

NASA: Step Function Improvement in Computers for Satellite Applications

NASA has issued a request for proposals to support its need for dramatic improvement in the performance of the computers used in controlling different aspects of satellite functions. They have an interest to see multiple approaches to enhance computer performance, including such things as optical within-chip communication, advances in memory technology beyond RAM and flash, reductions in mass and volume of the computer, temperature control methods, power requirements, etc. (your product may address any or all of these). NASA is not interested in proposals for next generation processors – that is being adequately covered by industry giants such as Intel.

You are the Chief Technology Officer of a company that has specialized in creating low volume customized high reliability electronic systems for specific applications in harsh environments (e.g., radiation hardness). Your CEO believes that the company's expertise in micro to nanoscale materials, processing, and devices could provide a research and development path to meet NASA's objectives in their solicitation. Even though each individual satellite would require a custom configuration, your job is to define the research and development needed for new base technologies that would provide the platform for many future satellite systems, and perhaps even expansion into other harsh environment computer markets.

While meeting the NASA performance requirements are your priority, the cost of customized systems for NASA satellites will always be very high as compared to off the shelf commercial systems. In order to have potential to be competitive in other market applications which value compact, high-performance computing (military vehicles, military and commercial drones, free-moving human-like robots, etc.), it is desirable if your approach can be easily modified or adapted for lower price-point markets.

Your job as CTO is to deliver a complete proposal with your plan for the company to compete in this area to your CEO by your Monday morning, March 30th deadline.

YOUR DELIVERABLE

Your task is to write an internal proposal for your corporate officers describing your idea for research and development. The proposal should include the following:

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

Most Importantly – The significance and novelty of your creative solution, one that moves the boundaries of knowledge outward, will be the primary assessment focus of your review panel. The list below is just a minimum list of issues you might consider. There may be many more. The point is that your proposal *should contain the evidence* needed to make an effective and compelling case to your CEO in order to insure that she/he makes the right decision.

At a minimum, be sure you address all of the following:

Current Science and Technologies - What is already being done in this area by other researchers, companies and governmental institutions? Describe the current state-of-the-art for both the science and the implementation. Use diverse resources such as science literature, journals, conference proceedings, the internet, patents or other sources of existing public knowledge. **Cite all references you use and use quotes for any word-for-word transfer to your report.**

Your Design Approach – What is the basis for your design approach to the problem? Why is your technology better than existing technologies? What technology attribute(s) make it likely to be selected by NASA? Address scientific *and* engineering aspects of these questions.

Testing and Qualification - Describe a set of tests you will use to demonstrate that your approach is effective and that your implementation of the solution will launch successfully.

Cost Analysis – Identify cost and market issues that will impact the pricing strategy of the solution you have proposed. Consider 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 that could drive up costs if the primary path item fails; costs of IP licensing needed, etc. Provide justification and/or reasoning behind your decisions. Estimate manufacturing cost for the total system as the technology reaches mature stage (in this case, consider mature to be after the fourth successful satellite orbit insertion with full satellite functionality demonstrated), so the marketing team can determine potential for penetrating other markets. Avoid subcontracting manufacture or assembly of any proprietary component outside the company, because the CEO is concerned with potential IP leakage.

Intellectual Property – In Appendix B, list in rank order of importance **all** commercial, academic, and governmental IP sources that were consulted while formulating the answer, including reference data. For instance, include the patent number; title; inventor name; and assignee name for a patent. Discuss the 3 most significant IP documents affecting your approach to your solution in the 15-page document. Compare strengths and weaknesses of these approaches relative to your own. Recommend how these IP threats should be handled.

Hint – Clearly state your hypothesized solution. Identify its innovation(s) and advantages relative to state of the art. Describe both existing data, and work needed to support each aspect of the hypothetical solution. Consider theoretical, fabrication, and characterization aspects: for each, identify software/equipment and methods to use, parameters to vary, anticipated outcomes, and possible alternatives in the event of unsatisfactory results. Discuss material, process, device, and systems aspects of your solution. *Refine* your hypothesized solution as you accumulate information and prepare the manuscript. **Remember:** clearly distinguish what is known from what is hypothesized or not known. What is needed to distinguish the important things to know?

Reference the 2015 PhD Candidacy Exam Guidelines document for general instructions.