# My Quest for an Internet

In the seventh installment of our weekly series at emeagwali.com, we focus on the continuous reinvention of how to use interconnected computers as an internet. In 1989, Philip Emeagwali used 65,536 computers to perform a world record 3.1 billion calculations per second. His computers were connected as a 16-dimensional hypercubic, polycentric internet.

The Reinvention of the Internet

Transcribed and edited from a lecture delivered by Philip Emeagwali. The unedited video is posted at

emeagwali.com.
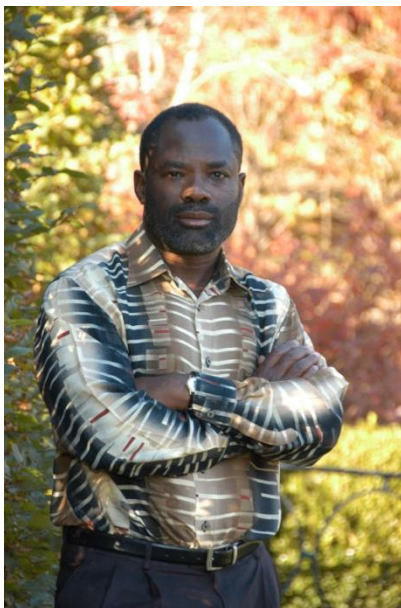
The Internet began unheralded in 1940. That was the year a telephone was first used to remotely control a computer. That internet has been continuously reinvented. Today, it is a 10,000 mile-wide electronic network that enshrouds the planet. Our understanding of how to use this network to compute and communicate has grown since 1940.

I theorized that a network of 65,536 computers enshrouding the Earth could be used to forecast the weather. I coined the term "hyperball" to describe my invention which had the size, shape, and form of the Internet. Some of the knowledge I developed from my theorized internet were applied when I programmed 65,536 sub-computers to compute at the then unheard of

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rate of 3.1 billion calculations per second in 1989. This feat made headlines because I succeeded in pushing the technology's frontier by programming an ensemble of sub-computers to do something it could not previously do.

I programmed a dozen machines powered by connected computers, each slightly different,

> I programmed a global network of 65,536 computers like an internet.

but most were asynchronous. They are the most deceptive ensemble I have ever programmed. I spent 90 percent of my time on the communication primitives of asynchronous systems, not on computation as was widely believed.

I focused on the "memory wall" problem. I had to think about the time to load a floating-point from main memory into processor versus the time it takes to do the operation. For data-intensive problems, it reduced the efficiency of the ensemble of

65,000 computers to that of the main memory of each sub-computer.

The world's fastest computation can only be achieved with the fastest communication. So while others were focusing on the raw computing power that made it a supercomputer, I focused on the communication speed that made it an internet, or the exchange and flow of data from one sub-computer to another. This process involves a sub-computer emailing data to its nearest-neighboring sub-computers. Using all 65,536 computers to simultaneously compute only works if each sub-computer receives the exact data that the sending computer intends to send.

The computation that defined it as a supercomputer was conventional but the communication that redefined it as an internet was unorthodox.

To the layperson, the humongous communication is invisible, the fast computation is visible, and the technology is merely a supercomputer. From my perspective as the programmer that crafted the communication primitives, each asynchronous ensemble is more of an internet than a supercomputer. To this day, it remains the most charismatic, glorious, and temperamental ensemble of computers I

have ever programmed.

The journey from an internet with only one computer to one with 65,536 computers to one with a billion computers to one 10,000 miles wide had 10,000 *ah-ha!* moments. Mine was one of those *eureka* moments, and it made the headlines.

It's a myth that the internet has one, and only one, father. It's just that, a myth. The

> The deeper you understand the internet, the closer you see the planet-sized supercomputer of the future.

On the practical side, 65,536 interconnected sub-computers was a fearsome ensemble. The thought of programming 65,536 computers as an internet was so intimidating that it was declared impossible mission. For that reason, most supercomputer programmers didn't give it a second look, and the machines were abandoned.

Typically, I simultaneously fired 65,536 emails to 65,536 addresses of 65,536 computers, each a unique string of 16 zeroes and ones. The emailed data was transmitted along 16 directions and used to perform 65,536 calculations at the same time, breaking world records and breaking new ground.

laws of physics, the techniques of mathematics, the tools of computing, and the technologies of the internet are the end products of rediscoveries and reinventions.

In theory, the internet was invented in 1940 with only one computer. I theorized 65,536 computers as an internet. I programmed 65,536 computers like an internet. Thus I reduced my theorized hyperball to practice as a hypercubic internet that performed world record computations and communications.

The internet contains the web.

The internet is a planet-sized container of information and an electronic cloth that enshrouds the planet like a rain forest

canopy. The Web is one of the items within that container. The internet contains the web just as the Earth contains Lagos.

The idea of an internet occurred to many people at different times and places. As a result, the internet has many fathers, as well as mothers, aunts, and uncles and each must be acknowledged for us to understand the various threads that define the technology.

