Laser Ranging Ground System

- **Progress**
  - Zimmerwald (Switzerland) and Herstmonceux (Gr.Britain) have been approved by the Selection Committee to participate as ground stations for LRO Laser Ranging.   Mount Stromlo (Australia) has submitted a proposal and Wettzell (Germany) is also expected to turn in a proposal this month. Grasse (France), Matera (Italy), and Katsively (Ukraine) have also indicated an interest in participating.

  - Design completed for modifications needed for MOBLAS-5 (Australia) and MOBLAS-6 (South Africa) to participate in LRO-LR. Timing board has been purchased and is in-hand. Testing in lab to start shortly.

  - One-way system delay measurements are in progress at NGSLR. MLRS and Herstmonceux are also working this issue at their stations.

  - All LR tests at NGSLR have been completed and passed with the exception of the independent timing test with Instrument Scientist. This will occur as soon as one-way system delay has been adequately determined.

  - Document detailing the LR tests at NGSLR and results is in preparation and a presentation on this testing was given at the ILRS Workshop in Poland (Oct 13-17,2008).

  - There were several presentations given on LRO-LR at the International Laser Ranging Workshop in Poznan, Poland (Oct 13-17). All of the participating ILRS stations were in attendance and we had good discussions with all of them.

- **Issues & Risks:**
  - Disruption to LRO-LR due to NENS to SCNS contract change.
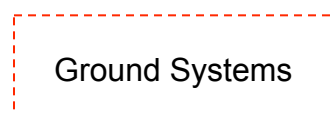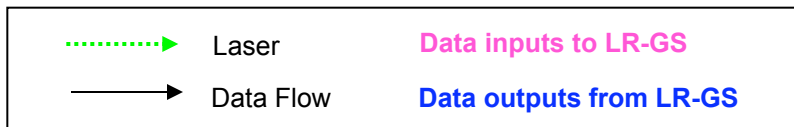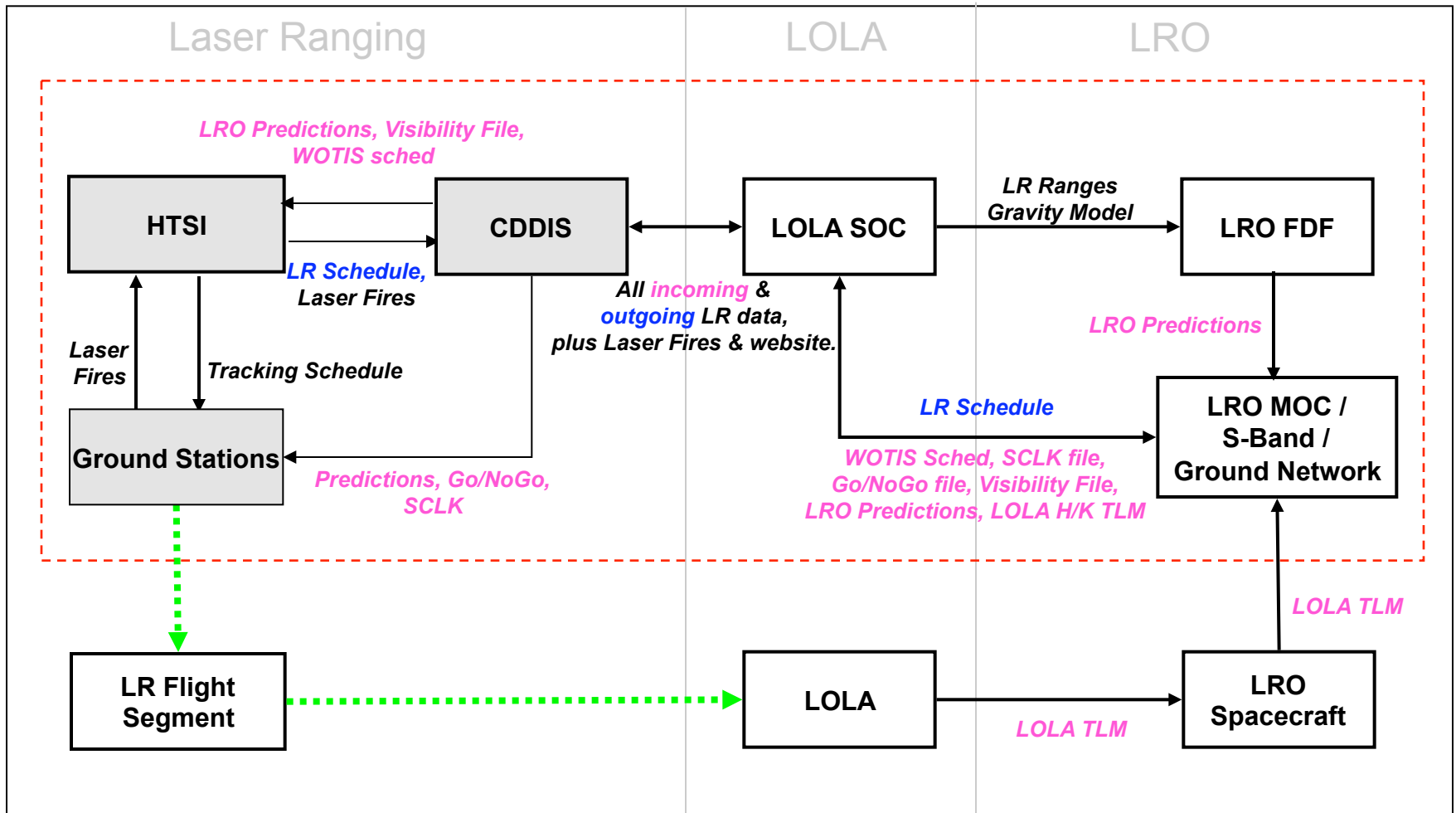
Ground Station Characteristics

