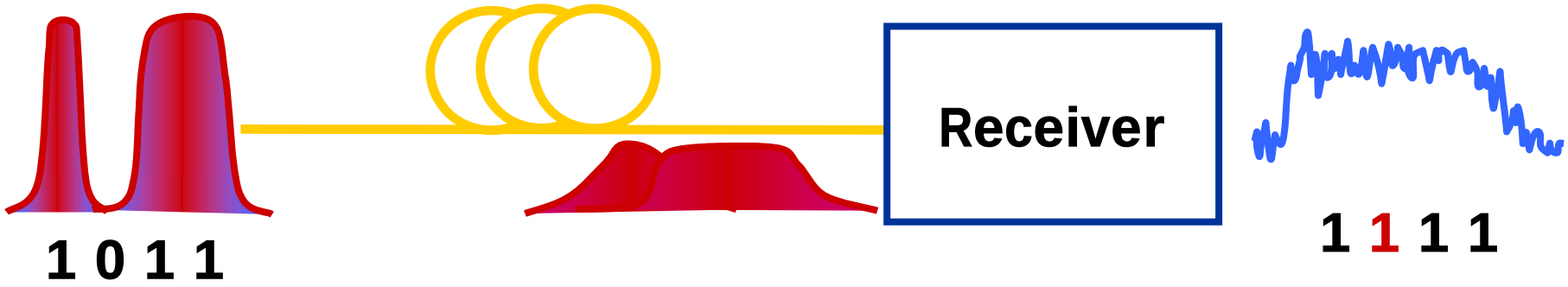
Design Constraints

Bit Rate is limited by:

