



Quest for internet

In this, the sixth installment of our weekly series at emeagwali.com, we focus on the network behind Emeagwali's 1989 discovery of how to use 65,536 computers connected as a polycentric superinternet (two words Emeagwali coined) to perform a world record 3.1 billion calculations per second. It was the most expensive experiment in the history of computing, earning him a mention in the *Wall Street Journal*. In 2010, a similar supercomputer costs millions of man-hours and 1.32 billion dollars, according to the October 5, 2010 issue of the *Wall Street Journal*.

How I Discovered a Perfect Superinternet

by Philip Emeagwali

Transcribed and edited from a lecture delivered by Philip Emeagwali. The unedited [video](#) is posted at emeagwali.com.

Every invention is imperfect; yet each imperfect product is an opportunity for

The 18 equations and algorithms that I invented went into a machine that was part supercomputer and part superinternet (a word that I coined), comprised of a union of 65,536 computers and over a million email channels that sent and received emails along 16 perpendicular directions and over an interconnect that is polycentric.

another reinvention. When the modern computer was invented, it was hailed as a supercomputer, and people believed that the world would need only one. Now that we've reinvented the supercomputer as a superinternet— as 65,536 computers sending and receiving emails as a superinternet— I predict that the world will need only one.

We must plan for the era when the computer, as we know it today, will be obsolete. If history repeats itself, the supercomputer of today will become the computer of tomorrow. I believe that the supercomputer that will replace the computer will become an internet.

One of my *Aha* moments came when I discovered that the 65,536 connected sub-computers are polycentric, with centers everywhere. Their two-to-power-16 centers defined and outlined a polycentric internet.

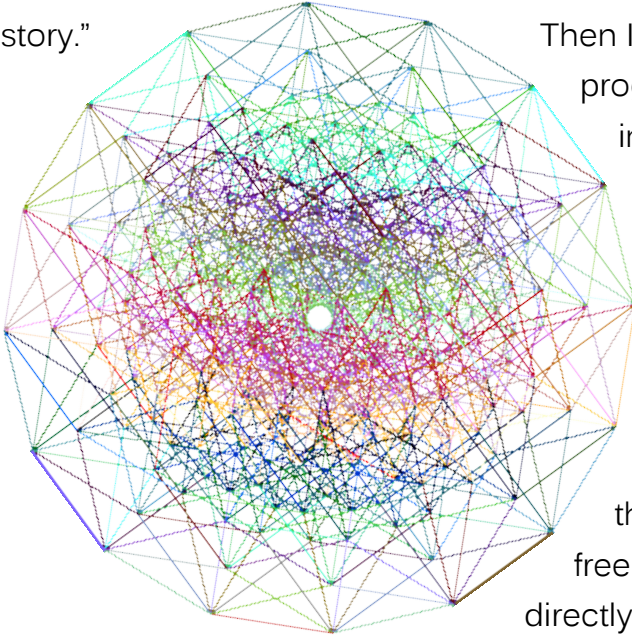


My wife Dale and I in Sandals Royal Carribean, Montego Bay, Jamaica, March 21, 2001. I was heading to Kingston Hilton Hotel to deliver a lecture to the Jamaican Computer Society.

That discovery enabled me to look into the 16th dimension of my superinternet, as well as take advantage of its hypercubic symmetry. We are blind to what exists from the 4th to the 16th dimension. So I had to emulate the blind person who relies on his or her mind's eye to see without seeing. Polycentricity enabled me to reduce the 16th dimension in my mind's eye and see it in the third. re programming, I meditated on putting my consciousness at the centers, and nowhere outside. I visualized independent calculations made at each center followed by answers communicated to its 16 nearest-neighboring centers. Because the polycentric superinternet has no dominant center, it has no

controlling computer. It became a supercomputer formed out of 65,536 computers.

