

A “Pile of Parts” Cost Model for LWA Stations

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The spreadsheet associated with this document (LWA_CM_SE060811.xls) provides a model for the “pile of parts” (PoP) cost of LWA stations. The PoP cost is defined here to include the cost of all materials, plus the cost to assemble materials into discernible subsystems; i.e., antennas, front end modules, and so on. PoP cost does *not* include any of the following items:

- Cost of shipment of materials to point of construction, nor cost of shipment of subsystems to point of installation.
- Cost of prototypes or other costs associated with non-recurring engineering (NRE).
- Cost of spare parts
- Overages intended to accommodate “infant mortality” (e.g., subcontracted boards delivered “dead” which must be “written off”).
- Any overhead costs, such as F&A costs typically imposed by universities on materials and subcontracts.
- Cost of site preparation, installation, or integration.

The above costs are significant and the expectation is that these will be accounted for in other components in the overall project cost model.

The “Strawman Design Document” (LWA Memo 35) was used as the context for developing for this cost model. Cost data was drawn from several sources, including extrapolation from LWDA and ETA actual costs, experience with these and similar projects, and, in many cases, educated guesses. Whenever detailed designs are used as a basis for a cost estimate, it should be understood that these designs are considered only for the purposes of generating cost data, and should not be taken at a this point as commitment to use any particular design.

Two drafts of this cost model were circulated among a group of key personnel from ARL, NRL, UNM, and VT who in turn sought input from key personnel within their organizations. Thanks are due to all these folks for essential contributions to this work. Specific sources of cost data and justifications for various assumptions are documented in the spreadsheet.

Summary of Findings:

- ***The current model predicts that the first LWA station, LWA-1, is likely to have a PoP cost of \$836K with an estimated upper bound of \$997K. The second station, LWA-2, is estimated to cost approximately the same. Estimates for subsequent stations (LWA-3 and later) are \$732K (best guess) and \$1M (conservative).*** It should be emphasized that these estimates are only as good as the supporting data which, while credible, is preliminary and crude. It is expected

that this model will be revisited at the various milestones in the project (SRR, PDR, CDR), and when/if there are significant changes in requirements or specifications.

- The largest single subsystem cost (in terms of fraction of station cost) in the current model is antennas. Antennas account for 25%-34% of the PoP cost. The cost of antennas in the current model is dominated (59% of subsystem total) by labor. Cutting the labor cost for antenna subsystems by 50% reduces station cost by 7%-8%, and this seems plausible as the cost data are based on manual assembly of the existing design in small quantities. ***An aggressive program of antenna cost reduction, aimed at reducing labor costs and (as much as possible) materials costs is recommended, as cost reductions here will most effectively impact station cost.***
- The next largest subsystem cost (in terms of fraction of station cost) is analog receivers (ARXs), which account for 22%-25% of the PoP cost. It does not seem likely that any dramatic cost reduction is possible, although effort is certainly warranted here.
- The third largest subsystem cost (in terms of fraction of station cost) is digital receivers (DRXs), which account for 14%-20% of the PoP cost. There are two issues of concern here. One is uncertainty concerning the precise FPGAs and other ICs required to implement the required processing, coupled with uncertainty due to the fickle and dynamic nature of the FPGA market. The other issue of concern is the possibility that extraordinary measures may be required to shield digital electronics to meet EVLA emission standards. ***To better constrain cost uncertainty, a technical effort to establish a DRX proof-of-concept design should be a high priority and “left-justified” in the development schedule.*** Furthermore, every effort should be made to avoid paying “retail” for FPGAs by: (1) Carefully planning the timing and quantity of purchases to mitigate the volatile nature of part pricing, (2) Seeking quantity discounts on smaller purchases, arranging to buy lots of past-production (i.e., excess) components, (3) seeking donations, or similar strategies.
- The fractional cost of all other subsystems are predicted to each be less than 10% of station cost. Thus, extraordinary efforts oriented toward cost reduction are probably not warranted for these subsystems in the sense that such efforts would not have the same financial impact as other efforts described above.