Spreading over long distance

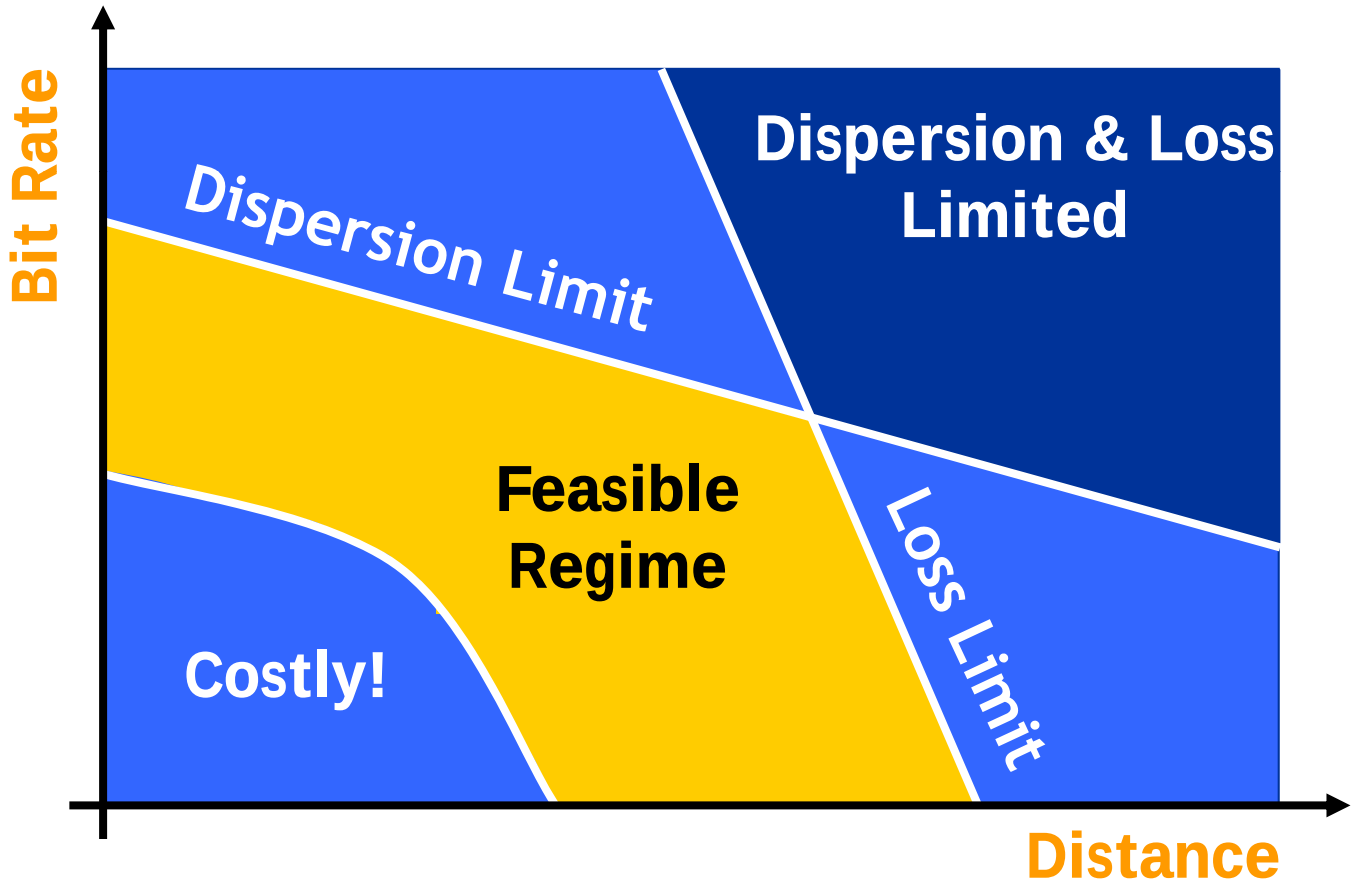


Spreading due to pulse chirp



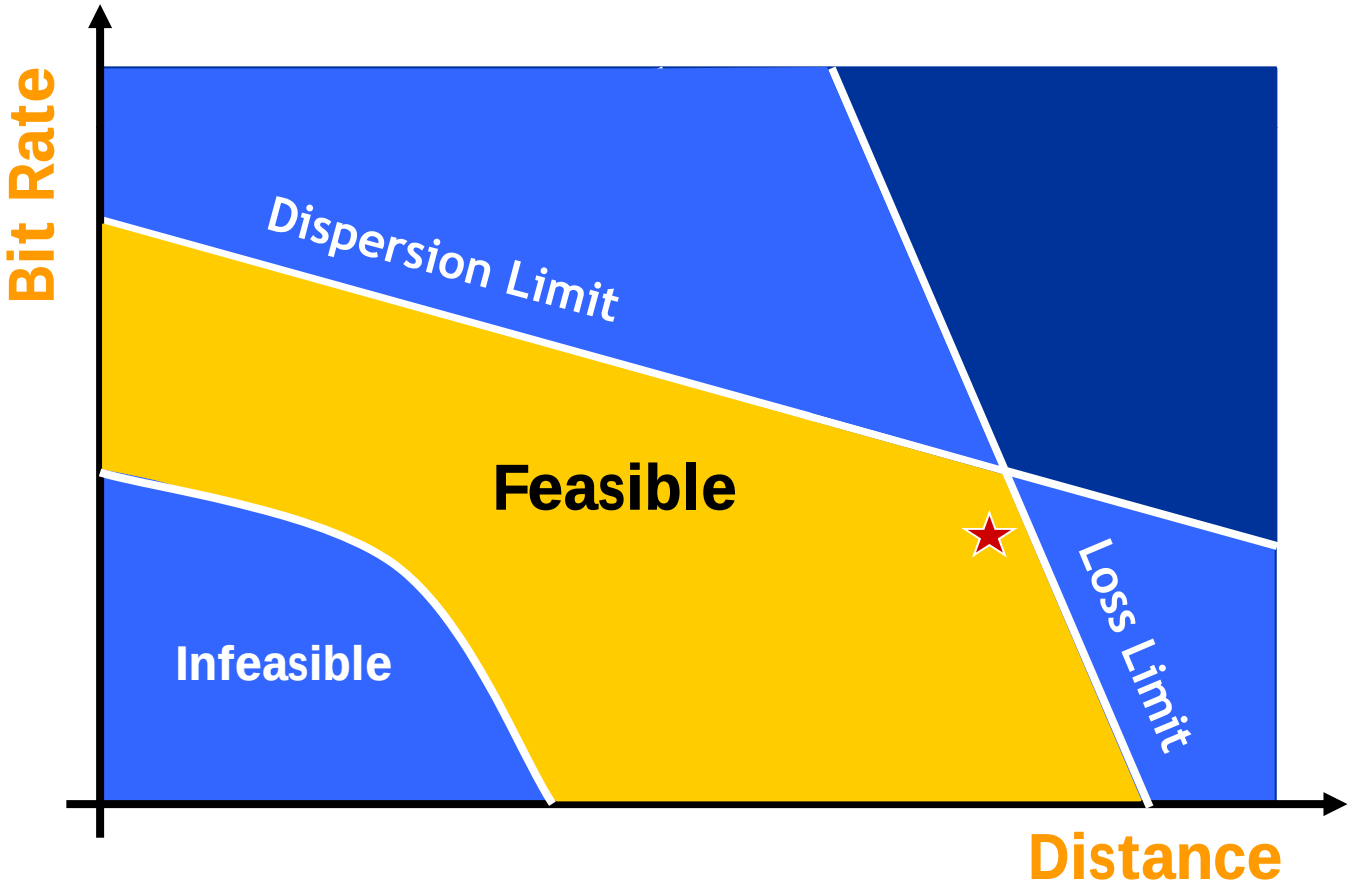
Design Constraints

Limits can be represented graphically



Easing Design Constraints