➤ Station fire rate and probable events per second in LOLA Earth Window with system configurations as we currently understand them:

	Synch?	FireRate	Events/second in Earth Window	Energy per pulse at LRO fJ/cm^2
NGSLR	YES	28Hz	28	2 to 5
MLRS	NO	10Hz	2 to 4	4 to 12
Zimmerwald	YES	28Hz	28	2 to 10
Herstmonceux	YES	7 or 14Hz	7 or 14	1 to 3
Mt Stromlo	YES	28Hz	28	3 to 14
MOBLAS	NO	5Hz	1 to 2	1 to 2

Requirement: between 1 – 10 femtoJoules per square centimeter at LRO and between 1 and 28 events per second in LOLA Earth Window.

➤ Stations that can deliver energy densities of > 10 fJ/cm^2 or peak power of > 0.07 mW/cm^2 at LRO will need to modify their configuration.   This will be worked out prior to predictions being available.

Laser Ranging Network Block Diagram

Laser Ranging | LOLA | LRO

LRO Predictions, Visibility File, WOTIS sched

HTSI

CDDIS

LOLA SOC

LR Ranges Gravity Model

LRO FDF

LR Schedule, Laser Fires

Laser Fires

Tracking Schedule

All incoming & outgoing LR data, plus Laser Fires & website.

LRO Predictions

Ground Stations

Predictions, Go/NoGo, SCLK

LR Schedule

LRO MOC / S-Band / Ground Network

WOTIS Sched, SCLK file, Go/NoGo file, Visibility File, LRO Predictions, LOLA H/K TLM

LOLA TLM

LR Flight Segment

LOLA

LOLA TLM

LRO Spacecraft

Laser — Data inputs to LR-GS
Data Flow — Data outputs from LR-GS

Ground Systems

JLFM 9/30/2008

Presented at 16th ILRS Workshop, Oct 13-17 (McGarry)

Real-time Feedback from Spacecraft

➢ Website: http://lrolr.gsfc.nasa.gov hosted on CDDIS.

➢ "Real-time" spacecraft telemetry display will be password protected.

➢ Delay from "real-time" will be between 10 – 30 seconds.

➢ Stations can use display to determine if their fires are being detected at LRO/LOLA, and where their pulses are falling in the Earth Window.

➢ Synchronously stations can use website to modify their fire times, if desired:

   - to move their returns earlier in LOLA Earth Window (pulse arrivals earlier in the window have a higher probability of detection because this is a single stop receiver)

   - to "scan" if LRO/LOLA is not detecting their pulses

Real-time telemetry website