The deeper you understand the internet, the closer you see

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the planet-sized supercomputer of the future. The internet is an infrastructure comprising billions of cables and computers but my supercomputer–which is also an internet–is comprised of millions of cables and thousands of sub-computers.

To reinvent the internet means to push the frontier of the technology and to make it do something it previously could not do. My work contributed to a new and improved technology that is part supercomputer and part internet. It was one of the *eureka* moments in the history of the internet and why I am profiled in some books on the "history of the internet."

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This photo was taken for the Detroit Free Press profile on internet pioneers. [Philip Emeagwali, *Detroit Free Press*, Page 8F July 8, 1991]

Date: 11/16/2007, 8:13 pm, GMT +6

Name: Mezie Okolo <86.13.220.163>

Location: London, UK

Number: 228

An illustrous son we admire. We are proud of you my brother. We look forward to an

Emeagwali Technological Institute that would give our people an opportunity to catch up with high tech.

Thousands of our jobless graduates could benefit and their talents harnessed.

Date: 11/11/2007, 10:45 pm, GMT +6

Name: Yinka <86.15.103.157>

Location: Manchester Uk

Number: 227

Im a teacher of ICT in an inner city Uk school. the days of using bill gate as a example to inspire black youth are gone. with great pleasure you are the model I present to those disengaged pupils and your achievemnts are a great inspiration to them. That you. keep up the good work. God Bless

Date: 11/10/2007, 7:37 pm, GMT +6

Name: Chidubem Dibie <193.219.221.73>

Location: Lagos, Nigeria

Number: 226

Sir, I have always admired and loved your achievements. You are a true ambassador of Nigeria, your tremendous achievements encourages the youths of africa that they could get to any height in life as far as they are determined. You are a sunshine and motivation to African youths and I respect you alot.

Date: 11/7/2007, 5:28 pm, GMT +6

Name: JOHN DIOKA <83.229.103.212>

Location: ENUGU NIGERIA

Number: 225

hi brother, keep up d good work n more grease 2 ur efforts at INVENTIONS. IGBOs, NIGERIANS, AFRICANS, etc are proud of u. take care n bye.

Date: 11/7/2007, 2:39 pm, GMT +6

Name: Obijiofo Fidelis C. <208.70.5.34>

Location: Kaduna-Nigeria

Number: 224

In the sight of God, we all are awesome creature. However, it is left for each individual to dicover their talent and make the best of it. Prof, it is an honour to know and read about people like you........because, its very inspiring. I hope Your son knows how blessed he is to have a dad like u.....he also should continue in that same spirit.

Date: 11/7/2007, 2:26 pm, GMT +6

Name: keji olawoyin <77.160.45.36>

Location: The Netherlands

Number: 223

Hi Prof.I have helped in spreading your

name and invention to the conservative white people who never belief anything great could come out of blacks and indeed Africa.

Date:	10/31/2007, 6:11 pm, GMT +6
Name:	UDENDU, Chukwulozie Emmanuel <41.204.224.7>
Location:	Ogidi, Anambra State Nigeria
Number:	222

Phil,
You have made Anambra People, 'Ndigbo' and Nigerians in gerneral very proud. You are an ideal role model.

Date:	10/29/2007, 10:32 pm, GMT +6
Name:	Okite Okite <81.199.193.211>
Location:	Umuahia-Nigeria
Number:	221

We over here are proud of you. Philip, you are a rare gem... you have written your name on GOLD. Please come home, and help the economy your NIGERIA... ONYE IJE LOTA, BIKO

Date: 10/28/2007, 4:56 am, GMT +6

Name: Chris Okoli <76.185.205.147>

Location: Dallas TX

Number: 220

I am so proud of what you have done for African Continent, and I urge you to continue to do more. God will continue to see you through in all your endeavors.

Chris Okoli.
Financial Adviser
972 697 6013. Cell Phone.

Date: 10/21/2007, 7:10 pm, GMT +6

Name: Raphael
               Bhembe <168.210.90.181>

Location: S

Number: 219

Thank you for being an African hero.
Please consider
tourinf Swaziland to promote Science and
Technology

Date: 10/17/2007, 7:28 pm, GMT +6

Name: Ezra <196.11.134.77>

Location: Johannesburg- South Africa

Number: 218

Dear Prof.. You're a blessing.. and thanks
for making me proud to be an African. I
hope and pray that most black kids can
know about ur achievement, especially in
Southern Africa.

Thank you.

Date: 10/14/2007, 3:01 am, GMT +6

Name: Anaekwe Ogonna
           Jnr <80.255.41.170>

Location: Lagos, Nigeria.

Number: 217

Dear Prof. Emeagwali,
I am exceedingly happy that a man of Igbo extraction is making waves all over the globe. You are a blessing to the world.

Date: 10/13/2007, 7:58 pm, GMT +6

Name: Dr.Clifford C.
           Wokocha <80.240.220.38>

Location: moscow

Number: 216

Your achievements are a great insp[ration to generations yet unborn.Nigeria,Africa indeed the world has a genius, whose sucess has a multiplier effect to all, who care.May the Almighty God ,continue to

inspire you to even greater, unexplored areas of human knowledge.