Technology Plan
for the
Coherent Subsystem of a
Space-Based Hybrid Doppler Wind Lidar

M. Kavaya, F. Amzajerdian, U. Singh
J. Yu, D. Emmitt

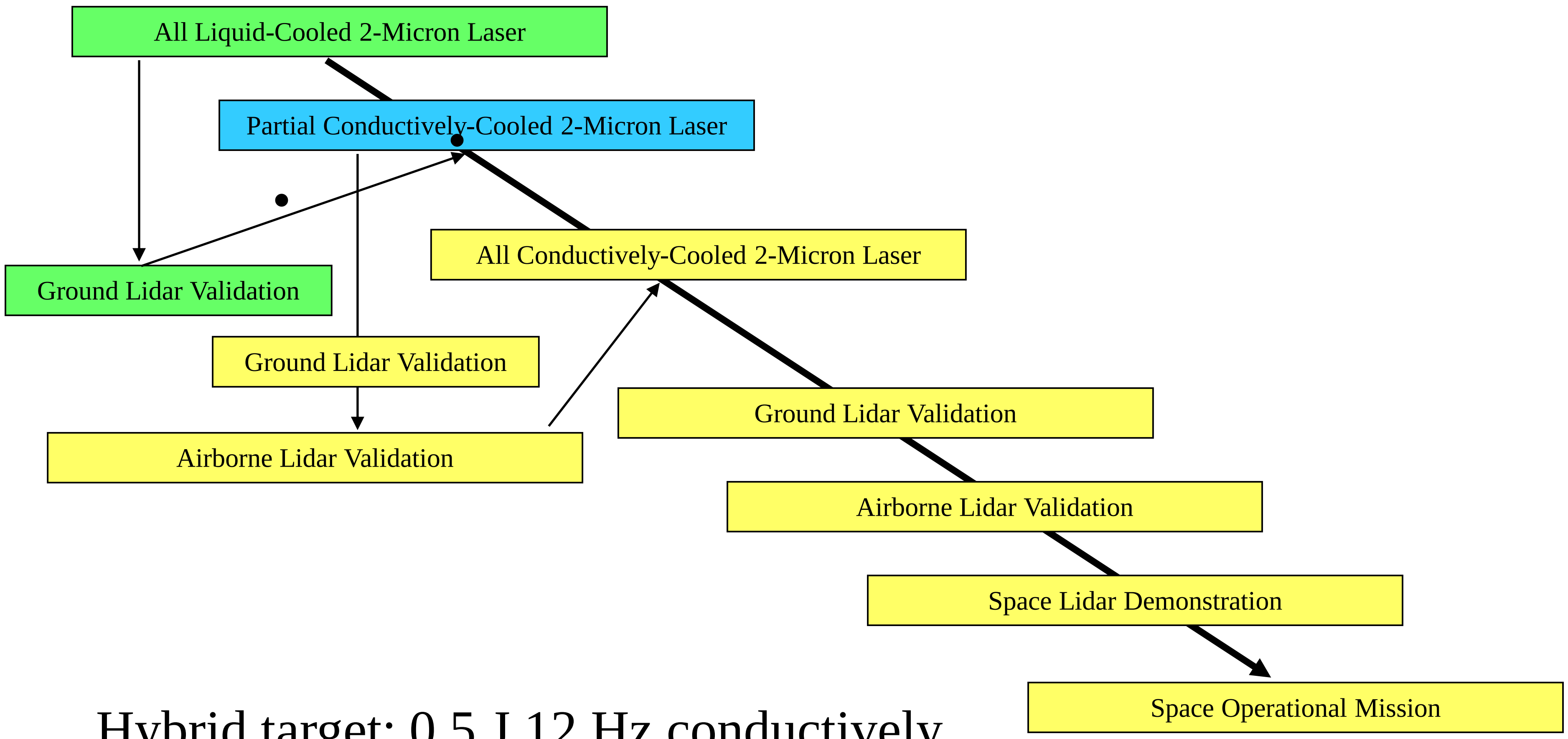
16 July 2002

Working Group on Space-Based Lidar Winds

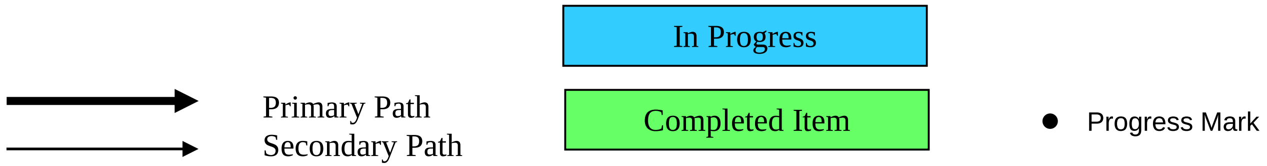
The Hybrid DWL Approach

- Direct detection component will be optimized to provide wind observations in the cloud free mid and upper troposphere (potentially lower stratosphere also)
- Coherent detection component will be optimized for the lower troposphere and cloudy regions
- The cost and time (and risk) of technology development is reduced