Loss limited systems can be improved:



By Improving:

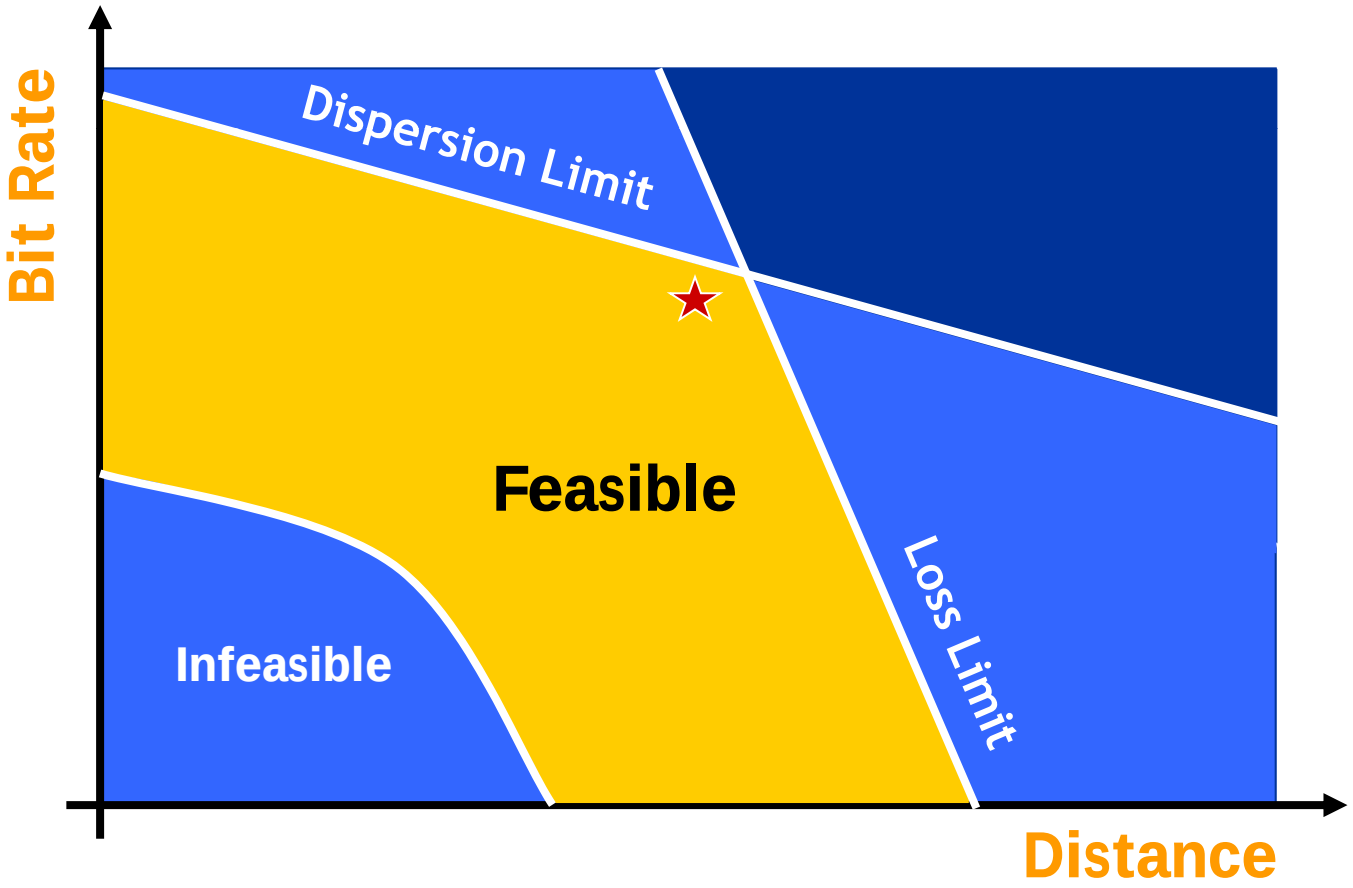
- **transmitter**
  - *increase power*
- **receiver**
  - *increase sensitivity*
- **fiber**
  - *lower loss*