So when I
story.”



was asked to reveal my secret, I said “it is a long
Then I add that one of my secrets was that I
programmed the machine differently,
including visualizing it as “polycentric.” I
was the first to use the term
“polycentric” to describe an internet.

I discovered that the sixteen-
dimensional hypercubic structure gave
the supercomputer regular form and
freedom in which each computer could
directly send an e-mail (for example, “give me
data”) to its sixteen nearest-neighboring computers before they all synchronously
move on to the next computation-communication cycle.

me to own who I am.

I Learned that it takes tremendous stamina and fortitude to ~~reach~~ enter into technology's terra incognita, or stay at the top of your game. When you arrive at the top, you will be proclaimed as the anti christ of your game.

I first heard that term, "anti-christ" when a ~~Klu Klux~~ Ku Klux Klan writer used it to describe me. They

I learned that every reigning Pope

chant-anti-christ-Of

I discovered that when the deep connections and the 16-dimensional orthogonal

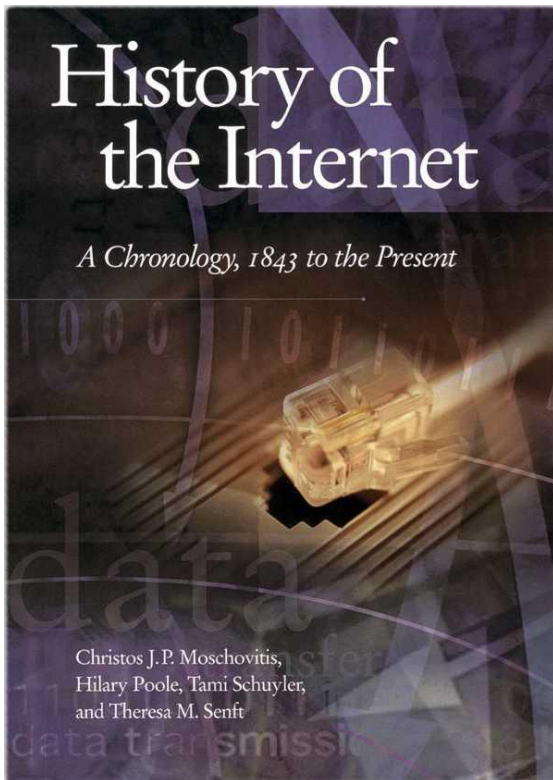
I visualized each computer that defined my superinternet as located at the vertices of a fictional hypercube, or a cube in 16 dimensions (2 to the power of 16). I discovered that my 16-dimensional hypercube is polycentric and can be embedded onto a honeycomb topology that I had previously invented.

symmetries of the hypercubic superinternet are concretized in the form of 2 to the power of 16 or 65,536 sub-computers. Each was connected to 16 sub-computers and they became a polycentric internet communicating in a Pythagorean democracy as one seamless supercomputer. This forces us to rethink everything we “know” about the supercomputer. The machine then called a supercomputer became reinvented as part supercomputer and part superinternet.



Contrary to what was widely publicized, I programmed a dozen machines in different cities, each part supercomputer and part superinternet. I theorized a planet-sized superinternet called a hyperball, two words that I coined. I programmed machines called hypercubes and hypertrees. The smallest and slowest had 32 computers while the largest and fastest had 65,536. For ease of understanding, I will describe a composite machine with the salient features of all sixteen.

I programmed 65,536 computers that were connected like a sixteen-dimensional hypercubic superinternet. This required that I envision the hypercube as a cube in a theoretical sixteen-dimensional universe. I visualized each computer as located at the vertices of a fictional hypercube, or a cube in sixteen dimensions (two to the power of sixteen). This sixteen-dimensional hypercube is polycentric and enormously more complicated than a factual cube in our observable three-dimensional universe.