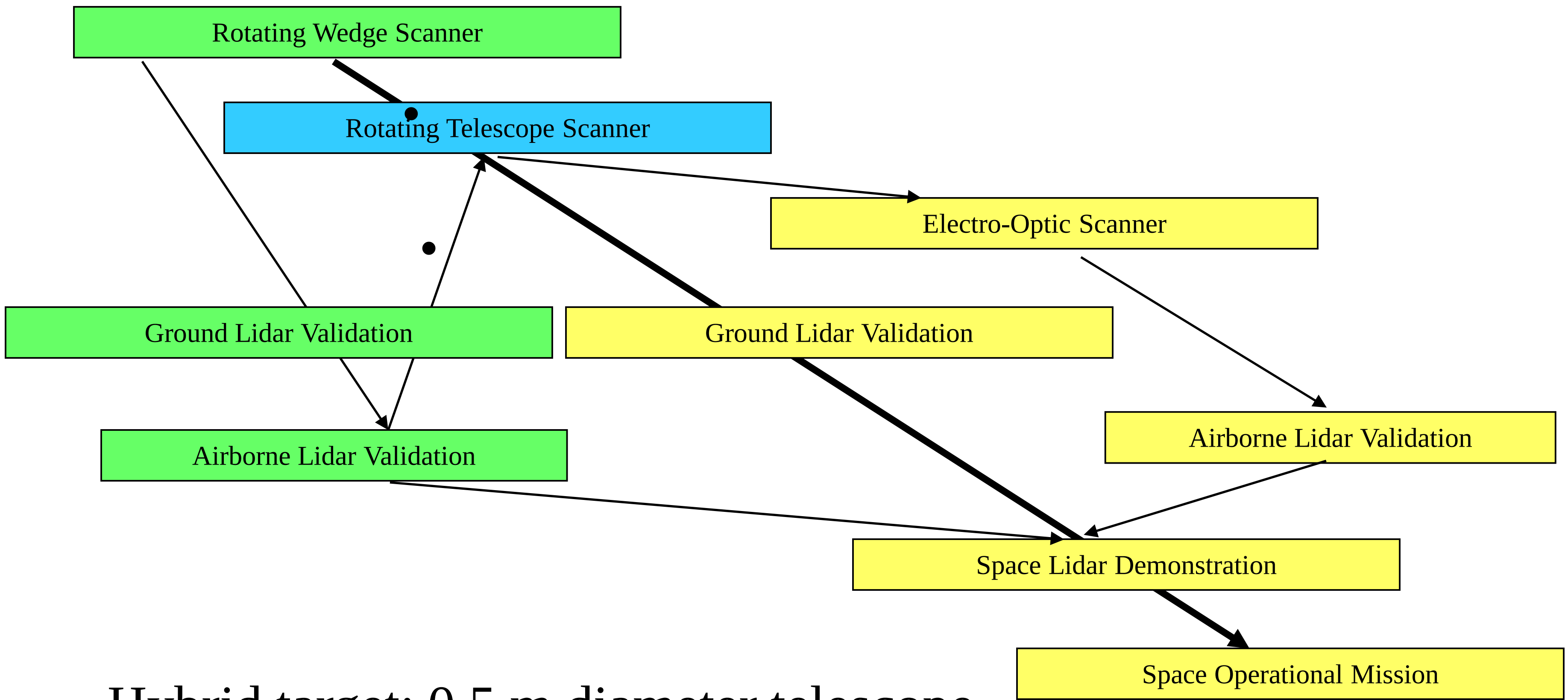
Coherent Doppler Lidar Pulsed Laser



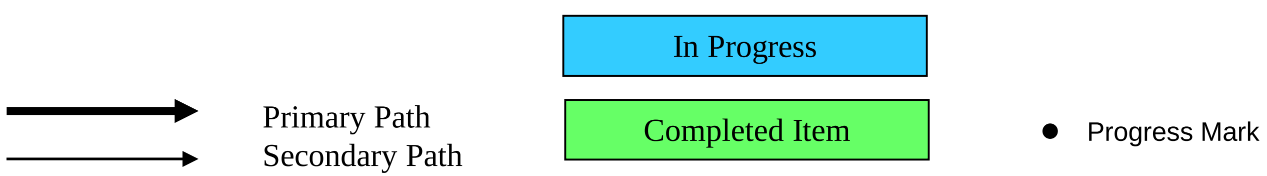
Hybrid target: 0.5 J 12 Hz conductively cooled with lifetime of 5 years



