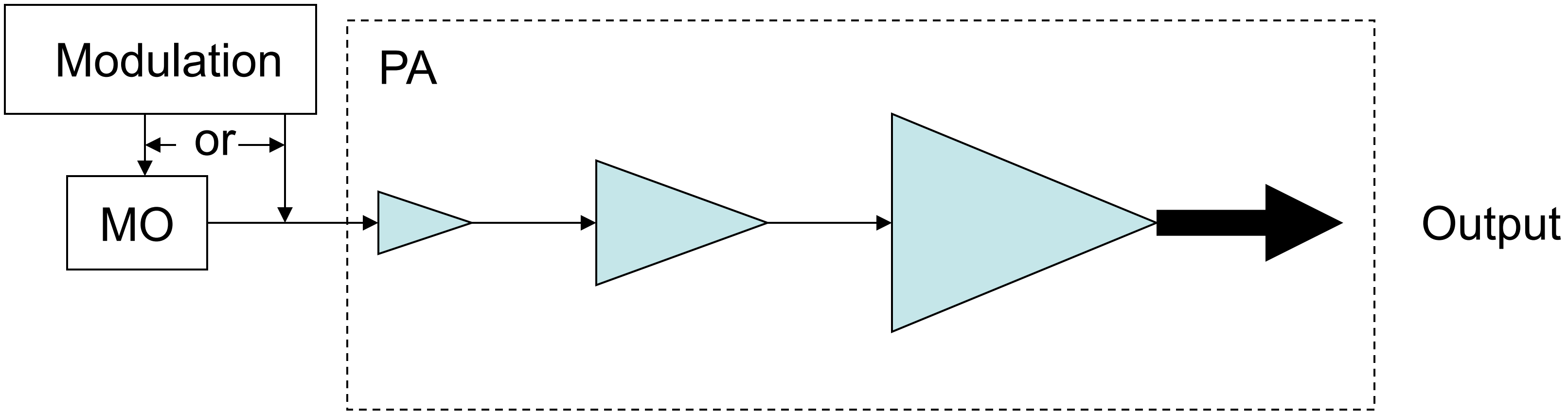
Master Oscillator (MO) Power Amplifier (PA) System



- MOPA system provides most flexibility in modulation format and systems (On-Off Keyed, Coherent, etc.)

- Control of MO (usually a laser diode) done at low optical and electrical power

- Enables a multi-channel system

- Gain blocks boost signal to required powers, are decoupled from modulation

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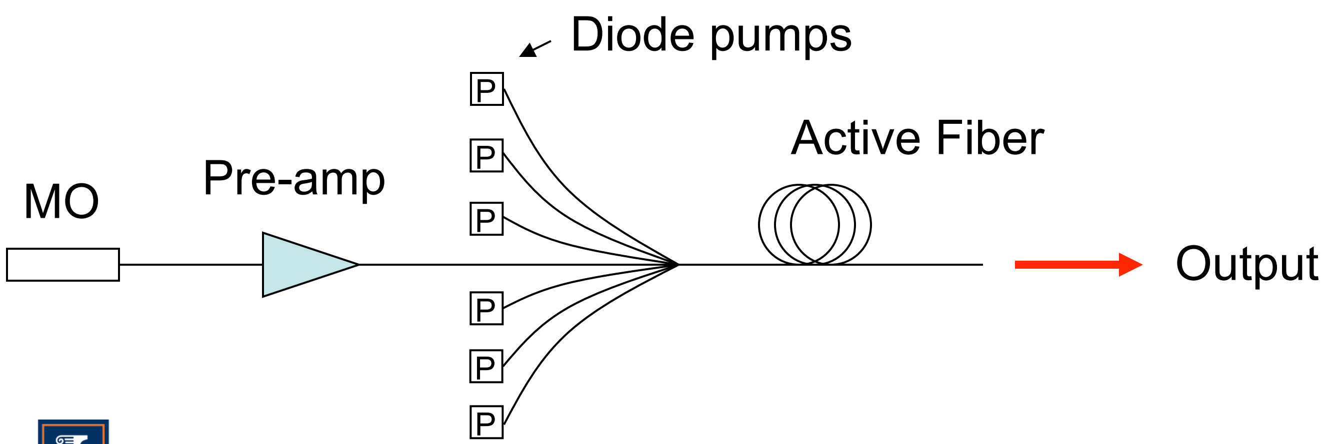
- Gain blocks should be diode-pumped for highest wall-plug efficiency
- Efficient gain blocks can be constructed from solid state (such as Nd:YAG) or optical fiber materials. A study into the trade-offs associated with the material selection is suggested.
- Signal saturation helps limit intensity noise in a laser and maximize system efficiency…this requires careful laser design. What platform is best in achieving this?
- In-band amplifier spontaneous emission noise can be a problem and should be looked at in terms of system BER.
- How critical are the alignments of the components in the MOPA? Can the system be ruggedized?