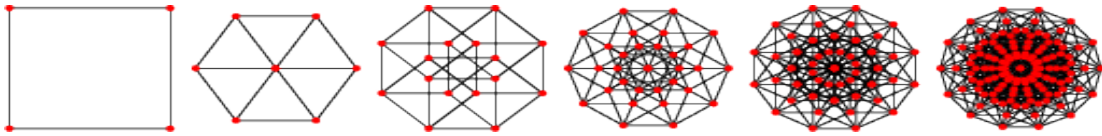
This book contains a one-page description of my contributions.

The story of my discovery began with the 330-year-old Second Law of Motion and ended on a polycentric superinternet. The Second Law became nine mathematical equations, and then nine supercomputer algorithms, yielding 24 million interlocking algebraic equations distributed across 65,536 interconnected computers. Those equations made visible the infinitesimally small, which made the invisible visible, making the future present when simulating fluids that flow anywhere in our universe.

The equations went into a machine that was part supercomputer and part superinternet, comprised of a union of 65,536 computers and over a million email channels that sent and received emails along sixteen perpendicular directions and over an interconnect that is polycentric.

Your dictionary defined the internet as a network of computers. By definition, my speed records in computation and communication pushed the frontiers of supercomputer and superinternet. The new frontier, in turn, redefined my network of network that is deeply nested sixteen times to the sixteenth dimension as connected like a superinternet. That is, my supercomputer is a superinternet, and vice-versa. It's a superinternet outlined by 65,536 computers.

My communication polycentric pathways for my emails messages from my ensemble of 4, 8, 16, 32, 64, and 128 computers that were connected as one seamless, cohesive superinternet that is a supercomputer.



This diagram is my original sketch of my five-dimensional hypercube with 32 polycentric centers.

Notes that led to my discovery that my supercomputer is a polycentric superinternet, or a network of a network. In the early media attempts to simplify a complex story, my 65,536 computers that were connected as a superinternet was unremarked upon and with the passage of time seemed unremarkable. They forgot the technique so it appears it had no technique and the technology became the focus. I became a victim of my own success.

I had a dozen machines of different hypercubic dimensions. The largest configuration had two-to-power sixteen (65,536) computers for logical and integer operations and two-to-power twelve (or 4,096) computers for floating-point operations. But with virtual computing, the floating-point emulated 65,536 computers.

The power of the machine emerged in the quiet, telling techniques: computing at 65,536 unique nodes and simultaneously sending and receiving as many emails via over one million email pathways.

THEORIZED SUPERCOMPUTER

Dimensions	Corners	Edges	Squares	Cubes
1	2	1	0	0
2	4	4	1	0
3	8	12	6	1
4	16	32	24	1
5	32	80	80	10
n	$\binom{n}{0} 2^n$	$\binom{n}{1} 2^{n-1}$	$\binom{n}{2} 2^{n-2}$	$\binom{n}{3} 2^{n-3}$

where $\binom{n}{k} = \frac{n!}{(n-k)!k!}$

$n! = 1 \times 2 \times 3 \times 4 \dots \times n$

For example, $\binom{5}{3} = \frac{5!}{3!2!} = \frac{1 \times 2 \times 3 \times 4 \times 5}{1 \times 2 \times 3 \times 1 \times 2} = 10$

Sixteen-Processor Hypercube Supercomputer

We ended up with two visions: their simplified understanding that I programmed a supercomputer and my complex explanation that I programmed a superinternet that I defined as a network of 65,536 computers.



Guestbook Letters, Unedited

Date: 6/21/2007, 3:57 pm, GMT +6
Name: Victor Solomon <82.206.131.167>
Location: Ota
Number: 184

Are you Born-again? if you are, your are

Complete.

Thanks

Date: 6/20/2007, 7:45 pm, GMT +6

Name: MariaEmmanuel
Okoye <213.181.91.50>

Location: University of Ibadan

Number: 183

You are a great man. Please do help us in processing information overload into value. Duplicate yourself among Nigerians

Date: 6/20/2007, 5:23 pm, GMT +6

Name: ikeazor anieto <195.245.109.67>

Location: imt enugu

Number: 182

come 2 nigeria and help the government of the day to develop technologies.thanks.