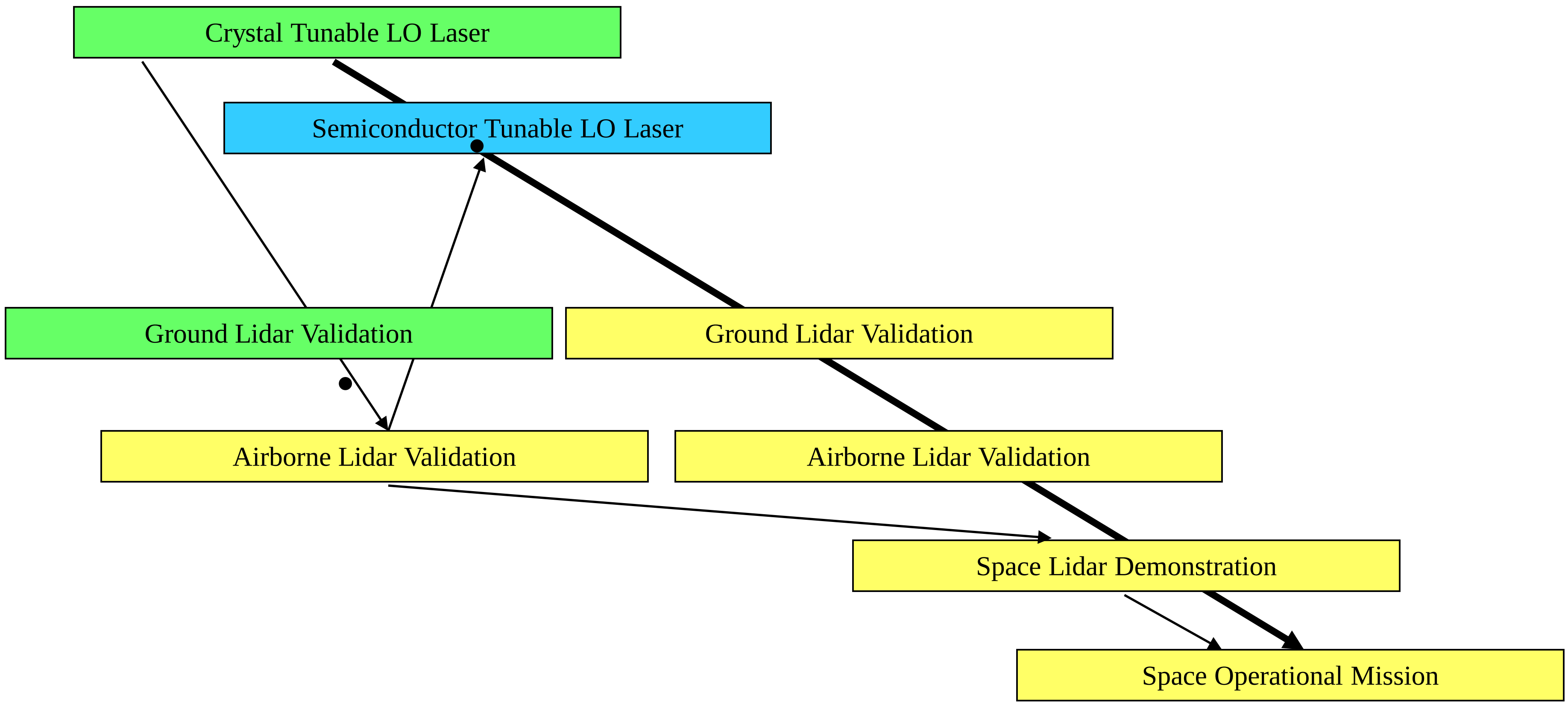
Coherent Doppler Lidar Scanner



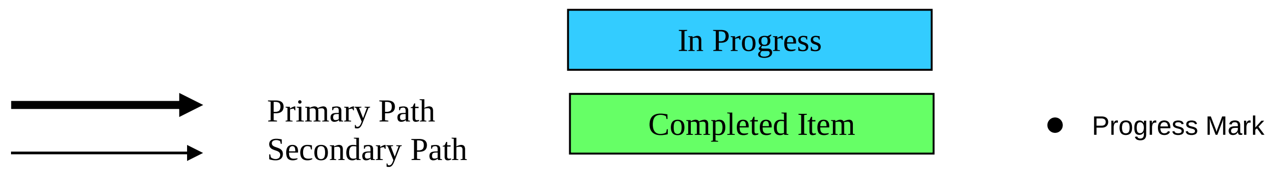
Hybrid target: 0.5 m diameter telescope with rapid step/stare