By adding:

- **optical amplifiers**

Easing Design Constraints

Dispersion limited systems can be improved:



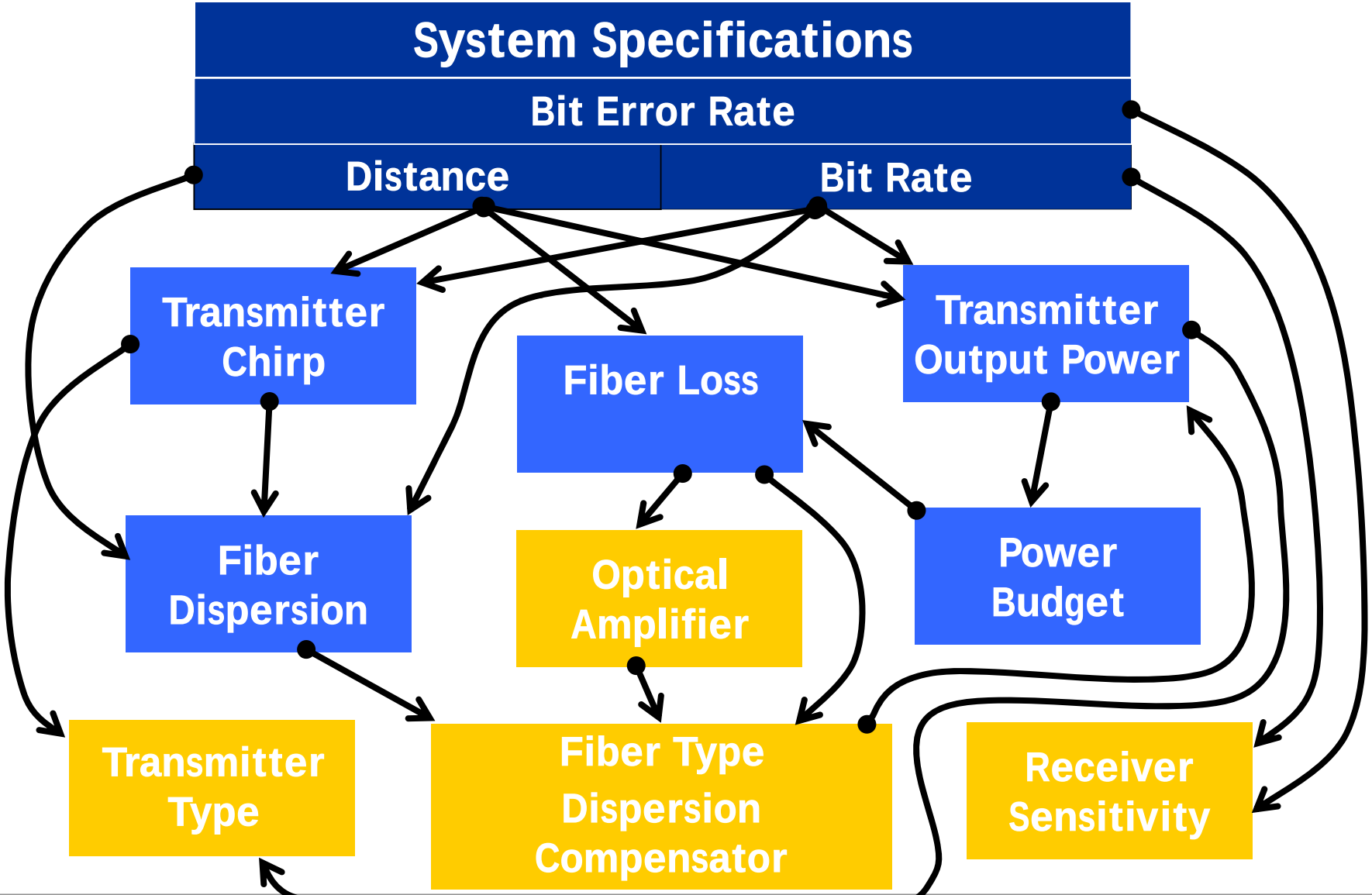
By Improving:

