The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

2025-19

Satellite Navigation Science and Technology for Africa

23 March - 9 April, 2009

Getting there without getting lost!

Chukwudozie Ezigbalike
United Nations Economic Commission for Africa
Addis Ababa
Ethiopia

Dozie Ezigbalike, Snr GIS Officer
African Centre for Statistics, UNECA

GNSS & [Possible] Addressing in Non-Cadastral Jurisdictions

Workshop on Satellite Navigation Science & Technology for Africa
The Abdus Salam International Centre for Theoretical Physics
Trieste, Italy, 23 March – 9 April, 2009

A true direction to somewhere in Africa

Drive passed the Village Market in the direction of Limuru. Keep going, pass the Runda turn off, and you will see a junction and road off to the right, this is the old Limuru Road, passing through Banana Hill, leading on to Tigoni and ending up in Limuru. It is in a straight line from this junction. Proceed along this road, through Banana Hill, then another small settlement, pass the Norbrook (veterinary products) factory, keep on the same road don't turn off, you now see coffee and tea growing on your left. Continue on for another 300m and you will see a large Bata sign (where the road bends) on the right hand side and mature trees on the left. The turning to the house is here on the left directly opposite this big Bata sign. If you miss the turning you will reach the Kentmere Club 400m further on. Turn around and go back to the Bata sign and turn in (now on your right). The drive is marked 'Higgin'. Continue up the drive (tree-lined) to the end where you will find a white old colonial house and large garden. If you get lost call me on.....

Recap: Major Uses of Addresses

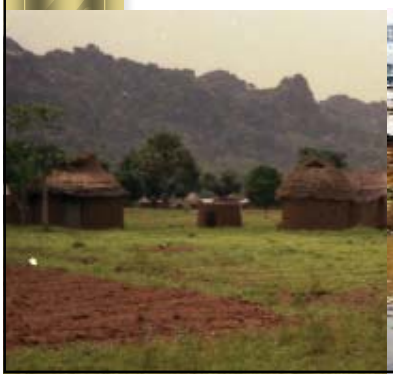
- Planning and management of public services
  - Health, schools, elections, etc
- Improved delivery of goods and services
  - Utilities, postal services, commerce
- Safety and security of persons and property
  - Emergency responses
- Revenue collection
  - Taxation and service billing
- Data collection
  - Censuses and statistics

Intuitive Approaches to Addressing projects

- Identification of “streets” on maps
- Development of standards and databases
- Naming of streets and posting of street signs
- Numbering of properties
- Education and awareness campaigns

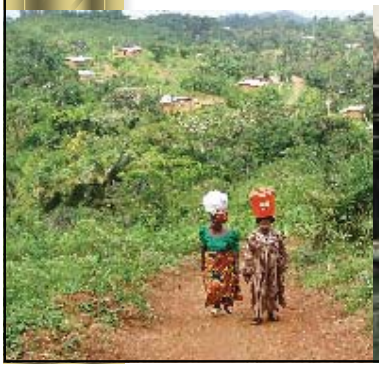
But must we have "Street" Addresses?

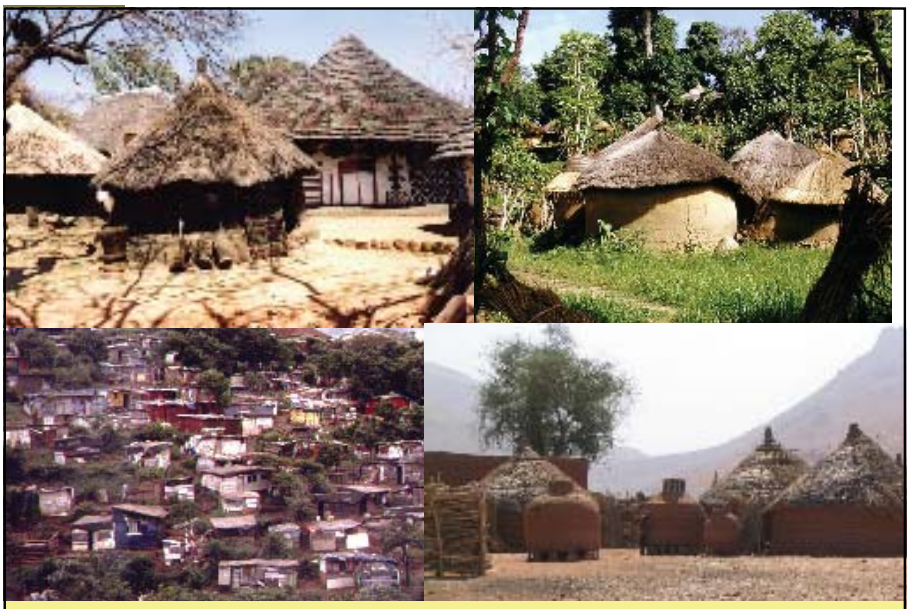
- Not all settlements in Africa are laid out in "streets" – even parts of cities



"Street" Addresses?

