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# Frontiers of Engineering 2013: Wireless Broadband Session

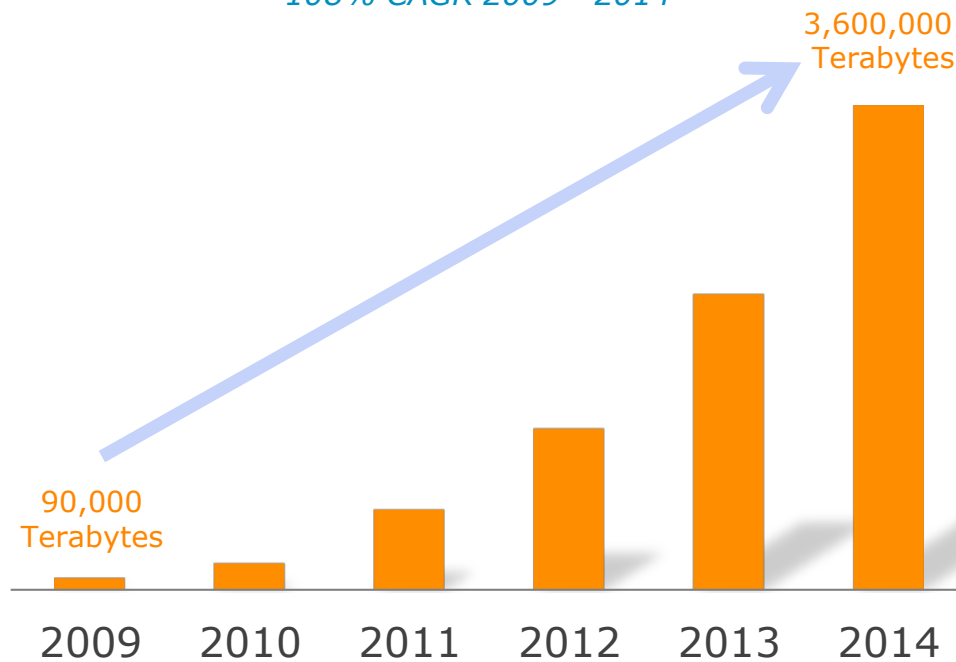


THE  
PERFECT STORM

# Wireless Data Tsunami

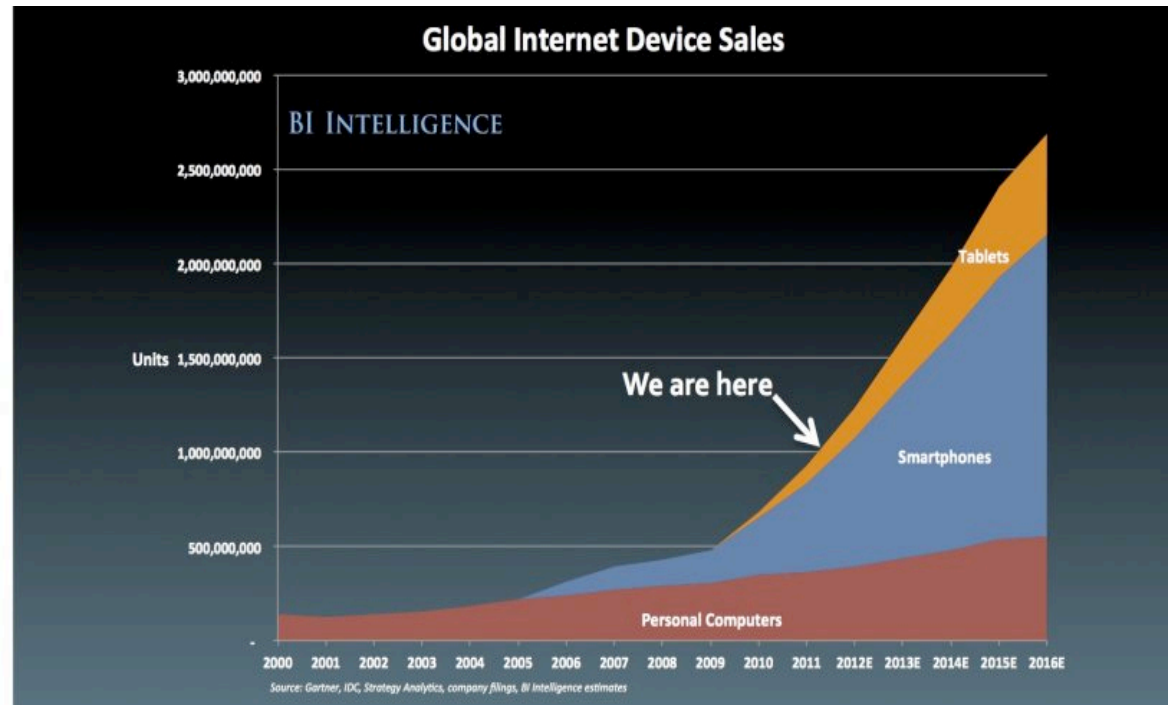
**Cisco Forecasts 3.6 Million Terabytes per Month  
of Global Mobile Data Traffic by 2014**