- **transmitter**
  - *lower chirp*
  - *external modulation*
- **fiber**
  - *reduce dispersion*

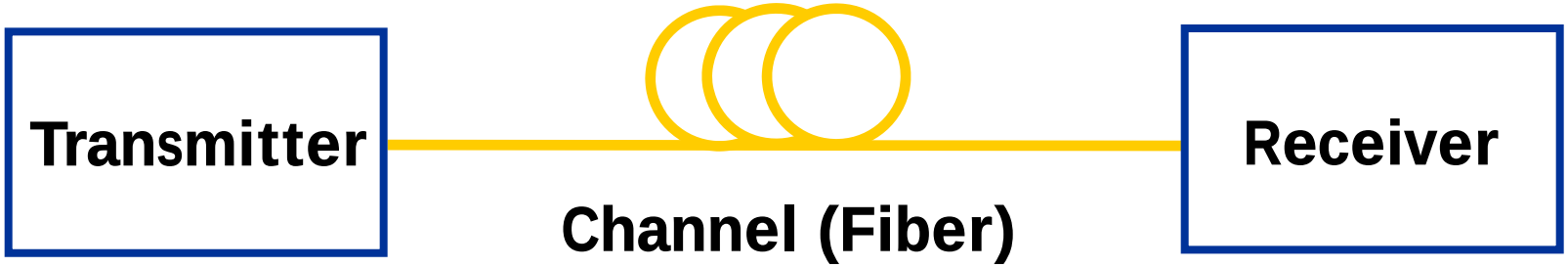
By adding:

- **dispersion compensators**

System Design Flow Chart

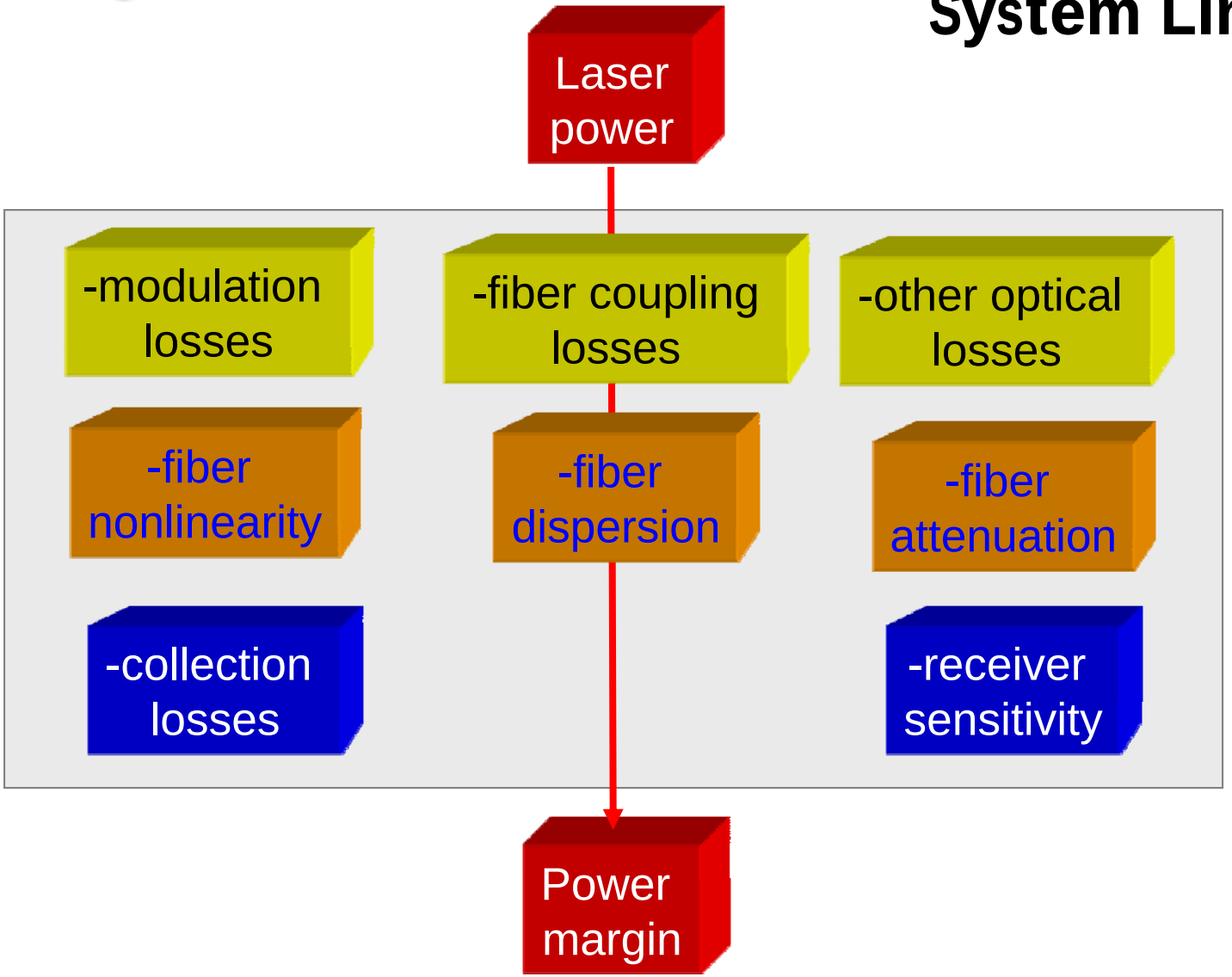


Link Power Budget



Item	Value	dB value
Transmitter:		
1a) Average output power	1.0 mW	0.0 dBm
Channel:		
2a) Propagation losses	1% Trans.	-20.0 dB
Receiver:		
3a) Signal power at receiver		-20.0 dBm
3b) Receiver sensitivity		-30.0 dBm
Link Margin (Power Margin)	= (3a – 3b)	+10.0 dB

Components of Fiber System Link Budget



Summary

So far, the following have been introduced:

- **The three main design goals for fiber-optic links**
- **Design constraints on system performance**
- **Easing design constraints**
- **System design flow chart and Link Power Budget**

Proceed with the *Interactive Learning Module*