- Yet we need to provide for all types of parcels, thoroughfares, buildings and properties, even when there are no streets





The people who live at these places also need to be identified and counted (only once) during censuses and emergencies

These homesteads could be producing substantial agricultural products and need to be accounted for during agricultural censuses

If this were a local water merchant, he is likely to know the homes of all his customers and therefore does not need an addressing system – but we still need to find and count him …

This one definitely needs an address – it could be the latest addition to the eco-tourism offerings and she would want people to find her

And we can't tell her to wait until we produce (cadastral) maps to "assign" her an address

Situs Addressing

- To be uniformly inclusive, addresses should be assigned in situ, without relying on means of access (streets)
- Therefore we talk about “situs” addressing
  - Definition: The precise, complete and unambiguous description relating a feature or place of interest to a unique location
  - A street address is a form of situs address, where “streets” exist
    - But we may not always have streets

Important Features of Addresses

- Completeness: every feature that needs to be addressed must be “assigned” an address
- Uniqueness: the address assigned to each feature must not be assigned to any other
- Unambiguous: each feature must be assigned only one address in a particular addressing system

Important Features …

- Accessibility: Users must have access to information to relate or associate features to their addresses
  - Usually the addressed features are shown on a map in some office
  - Street names are usually displayed at intersections and other appropriate points
  - House numbers would be written on houses

Important Features …

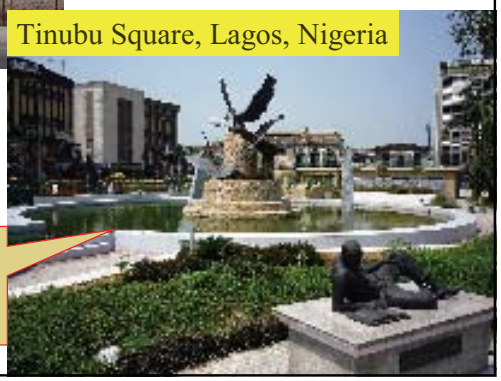
- Intuitive: There is a logic so that if numbers are not written, they can be inferred from neighbouring houses
  - Spatial ordering
  - Odd/even sides
  - Starting from one end and increasing

Landmarks – A Common Situs Direction System

- Conspicuous features or objects whose location is known and places of interest are described relative to them
- "Locals" are expected to know these features and how to get there
- Used mainly to provide a reference point for giving direction
- Not really "addresses" per se, but directions
  - We want addresses

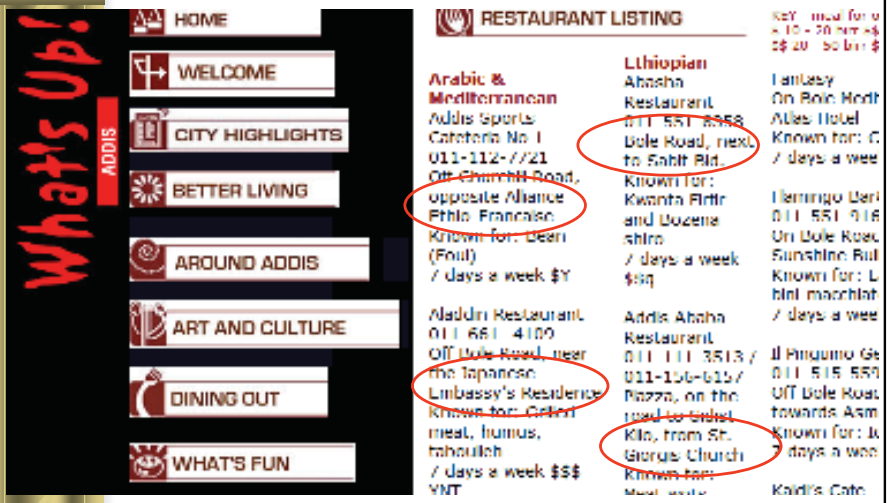
Bole Medhane Alem Church, Addis Ababa, Ethiopia

Tinubu Square, Lagos, Nigeria



Even when we have street addresses, landmarks are still useful in crowded/busy settings

Landmark-based “directions”



Coordinates as Potential Addresses

- The geographic or Cartesian coordinates of a point feature provides unique identification
- For parcels/properties, a distinctive location in the parcel
  - In geo-referenced address databases, the main access point is adopted
  - May need to “designate” main delivery point, if many points are possible

