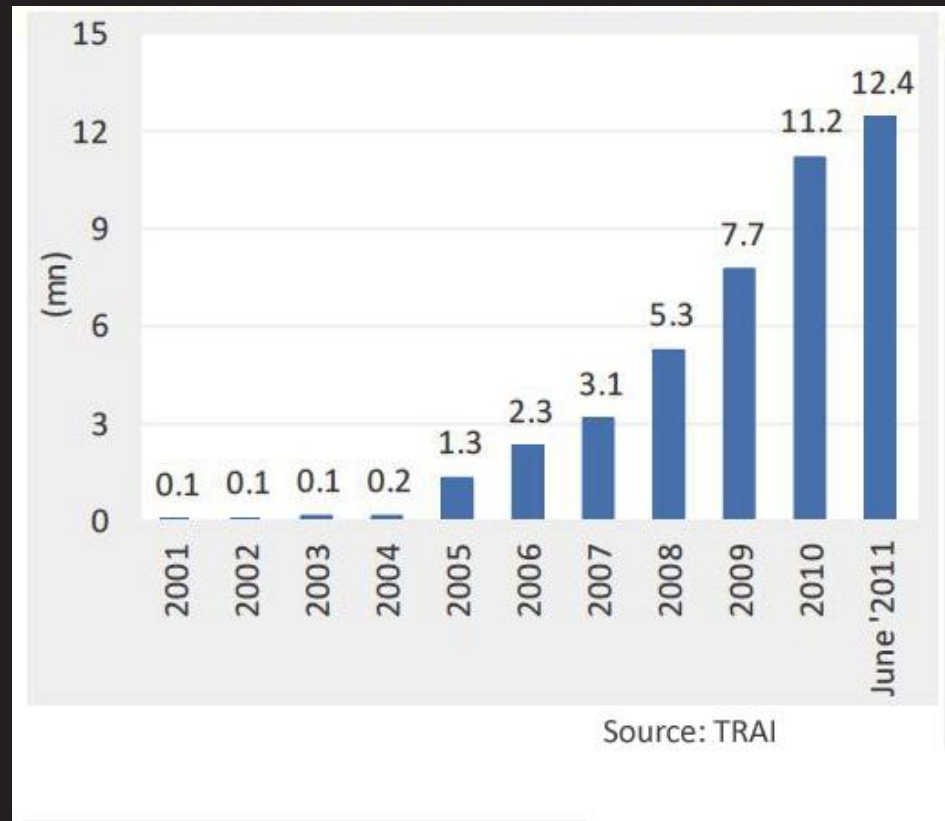


An International Perspective on Whitespaces and Spectrum Sharing

The Indian Broadband Challenge



2012: 14.3M connections, 8.4% penetration

TV Whitespace Opportunity in India

- One Incumbent TV broadcaster
 - Managing incumbents and incentive auctions are not issues
- User devices must be extremely cheap
 - They will be WiFi, not Whitespaces
- Whitespaces will be the backhaul
 - Supporting WiFi access points
- Goal is to increase broadband availability
 - Mobility not a major driver

