University of Arkansas Microelectronics-Photonics Graduate Program

PhD Candidacy Exam – Communications Topic – March 13, 2009

PROBLEM TO BE SOLVED

In about 8 years from now, an American astronaut will set foot on the moon, ending an absence of about 45 years. Back in 1969, TV images of Neil Armstrong's first steps were broadcast live to billions of people worldwide. It was a low-resolution, grainy, slow-scan image:

http://www.youtube.com/watch?v=R9XBAxdKVRE

Your CEO is dedicated to the task of providing the world in 2017 a high-definition system for the next moon landing. His dream is to provide a solution that begins at the camera and ends on the ground station on Earth where the signal first arrives. You should image the astronaut taking the first steps and deliver that image in lossless 1080p format to the ground station. Don't worry about sound, as that will be handled by the existing audio communications system.

Per NASA specs, all video transmission from the Lunar lander to Earth will be by laser. NASA also has an interest in your system continuing to operate through the lander base for at least 20 years after the initial mission, with your system providing both scientific and promotional value. NASA is willing to consider additional contract funding to develop interesting ideas.

SPECIAL DEFINITIONS:

"flight hardware" = goes to the moon
"ground hardware" = stays on Earth

YOUR DELIVERABLE

Your task is to write an internal proposal for your corporate officers describing your approach to this issue. The proposal should include the following:

- Executive summary (one page)
- Risk assessment roadmap form (one page)
- Full proposal (15 pages maximum)
- Appendix A: Bibliography (no page limit)
- Appendix B: Ranked list of intellectual property documents examined (no page limit)

Be sure you address at least all of the following:

Current Science and Technologies - What is already being done in this area by other researchers, companies and governmental institutions? The current state-of-the-art for both the

science and the implementation should be described, making use of diverse resources such as science literature, journals, conference proceedings, the internet, patents or other sources of existing public knowledge. ***Be sure to cite all references that you use and to quote any word-for-word transfer to your report.***

Your Design Approach – What is the basis for your chosen design approach to the problem? Address how your approach balances the many different physical and operational constraints of interest to NASA for this mission. Be sure to address both the scientific and engineering issues of the question.

Testing and Qualification - Describe a set of tests and demonstrations that you will use to demonstrate the effectiveness of your approach and to give confidence that the implementation of the solution will meet NASA's mission objectives.

Cost Analysis – Detail any kind of costs that will impact NASA's acceptance of your proposal for a lunar flight qualified system. Because the CEO is concerned with potential IP leakage if a device is built outside of the company, subcontracting of the manufacturing or assembly of any proprietary component outside of the company is discouraged.

For instance, your analysis could include such things as the major cost items that would impact the implementation, which elements of your implementation solution would be handled in-house versus externally-sourced, major risk elements and recovery plan in case of failure, costs of IP licensing needed, etc. For anything you address, be sure to include not just the "what", but also the justification and/or reasoning behind your decisions.

Intellectual Property - List in rank order of importance all commercial, academic, and governmental IP sources that were consulted while formulating the answer, including key important reference data, in Appendix B. For instance, if the IP source is a patent, include the patent number; title; inventor name; and assignee name. The three that are the most significant threats to your solution should be discussed within the 15-page document, making comparisons of strengths and weaknesses of these approaches relative to your own. Include your recommendations on how these IP threats should be handled.

Most importantly - this is just a minimum list of issues you might consider. There may be many more. The point is that your report ***should contain the evidence*** needed to make an effective and compelling case to your CEO in order to insure that she makes the right decision.

Hint - Your report should read like a story – one logical step followed by another. This will help you stay focused! Re-read along the way to be sure that you have one logical step followed by another.