Mid-Term Requirements – Fiber Lasers

- Fiber lasers at the 10 – 100 W level in a single mode beam are currently available in a truly single mode fiber

- Laser diode seeders can be directly or externally modulated to achieve 200 Mbps

- Can be monolithic (no critical free-space alignments)
  i.e. all components are fiber coupled and spliced together



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Mid-Term Requirements – Fiber Lasers

- Laser diode seeders can be directly or externally modulated to achieve 200 Mbps

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- Redundancies may be built into the system to compensate for diode laser failures or limited lifetimes (10,000 – 50,000 hours typical)

- Passive cooling up to 100 W with fiber design achievable

- Radiation-induced damage in fibers usually results from the cleavage of oxygen bonds in the glass, usually forming absorptive color centers
  -shielding of the fibers via metal or other coatings
  -novel materials should be studied to eliminate color center precursors

Power Scaling (Long-Term)

- Another amplifier stage is required to achieve kW-class transmitters

- **Fibers** (key questions and considerations)

  -can fiber lifetime (photodarkening) be extended for long-term operation, or can a tolerable 'burn-in' condition be achieved?
  (there is still no definitive consensus on the cause of photodarkening, and manifests itself as a gradual reduction in power. Least significant in CW and QCW systems.)

  -is it possible to run fibers passively cooled?

  -can robust single-mode operation with low pointing jitter be maintained with larger fiber core diameters (> 30 μm)? Is active jitter control feasible?

  -nonlinear effects should be considered at high power, but will depend on the modulation format and system configuration

  e.g. Stimulated Brillouin scattering limits the power-per-bandwidth per unit length in traditional systems to

  2 – 20 W/MHz/m (10 – 30 μm core)

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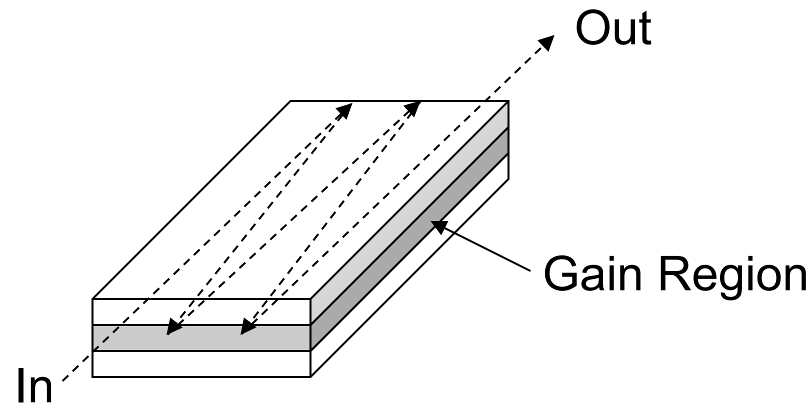
<u>Power Scaling (Long-Term)</u>

● **Solid state lasers** (key questions and considerations)

-zig-zag planar waveguide amplifiers have been demonstrated at multiple kW



-can you passively cool these?

-what are the trade-offs between solid state and fiber technology?

-can you reduce any system limitations (such as nonlinear effects) in going to such a design?

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