pointing (shared telescope with direct detection subsystem to be considered)



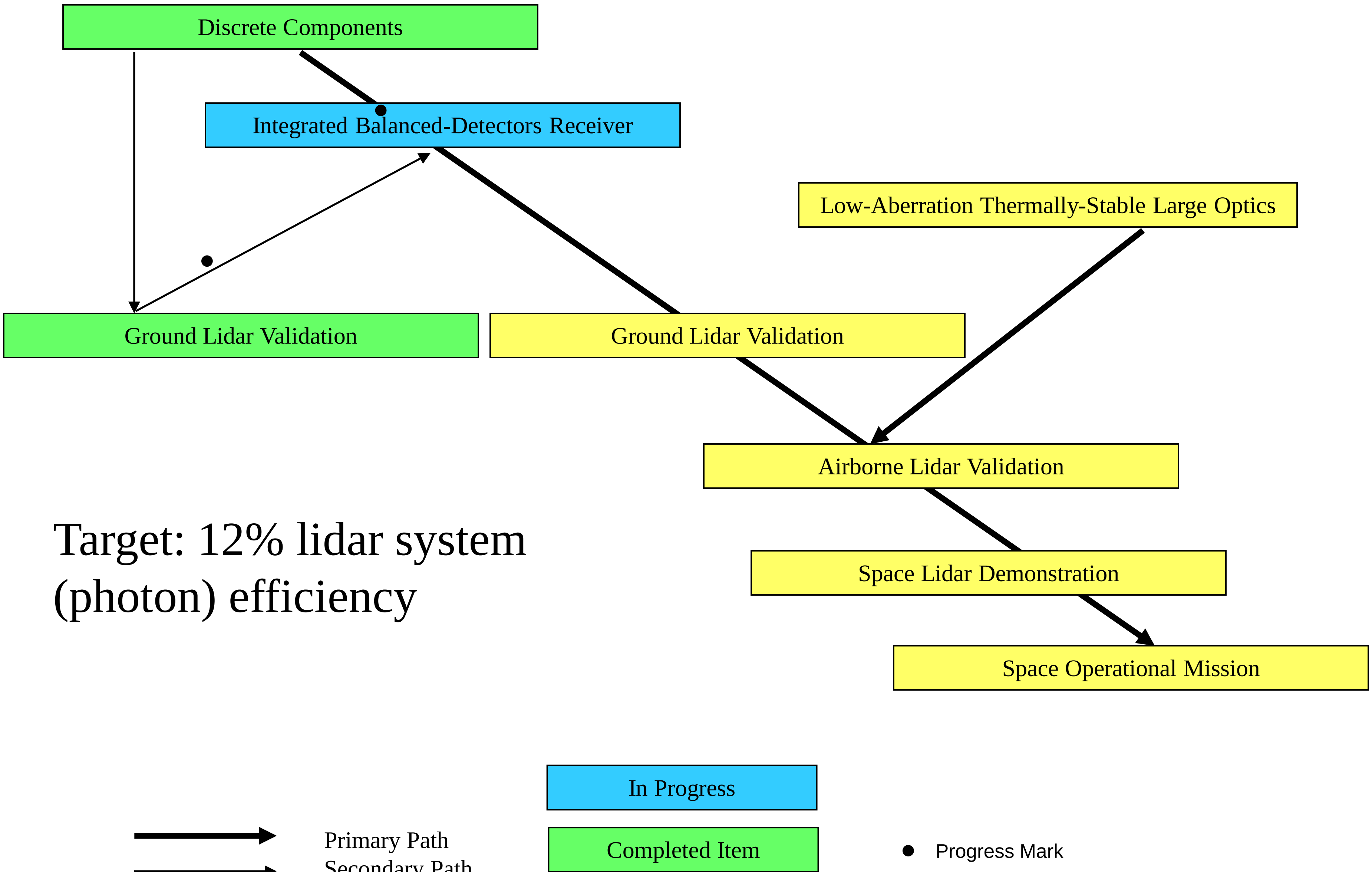
Coherent Doppler Lidar Tunable Local Oscillator Laser



