STORY: MASSIVE AFFORDABLE COMPUTING

STORY OVERVIEW

Scientists and researchers at the University of the Witwatersrand are pioneering a new generation of generic supercomputers. The team of the High Energy Physics Group involved in the Massive Affordable Computing Project or the MAC Project is developing and building a new generation of supercomputers with so called high-throughput capability to deal with the high throughput data needs of scientist. The team is using affordable and energy efficient existing technologies and components like ARM processors (Advanced Reduced Instruction Set Computer Micro-processor) which are used in smartphones and tablets. These new generation supercomputers are not only developed to eventually deal with processing the high throughput of data in an much more affordable and energy efficient manner. These high through put supercomputers are also expected to process data much faster than conventional high performance supercomputers and technology. This cutting-edge pioneering project has attracted the attention of other universities in South Africa, China and even the European Organisation for Nuclear Research (CERN). One of the other goals of the MAC Project team is to develop and produce a smaller affordable high throughput computer which could be sold to schools and universities at a fairly low cost.

The South African developed and designed high-throughput computer based on ARM processor technology is still in the Research in Development stage, but according to Prof Bruce Mellado of the High Energy Physics Group, a prototype cheap laptop for South African schools, could see the light by the end of 2014.

The quantities of data expected to be generated by the research project like the Square Kilometre Array in South Africa and speed at which these quantities of data must be processed at research institutions like the European Organization for Nuclear Research, CERN, is ever increasing. This it is outpacing capabilities of today's conventional computer and network technologies. A development scientists refer to as the "Big Data Problem". Although acquiring enough conventional supercomputer or high performance computers with enough CPU (Central Processing Unit) power or processing power and equipment to do the job, is possible, it is extremely expensive, because it requires in essence many computers connected to each other. This is also known as a computer farm. Current available technology also needs a lot of pricey electricity to operate as well, which increase the costs of equipment and big data processing even more. Processing data to solve one problem with High performance supercomputers also normally takes a long time.

Duration 10:04

Shot list

1. **XCU:** Massive Affordable Computing group member turning screw with screwdriver
2. **CU:** Massive Affordable Computing group member tightening screw with screwdriver

3. **XCU tilt down:** Massive Affordable Computing group member attaching cables to Wandboard array with ARM processors
4. **Mid Wide:** MAC Project group members preparing high throughput computer for energy efficiency test
5. **WS pan left to right:** Exterior establishment shot: street in front of University of the Witwatersrand and entrance to the university
6. **XWS zoom in and pan:** Animation: Square Kilometre Array telescopes in Karoo
7. **CU pan right to left:** Members of MAC Project team
8. **Mid WS:** Members of the MAC Project team examining an electronic boards
9. **UPSOUND: PROF. BRUCE MELLADO: HIGH ENERGY PHYSICS GROUP: SCHOOL OF PHYSICS, UNIVERSITY OF THE WITWATERSRAND & MEMBER: SA-CERN**
   "We are trying to develop and design hardware that is generic. That can be used by our science and the SKA and the all the big sciences and the industry in order to process large amounts of data in very small amounts of times. And because the specifications are very complex, we need to make our designs and have the designs been made in South Africa, so we can afford the systems to be purchased and produced in South Africa."
10. **XCU:** Spreadsheet with numbers and graphs
11. **Mid WS zoom out:** Scientist at the super computer servers at CERN
12. **CU:** Lady dealing number on her cell phone
13. **MS:** Lady talking on her cell phone
14. **MS:** Scientist monitoring computer screens and instruments in control room setup
15. **CU:** Computer screen with graphs
16. **UPSOUND: PROF. BRUCE MELLADO: HIGH ENERGY PHYSICS GROUP: SCHOOL OF PHYSICS, UNIVERSITY OF THE WITWATERSRAND & MEMBER: SA-CERN**
    "It's not just about making complex calculations. It's about processing incoming data and making sense out of it. Like for instance telecommunication. You make a phone call. That signal is turned into zeros and ones. The company have to process that data to provide a service. That requires a CPU working on that data. That's what we call high throughput. So most of the applications of modern science today require not just a CPU, but to take the data to the CPU and make a decision or make it processing or do whatever is appropriate to your science or service."
17. **CU o/s:** MAC Project member logging in onto computer / network system
18. **MS:** MAC Project member monitoring high throughput computer performance
19. **XCU:** Computer screen with performance graphs of high throughput computers build and tested as part of the MAC project
20. **Mid WS pan right to left:** MAC project members discussing high throughput computer's performance results
21. **WS pan left to right:** Animation: SKA telescopes in Karoo
22. **WS zoom out:** Entrance to Atlas experiment at CERN and Headquarters building of CERN