Date: 6/15/2007, 3:36 pm, GMT +6

Name: Oloyede Festus
Oyeyinka <81.18.42.99>

Location: UNIJOS, NIGERIA

Number: 181

You are a role model to me and many young people, especially NIGERIANS. I have concluded that i have no reason not to succeed and affect the world. My dear Prof. Philip, much is expected of you as "it is not life that matters but the courage you are able to bring to life".

Date: 6/4/2007, 9:21 am, GMT +6

Name: Nnamdi <193.93.97.162>

Location: Maiduguri, Nigeria

Number: 180

i was filled with a sense of nostalgia while reading articles on this website. All i can

say is thank you. I am very interested in the call center business mentioned in one of your speeches. I intend to follow up on it. Keep the light shining we are eternally proud of you. Dalu....

Date: 6/1/2007, 5:47 pm, GMT +6

Name: Adomair O.
Ogunbiyi <189.12.244.123>

Location: São Luís, Maranhão, Brasil

Number: 179

É motivo de grande orgulho para toda raça/etnia, desde África até toda a sua diáspora, saber de sua trajetória e conquistas. Você já consta de nossa Agenda Negra. A sua façanha está lá registrada para contribuir para o desenvolvimento da identidade étnico-racial e auto-estima do povo negro e/ou afro-brasileiro.

Date: 5/31/2007, 10:06 pm, GMT +6

Name: Olufemi Akande <41.220.64.126>

Location: San Francisco

Number: 178

Great efforts from a Great Man. But sir, you need to look back and start disengaging gradually towards home because the moment America sees you've got nothing extra to offer or there is a better invention then they become hostile to you and get you frustrated. Best of Luck!

Date: 5/31/2007, 1:49 am, GMT +6

Name: BOŞUN
ADEDOKUN <82.128.5.195>

Location: LAGOS, NIGERIA

Number: 177

Uncle Phillip, am really challenged by what God is using you for in our world. With

people like you we young ones at home are sure of a better future for the potential we carry. Our world is blessed to have you. Please continue to advocate for greater IT penetration in Africa through mind blowing initiatives. God Bless you.

Date: 5/26/2007, 5:21 pm, GMT +6

Name: Godwin Edmond <212.247.71.34>

Location: Ejigbo, Lagos

Number: 176

I will really start by appreciating the grace of God upon your life cos without it you would have probably be long gone in the civil war like others, but God kept you to discover what the world would not have ever uncover. But sir, I believe that God raised you so you can raise others. please do not neglect the young brains in your country, and I feel you should come back home and plant an IT training college in Nigeria that will also propel the

technological drive and innovations in the country. God bless u the more.

Date: 5/12/2007, 6:02 pm, GMT +6

Name: Martins Terlumun
Nyam <212.100.68.103>

Location: Zaria, Nigeria

Number: 175

sir, how do you impart this mavelous talent on the youths in nigeria.

Date: 5/11/2007, 7:22 pm, GMT +6

Name: Adeshina
Okunubi <196.200.115.135>

Location: Mile 2 Lagos

Number: 174

Thank you for rekindling science in me. I was just at the point of abandoning science.

Keep up the good work but help to source for materials and non financial research grants for our higher institution in nigeria. It will go a long way to assist new minds going into various fields of science. once again, thank you.
yours
shina

Date: 4/30/2007, 10:25 pm, GMT +6

Name: Robin <152.43.1.4>

Location: Charlotte NC

Number: 173

You are inspiring and I agree with what you are doing. Keep up the good work.

Date: 4/22/2007, 2:03 pm, GMT +6

Name: Adeyemo Akintunde
Festus <38.119.116.68>

Location: Ibadan, Oyo State, Nigeria

Number: 172

You have a great mind

Date: 4/21/2007, 7:45 pm, GMT +6

Name: Olubode
Oluwaseun <82.128.10.58>

Location: University of Lagos

Number: 171

Sir, you are one of the greatest and so also are many other nigerians waiting for that moment of uplifting. Hanging on to their hopes and faiths like never before just to have a better life not yet minding a brighter future. Please remember your people. Above all Sir, you are a great man.

