Abstract ID: 16502 Title: The Compute Cloud, a Massive Computing Resource for Patient-Independent Monte Carlo Dose Calculations and Other Medical Physics Applications

Purpose: Massive computing resources are needed to generate an extensive linac phase-space (PHSP) database for different radiotherapy beams that could serve as a starting point for several user-applications, such as patient-dependent dose calculations or Monte-Carlo-based quality assurance procedures. The goal of this project is to disseminate our knowledge about performing patient-independent Monte-Carlo dose calculations on the Amazon Elastic Compute Cloud (EC2) and educate medical physicists on technical aspects such as simulation instance management and cluster coordination while ensuring data security for a low CPU cost.

Methods: Amazon-Web-Services, along with Google, Microsoft, IBM, etc, offers resizable compute capacity in the cloud changing the economics of computing by eliminating the server fixed expenses. A cost-efficient elastic cluster is available for a wide users community who can perform Monte Carlo simulations or other numerical applications using Amazon Machine Images. These virtual machines can be configured to work in a particular scientific environment, i.e. GEANT4 or PENELOPE. GEANT4 patient-independent dose simulations were launched in parallel on EC2 using high CPU extra-large spot instances (7 GB of memory, 8 virtual cores at 2.13 to 2.44GHz). Data storage was performed using the Simple Storage Service (S3). The S3 Organizer was used to upload the simulation or download multiple files. The 4-layer EC2 security system, composed of the host/guest operating systems, Firewall, and signed secret access keys, ensures data privacy.

Results: A local script was set-up to launch multiple dose calculation instances on EC2 and automatically save the results on S3. Geant4-application development, testing, and debugging were performed on a local workstation, along with data analysis and comparison with experiment. IAEA-compliant patient-independent PHSP files were generated and dose calculations were successfully validated against experiment.

Conclusions: Cloud computing offers a low-cost alternative for improved radiotherapy planning and optimization algorithms by enabling beam transport and Monte Carlo-based dose calculations.

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