Target: 25 mW, ±6 GHz tuning
< 10 kHz/ms drift

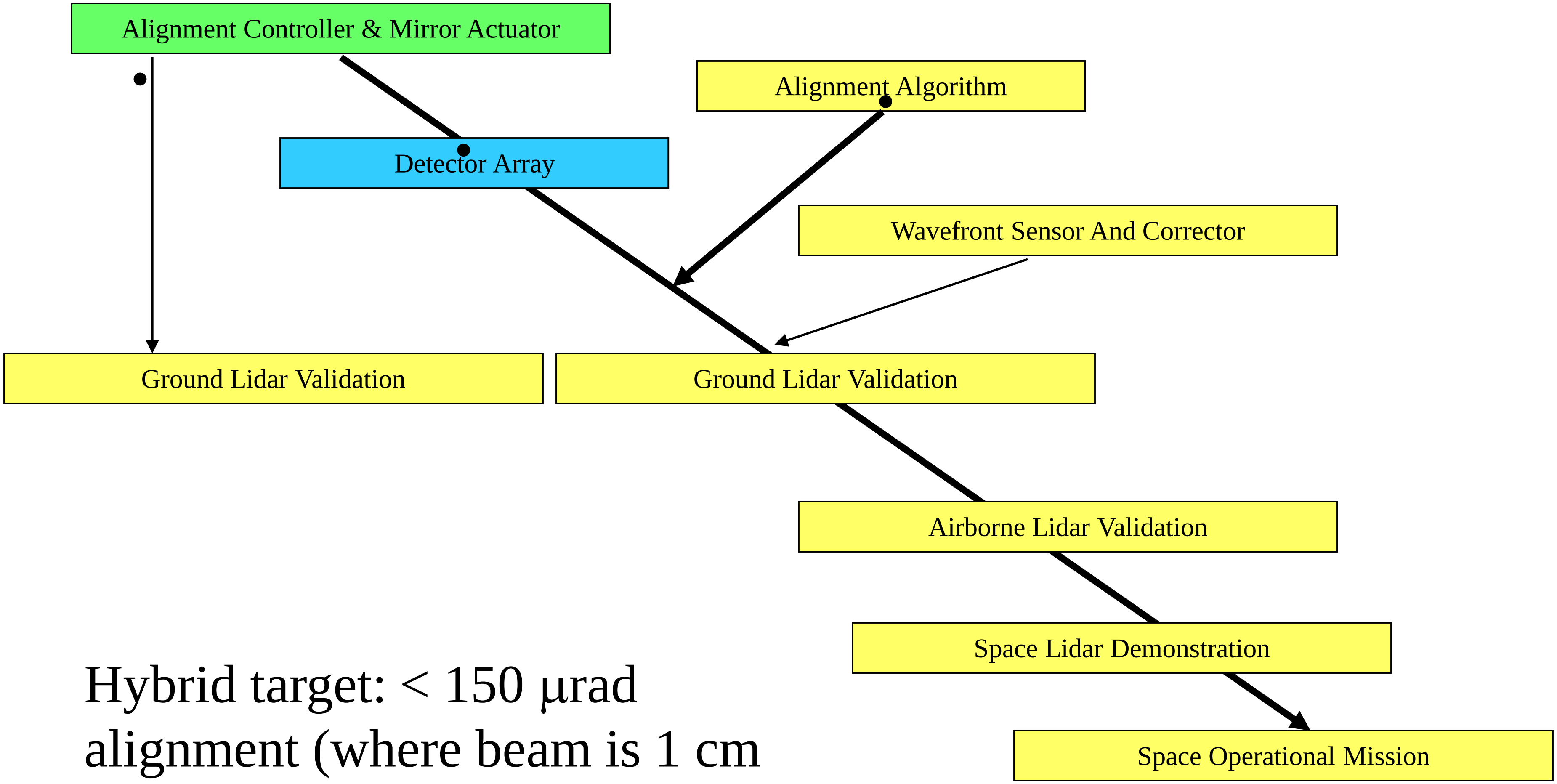


Coherent Doppler Lidar Photon Efficiency Technology



Target: 12% lidar system (photon) efficiency

Coherent Doppler Lidar Autoalignment Technology



Hybrid target: < 150 μrad alignment (where beam is 1 cm diameter)