Advantages of the Coordinate System

- Facilitates the location of point of reference on the ground with the aid of surveying or navigation devices and techniques
- Facilitates linking of records to graphical databases
- Does not have to be explicitly "assigned"
  - It is a natural attribute of the point

Disadvantages of the Coordinate System

- Requires calculation and therefore the information may not be readily accessible to every user
- Tends to be long strings of numbers and/or characters
- Coordinates depend on reference system and may change with redefinition of reference system
  - Addresses, as identifiers, should be unique and permanent

Disadvantages Reconsidered – Calculation

- Do I have to manually calculate coordinates?
  - Not really, if I have a device that can determine my location
    - GPS navigation devices
    - Google My Location
    - Other systems

Calculation Disadvantage Reconsidered …

- What about the cost?
  - How much would it cost if it moves from niche specialty to mass market?
  - Think cell phones, “wrist locators”, handhelds, etc

Disadvantages Reconsidered – Long Strings

- Mobile phones have shown that people can handle longish numbers "belonging" to them
  - Mobile phone numbers are up to 10 digits in some countries.
    - They may not remember the phone number – how many people actually remember their bank account numbers all the time?
    - But they can read it off a piece of paper
    - And in their language ("haya and, arba sost, …")
  - Use an address "code" rather than raw coordinates

Location "Codes"

- There are already coordinate based location "codes"
  - Natural Area Coding System (http://www.nacgeo.com/nacsite/) is based on WGS84 coordinates, e.g. 8KDB PGFD
  - The United States National Grid (http://www.fgdc.gov/usng), now an FGDC standard (FGDC-STD-011-2001) is based on the US national plane coordinate system, e.g., 18SUJ23480647
  - Both use grid systems, with variable number of characters depending on the size of the area or feature

Address Features Only

- We are interested only in fixed length addresses of main access POINTS
  - Or designated main delivery points
- As opposed to variable length general purpose feature location codes

Numbers vs Letters

- Dozie's Challenge: Can we design a coordinate-based coding system that uses the Hindu-Arabic numerals only?
  - Think of learning curve for the illiterate
  - Everybody counts; just need to learn the representation of 10 digits as opposed to so many letters
  - Hindu-Arabic numerals used in with several script
    - Common to hear "ammïst mäto sälasa sïddïst" and see "536" instead of ፭፻፴፮

Market Driven

- With expected volume of sale (the whole world)
  - Manufacturers are expected to respond with devices
  - Complement of mobile phones, PDAs or totally new devices
    - Think of how many people are already using mobile phones – about six billion
    - How many of them live in street-enabled places?

Motorola Announces Single-Chip Full GPS Solution

News Item | Related News

posted Sep 24, 2002, 7:06 PM

Motorola today announced Instant GPS, a self-contained, single-chip, assisted global positioning system (A-GPS) receiver small enough to fit into a wristwatch. Motorola Instant GPS is the first truly single-chip GPS solution in the world, combining Motorola's GPS design with IBM's silicon germanium (SiGe) chip-making technology. Instant GPS is compatible with almost any cellular network. By completing the position calculation in the chip, the device eliminates network overhead associated with network-centric GPS systems.

http://www.phonescoop.com/news/item.php?n=316

Possible Scenario

- Devices …
  - Low end devices display only location codes without maps
  - Up market version would incorporate maps and even voice directions, à la current GPS navigation devices
- Local authorities can now read off location codes of properties and add to existing databases or records
  - No more waiting for cadastral mapping before “assigning” addresses

Differential Coordinates

- We still have the problem of long strings of coordinates to deal with
  - If based on mobile phone technology, as expected, then let mobile phone towers be “beacons” or location code “landmarks”
  - Define address codes based on the difference in coordinates from tower, rather than absolute codes
  - But how permanent are the mobile phone towers?
    - Maybe system of agreed/standard “origins”

Full Address

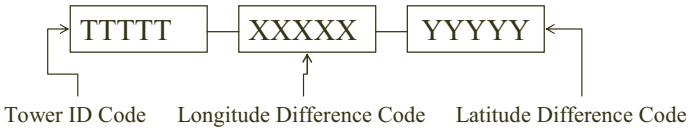
- Full location code (address) will include:
  - Name of locality (town, village, suburb, etc)
  - Tower ID code, which the consumer device will receive from the broadcast, and
  - The final code formed from the two sets of numbers representing differences in latitude and longitude from tower or other "origin" used

Spatial Data Infrastructures

- Spatial Data Infrastructure to include a layer for address data
  - For instance, the mobile tower codes or IDs could be published
- Houses and other permanent features will have permanent addresses, which could be written on the property, just like present-day street addresses
  - "The party on Saturday will be at TTTTT-XXXXX-YYYYY"