Potential India TV Band Plan

698 - 806

TDD LTE

646 - 698

Some legacy defense use,
future use TBD

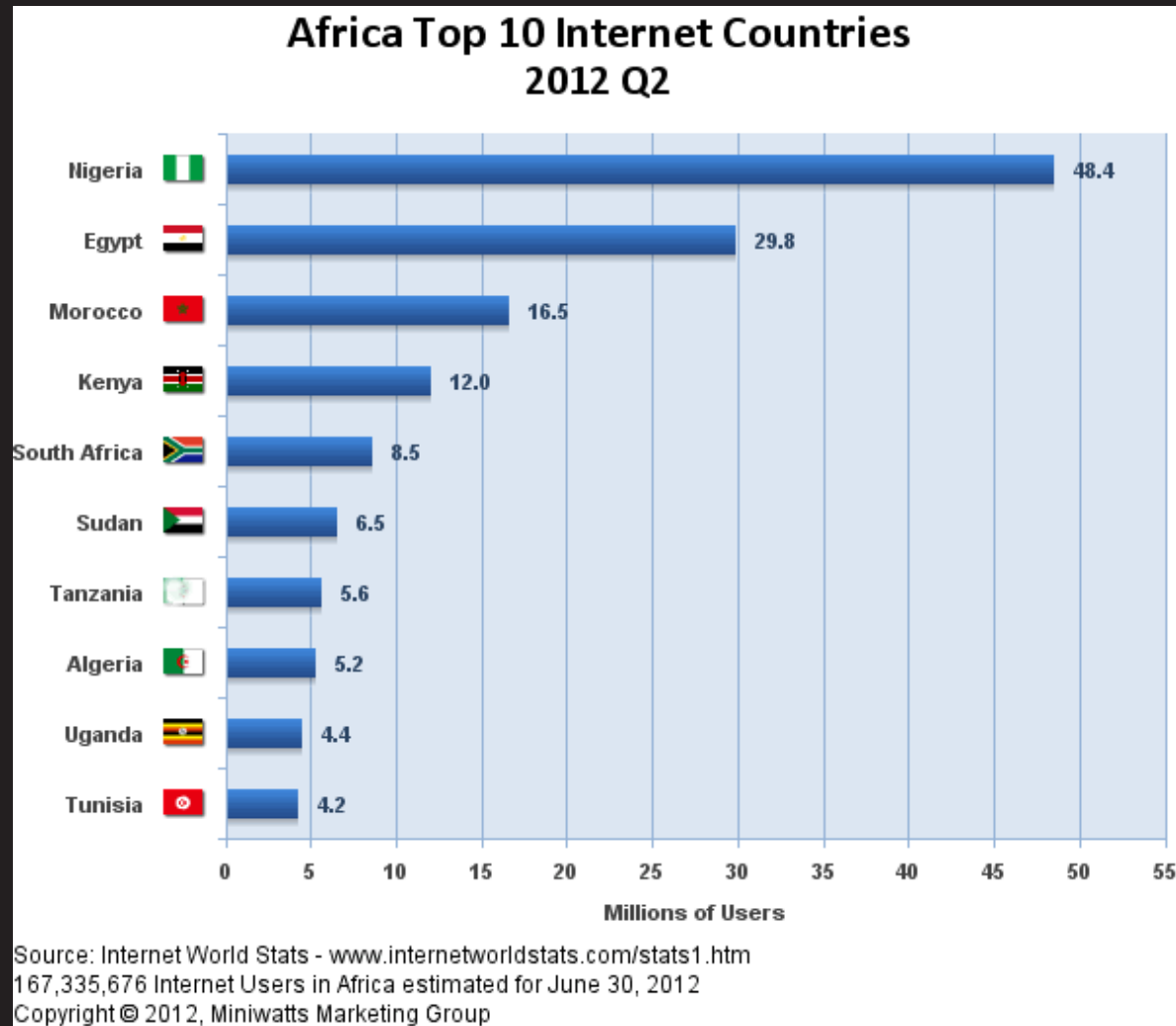
585-646

TV Whitespaces (free today)

470-585

Mobile TV ?

Africa Internet Penetration



Whitespaces in Africa

- Few incumbent television stations
- Goal to increase broadband penetration
- Google and Microsoft running whitespace trials in Africa
 - Supporting WiFi or Ethernet end points
 - Mobility not a primary goal
- Rural cellular backhaul a promising application
- Potential Risk: Second digital dividend may reduce available whitespace spectrum

US & Europe Challenges

- Managing Incumbent Interference
- Uncertainty around US incentive auctions
 - Urban spectrum availability unclear
- Chicken & egg problem for high volume, low cost devices

What this means

- **Developing market differences**
 - Wider channels
 - Likely leading to different waveforms
 - No whitespace device volume
 - No incumbent interference management issues
- **Implications**
 - Fragmentation of global market
 - No driver for device volume in growing markets
 - Less incumbent issues will lead to faster adoption in developing markets, and they will end up driving the standards around their spectrum and goals.

Where Should we Focus

- **Spectrum sharing is inevitable**
 - Even if we cleared 2.5 GHz of spectrum above 500 MHz, this is only 5x current carrier spectrum
 - This would only handle 2 years of traffic growth given current predictions
- **Eventually everyone will have congested spectrum**
- **US/Europe needs to get in front of sharing to open up new bands**
 - 3.6 GHz is a good starting point
- **Whitespace must be combined with other spectrum to provide benefits of low frequency where need**
 - Not likely to be a big enough ecosystem to support high volume whitespace-only mobile networks given fragmented global market

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