In Progress

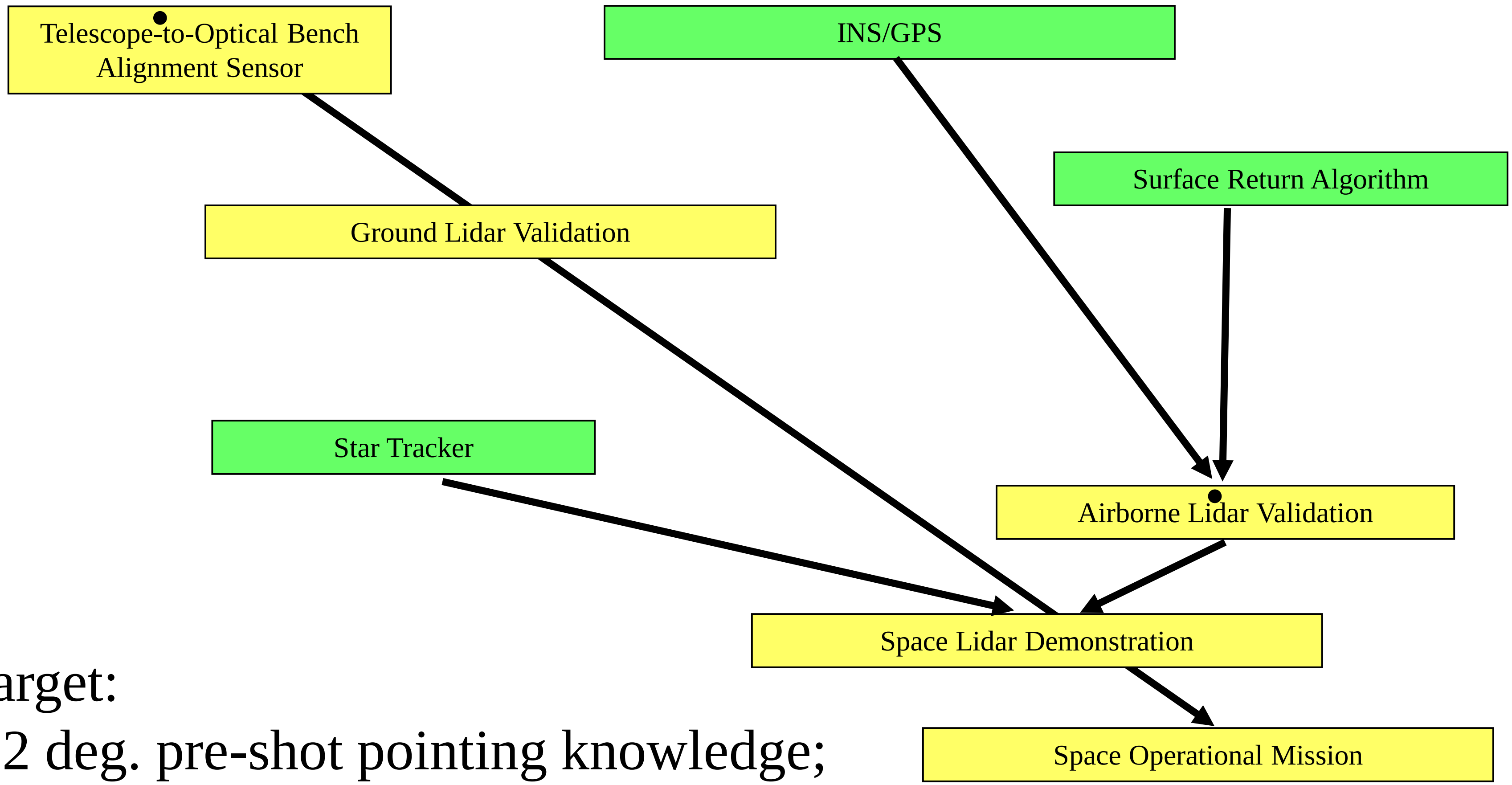
Completed Item

Primary Path

Secondary Path

Progress Mark

Coherent Doppler Lidar Pointing Technology



Target:
0.2 deg. pre-shot pointing knowledge;
50 μrad final pointing knowledge

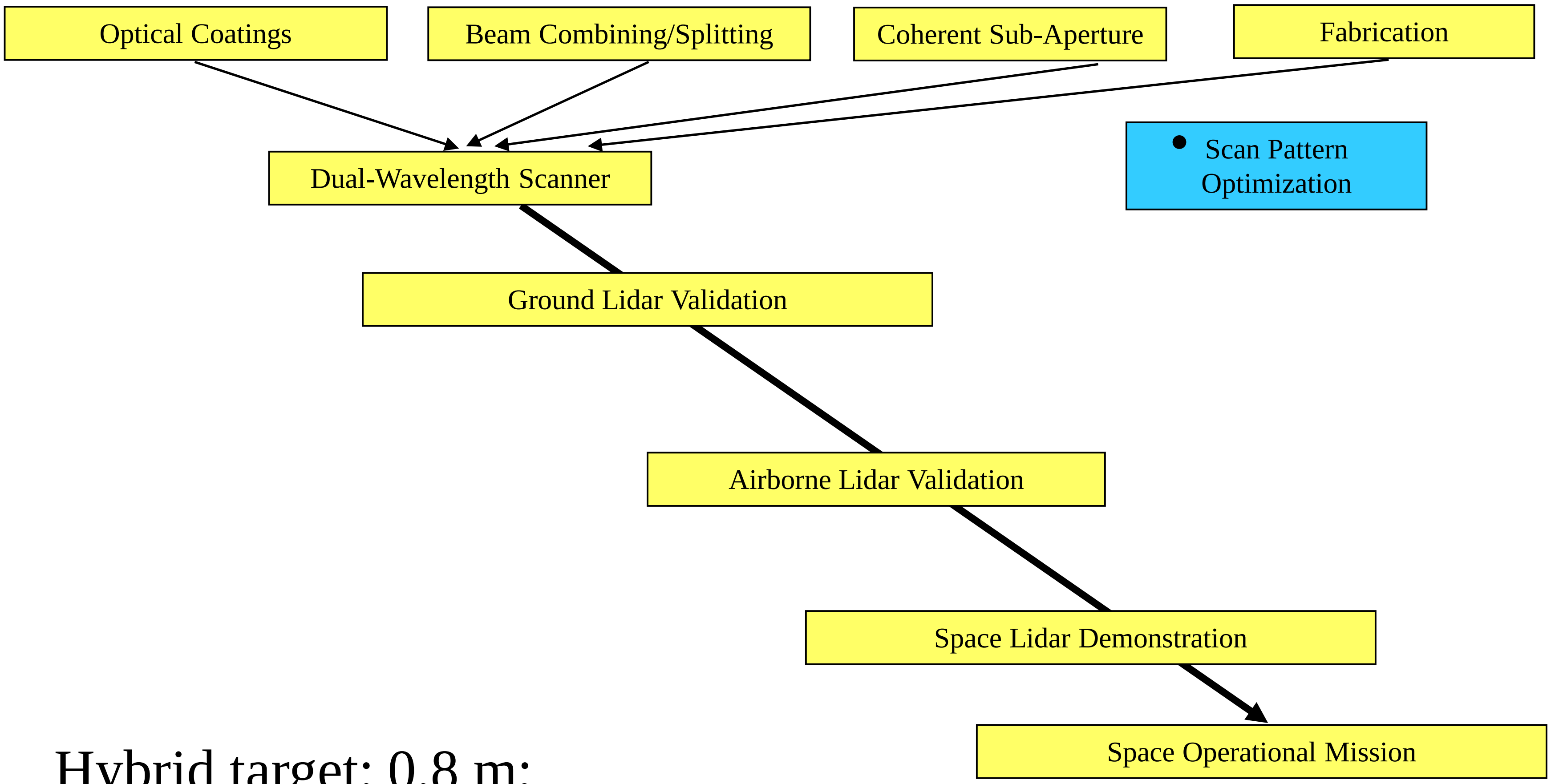
In Progress

Completed Item

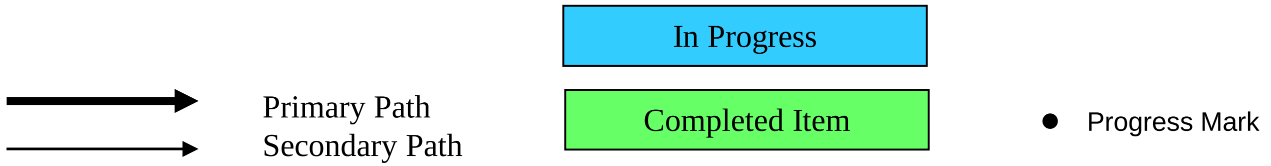
Primary Path
Secondary Path

● Progress Mark

Dual-Wavelength Telescope/Scanner



Hybrid target: 0.8 m;
355 and 2051.8 nm



Conclusions

- The hybrid Doppler wind lidar may be the optimum solution to the difficult global wind measurement opportunity
- The technology roadmap to a hybrid DWL is consistent and almost identical to the former "go it alone" technology paths