Date: 4/19/2007, 5:15 pm, GMT +6

Name: EBIWONJUMI DIMU
ELIJAH <212.100.73.14>

Location: University of Lagos, Nigeria

Number: 170

Prof, Phillip Emeagwali, you're a man of unmeasurable standard and intelligent and epitome of wisdom, Sir, Thank for your uncomparable contribution to world technology, I love you, Africa love you, More grease to your elbow

Date: 4/18/2007, 10:15 pm, GMT +6

Name: Dennis Ejiofoh <80.88.152.236>

Location: Lagos, Nigeria

Number: 169

My father never got to experience the "net". Today, I can't imagine life without it.

Thank you.

Date: 4/18/2007, 5:16 pm, GMT +6

Name: Okon <217.116.178.210>

Location: Australia

Number: 168

This is one thing people should know about
and it makes me feel good being a
NIGERIAN!
I AM PROUD OF YOU!

Date: 4/17/2007, 7:39 pm, GMT +6

Name: OLAKUNLE
OGUNJOBI <41.204.243.2>

Location: Lagos , Nigeria

Number: 167

Greatly impressed by your achievement. I
am deeply moltivated to keep moving
forward in life.I am inspired by your level
of EXCELLENCE. okdaniel states that
EXCELLENCE = INTELLIGENCE +
DILIGENCE. You are wonderful.

Date: 4/10/2007, 10:01 pm, GMT +6
Name: OSAJI, DONFRANCIS <81.199.56.130>
Location: FUTO
Number: 166

I am really very happy for ur achievements knowing fully well that Greater Heights attained by Great Men weren't by sudden flights but they when others slept toiled deep into d night. Your great works is as a result of great personal research & Effort

Date: 4/10/2007, 9:54 pm, GMT +6
Name: OSAJI, Donfrancis <81.199.56.130>
Location: Onitsha
Number: 165

When I remember Great MInds Born Out of Onitsha, I really recapitulate & extol Onitsha for its Fertility towards Great achievments made so far. Shakespear said something that'

Greater Heights Attained by Great Men weren't by sudden flights but they when others Slept toiled deep into d Night. Emeagwali being great today is as a result of personal effort & d grace of God. Your Inventions Today is as a result of Independent efforts towards knowiing d Uknown. I pray d Spirit of God 2 Bless U in all ur deeds towards uplifting humanity.

Date: 4/5/2007, 1:48 pm, GMT +6

Name: Ronald
Reagan.S.R <122.164.50.142>

Location: Pondicherry, India

Number: 164

Great works are praised ever...
but for a known person....
Here Dr Philip's work are undsaid....
Great Minds Great Work...
Am the least to praise u
Sir.....

Hats off.....

Date: 3/27/2007, 6:09 am, GMT +6

Name: Oyeneyin Oluwaseyi
Samuel <208.70.7.60>

Location: Okitipupa, Ondo state

Number: 163

I really appreciate God in your life and your are really a genius because i respect anybody in technology line.

I m in computer Science in University Of Ado Ekiti, Ekiti State, Nigeria, and I dont have opportunity of knowing much of computer though Im trying my best, but Sir can you help me in anyway I will be so glad to hear from you. thanks. I want to be like you. You are great.

Date: 3/26/2007, 3:06 pm, GMT +6

Name: Nwagbara Samuelson
Nnamdi <196.207.129.40>

Location: Enugu, Nigeria

Number: 162

Nigeria, Africa, The world and God Himself
is proud of you for making the world know
that there's something about the Blacks.
You're my inspiration.



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Press [CTRL-P](#) to PRINT

Philip Emeagwali