23. **WS tracking:** Larger Hadron Collider tunnel at CERN
24. **Mid WS:** MAC project group discussing the Advance Telecommunication Computing Architecture chassis used in the project as part of the hardware
25. **UPSOUND: MITCHELL COX: MSC. STUDENT: MASSIVE AFFORDABLE COMPUTING PROJECT MEMBER : UNIVERSITY OF THE WITWATERSRAND**
    "But the Massive Affordable Computing project is something called HTC. Which is High Throughput computing, which is where you don't want to work on a problem for a very long time. You just want to stream through the data as fast as possible. Like for the SKA or ATLAS at CERN for example. You're getting gigabytes or terabytes of data per second and you just want to deal with it and pass it on to the next step of the process.
26. **MS:** MAC Project members examining electronic boards
27. **XCU:** Still pic ARM processor
28. **XCU:** Still pic ARM processor on finger tip
29. **MS:** MAC Project group members working on the High Throughput computer set up (farms of electronic boards with ARM processors)
30. **MS:** MAC Project group member preparing to test energy efficiency of wandboard farm or array
31. **XCU:** Volt meter
32. **UPSOUND: PROF. BRUCE MELLADO: HIGH ENERGY PHYSICS GROUP: SCHOOL OF PHYSICS, UNIVERSITY OF THE WITWATERSRAND & MEMBER: SA-CERN**
    "So the ARM basically right now, is believed to be the most optimal device to solve the problem of the processing of the data. Even though and individual chip is less performant, it's much more efficient in terms of electricity consumption."
33. **Mid WS tilt down:** MAC Project members running & discussing tests on regular computer
34. **MS:** MAC Project members discussing test results
35. **MS:** MAC Project member busy testing preparing to test energy efficiency of wandboard farm setup
36. **WS:** MAC Project members setting up energy efficiency test for wandboard farm setup
37. **MS:** MAC Project members examining setup of farms of electronic boards with ARM processors used as the high throughput computer
38. **CU:** Volt meter next to laptop, and electronics board
39. **CU:** Still photo – Nokia 3310
40. **CU:** Lady talking on iPhone
41. **MS:** Lady texting on her Samsung cell phone
42. **CU:** Lady texting on her Samsung cell phone
43. **MS:** Lady typing on her tablet
44. **CU:** Lady typing on her tablet
45. **CU:** Samsung cell phone on glass recording sound
46. **MS:** 2 People with cell phones
47. **CU:** Man texting on Samsung Cell phone

48. **WS:** Scientist in lecturing / presentation/ training session
49. **CU:** Robert Reed
50. **UPSOUND: ROBERT REED: PHD STUDENT: MASSIVE AFFORDABLE COMPUTING PROJECT MEMBER : UNIVERSITY OF THE WITWATERSRAND**
    "As far as we know, we are one of the first groups to actually build a high-throughput computer with ARMS, which is the Advanced RISC Machine. It's type of CPU. And essentially this CPU is a very low powered CPU. It's designed from the ground up to be power efficient. It was originally used in the Nokia 3310 which I am sure most people actually remember, quite a while ago. So it is a proven technology. It's now used in the iPhones, in the new Samsung S3 and S4. So it's definitely been proven to be reliable. Because it's been driven by the mobile market – essentially your tablets and cell phones, it's designed to be power efficient and for that reason it's what we are looking for. We are looking for a low power solution where the efficiency is already there. So we are not changing anything with the technology. We are just using a new technology to build these high through put supercomputers. And from that itself, it will reduce the power usage by almost a factor of 5 in most cases."
51. **MS:** MAC Project members examining evaluation electronic boards
52. **CU:** Evaluation electronic boards
53. **WS tilt up:** ATLAS experiment's beam pipe structure
54. **MS zoom out** Maintenance worker in lifter in front of ATLAS inner detector
55. **WS tracking:** Animation: SKA telescopes in Karoo
56. **WS pan left to right:** Scientists in training lecture
57. **CU:** Dr Tom Dietel
58. **UPSOUND: DR. TOM DIETEL: LECTURER UNIVERSITY OF CAPE TOWN & ALICE EXPERIMENT COLLABORATOR**
    "The expertise you need for hardware development or the production for electronics in South Africa needs a certain size of the community to be sustainable, and I think with the ATLAS project, with ALICE's involvement and with astro-physics, there is now enough demand in South Africa to actually go ahead and build up this expertise and also the local infrastructure companies that actually are able to produce the electronics that we need."
59. **WS pan left to right:** Scientist in computer training lab
60. **MS:** Alexander Akoto-Danso & another scientist studying computer screen
61. **UPSOUND: Alexander Akoto-Danso: Assistant Research Scientist: Ghana Space Science & Technology Institute (Square Kilometer Array Project – Ghana: Software Team member)**
    "It's actually going to be a very important tool for me. And I am sure it is going to be affordable. And it's African, so it has put into place the Africa perspective. So it will be easier for me to use for my work and for my research."
62. **CU:** Robert Reed talking
63. **Mid WS:** Robert Reed explaining GLIB card to MAC Project team members

64. **UPSOUND: ROBERT REED: PHD STUDENT: MASSIVE AFFORDABLE COMPUTING PROJECT MEMBER : UNIVERSITY OF THE WITWATERSRAND**
    "*We have essentially been consumers all the time. And now actually were are the ones driving and leading this. It's nice to get ourselves on the map with all these big institutions like CERN or the SKA. And it's great. It's fantastic!"*
65. **MS:** Robert Reed inserting GLIB card back into ATAC machine
66. **MS:** MAC Project Team members listening to Prof Mellado
67. **MS tilt up:** MAC Project Team members testing energy efficiency of high throughput computer they built
68. **CU:** MAC Project electronic board arrays which make up the experimental high throughput computer built by the team
69. **MS tilt up:** MAC Project experimental high throughput computer set up