Instant Addresses

- Temporary addresses for rendezvous direction:
  - "Mum please come and get me. I'm at …"



Numbers read off the mobile phone; or if she has slightly more sophisticated devices, address would be transmitted with caller ID

Role of the Navigation/GNSS Community

- You are experts in the science and mathematics of positioning and navigation
- Research and propose appropriate "origins" for differential codes
- Advise on the format and precision of the codes
- Talk to other stakeholders
  - Mobile phone and consumer electronics manufacturers; standards bodies, etc

Your Role as Africans

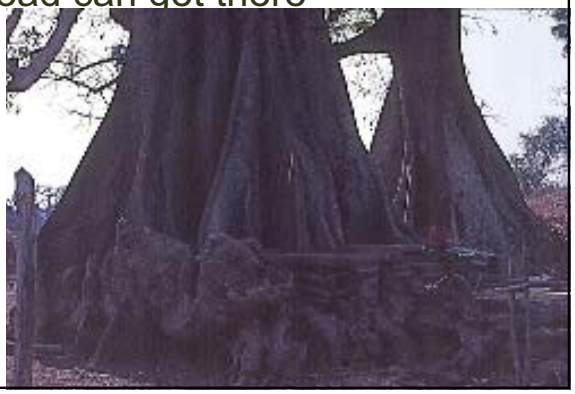
- Participate in the AFREF project to create uniform geodetic frame for Africa
  - http://geoinfo.uneca.org/AFREF
  - Contact Andre Nonguierma (anonguierma@uneca.org)
- Write papers and propose solutions to Dozie's Challenge
  - Equipment manufacturers are listening and yours may be the one they will adopt
  - Remember VHS vs Beta?

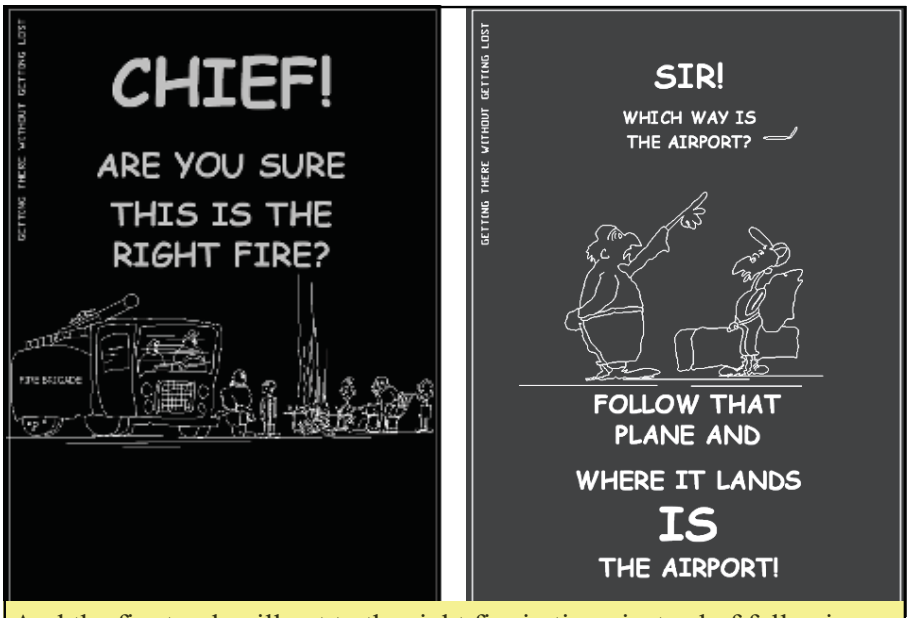
Role of Governments

- Formalize and adopt address code standards
- Use the new "standard" in all administrative records
- Create the address layer of the SDI

Under the Cotton Tree

- Soon even “under the cotton tree” where village meetings hold will also have an address, so “sons of the soil” from abroad can get there





And the fire truck will get to the right fire in time, instead of following the smoke to a barbeque fire first

Contacting Us

- Dozie Ezigbalike, Senior GIS Officer
  African Centre for Statistics (ACS)
  United Nations Economic Commission for Africa
  Addis Ababa, Ethiopia
  ezigbalike.uneca@un.org
- Ben Kiregyera, Director of ACS
  bkiregyera@uneca.org
- General Enquiries
  statistics@uneca.org

Acknowledgements

These ideas developed from discussions with **Associate Professor Abbas Rajabifard,** in connection with Georeferenced Address Files in the context of Spatially Enabled Government Services during my sabbatical programme at the **Collaborative Research Centre for Spatial Information (CRC-SI),** in Melbourne, Australia (http://spatialinfocrc.org)