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Laurence E. LaForge

on behalf of co-authors Jeffrey R. Moreland, Raymond G. Bryan, and M. Sami Fadali

will present a 10 – 30 minute overview of

VERTICAL CAVITY SURFACE EMITTING LASERS FOR SPACEFLIGHT MULTI-PROCESSORS

Abstract of Full Paper. We highlight how the vertical cavity surface emitting laser, or VCSEL, empowers interprocessor communication for grids of spaceborn computers. To put a face on how VCSELs benefit spaceflight multi-processors, we quantify the scalability of point-to-point optical channels, implemented to achieve fault tolerance and connectivity tuned from sparse to dense. VCSELs can free designers from the tyranny of planar layouts, reduce mass, and realize multi-processor architectures previously considered infeasible. We illustrate with a scalable family for grid computing whose fault tolerance can be tuned from a worst-case constant, to a probabilistic constant fraction, to a worst-case constant fraction of all processors. We synopsise the device integrity and channel robustness of VCSELs, particularly in the presence of low-earth orbit radiation. We conclude by describing multi-processor prototypes that would enable objective, experimental comparison of alternative ways to deploy VCSELs: i) fiber waveguides; ii) photonics crossbars and backplanes; iii) direct, processor-to-processor beams.

Relating historical and programmatic context to what we can (and should) build, this is a survey targeting an audience versed in avionics, optical communications, or computer interconnection technologies. The original paper appeared in the *Proceedings of the 2006 Aerospace Conference*, along with two companion contributions: "Multi-Processors by the Numbers", and "Spaceflight Multi-Processors with Fault Tolerance and Connectivity Tuned from Sparse to Dense".

KEY WORDS AND PHRASES

Spaceflight multi-computers, radiation resistant computing, vertical cavity surface emitting laser (VCSEL), photonics backplanes, Hamming networks, Hamming graphs, Hamming routing, Hamming architectures

Laurence E. LaForge is President of the Right Stuff of Tahoe. Previously on faculty with Embry-Riddle Aeronautical University, he twice held NASA/ASEE Fellowships at the Jet Propulsion Laboratory, where he worked on bus fault tolerance and the *Deep Space 1* probe. He has been guest editor for the *IEEE Transactions on Components, Packaging, and Manufacturing Technology*, and program chair for the IEEE International Conference on Innovative Systems in Silicon. His baccalaureate in mathematics is from the Massachusetts Institute of Technology; he earned his PhD in computer science from McGill University.