- There is much studying to do regarding shared technology, shared scan patterns, and shared spacecraft

BACK UP SLIDES

Progress Mark Explanations

- Pulsed Laser
  - LaRC all-liquid laser validated on the ground already; 700 mJ
  - CTI all-liquid laser, different material, validated in aircraft
  - LaRC partial CC laser close to completion
- Scanner
  - Rotating wedge validated on aircraft by MSFC (MACAWS)
  - Rotating telescope concept examined by GSFC ISAL/IMDC teams
  - LaRC developing low-mass telescope, begun FY02 (ALTP/ECTP/LRRP)
- LO Laser
  - JPL crystal LO validated on ground by CTI (SPARCLE PDR, 12/98)
  - JPL semiconductor laser under development (ATIP)
- Photon Efficiency
  - CTI measured discrete component system efficiency (1999 CLRC, p. 247)
    - ($LSE_{CTI} = LSE_{LARC} * 0.46 * 0.955 = LSE_{LARC} * 0.44 = LSE_{LARC}/2.28$)
  - LaRC developing integrated receiver, begun FY02 (ALTP/ECTP/LRRP)
- Autoalignment
  - CTI SBIR produced 5-element detector array
  - U. Colorado developed detector array theory and algorithm
  - Mirror and controller are COTS; not procured yet
- Pointing
  - GSFC IMDC team designed telescope sensor (2/02)
  - SPARCLE procured INS/GPS (SIGI)
  - SWA developed surface return algorithm
  - TODWL tested surface return algorithm on aircraft (LAHDSSA)
  - GSFC IMDC team stated that current star trackers are adequate (2/02)