*(TB per Month)  
108% CAGR 2009 - 2014*

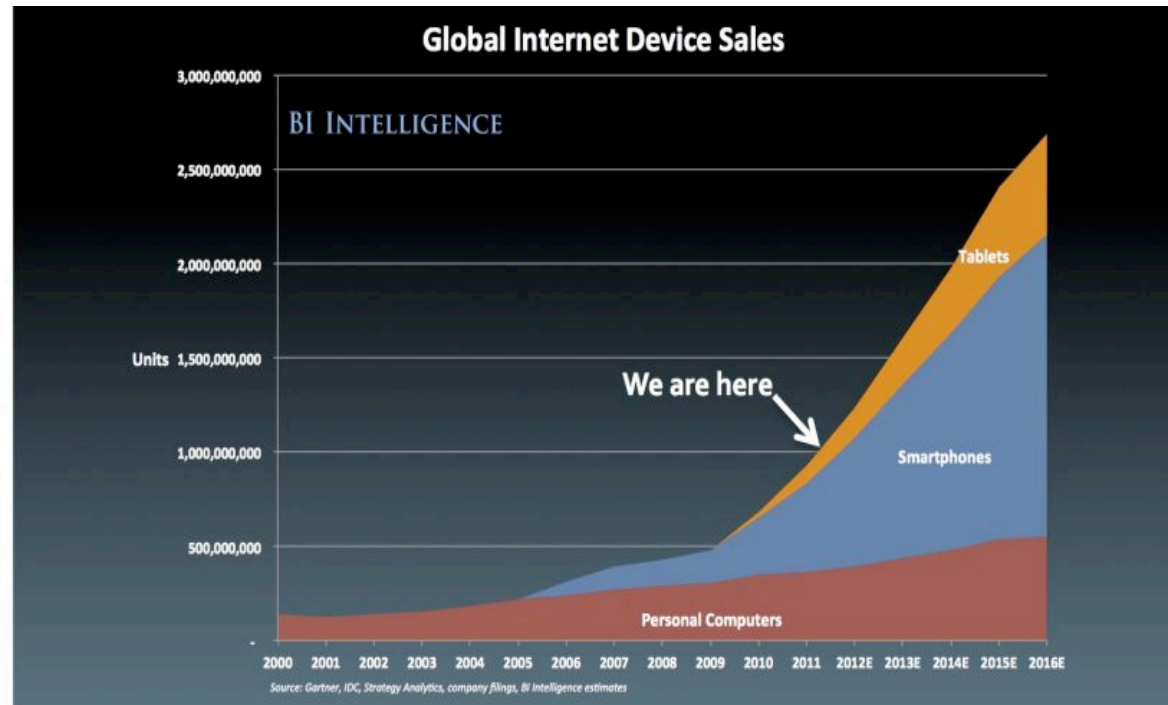


Mobile data to increase 1000-fold in current decade (2/3 video)

- Smartphones: 1 Billion shipped in 2013

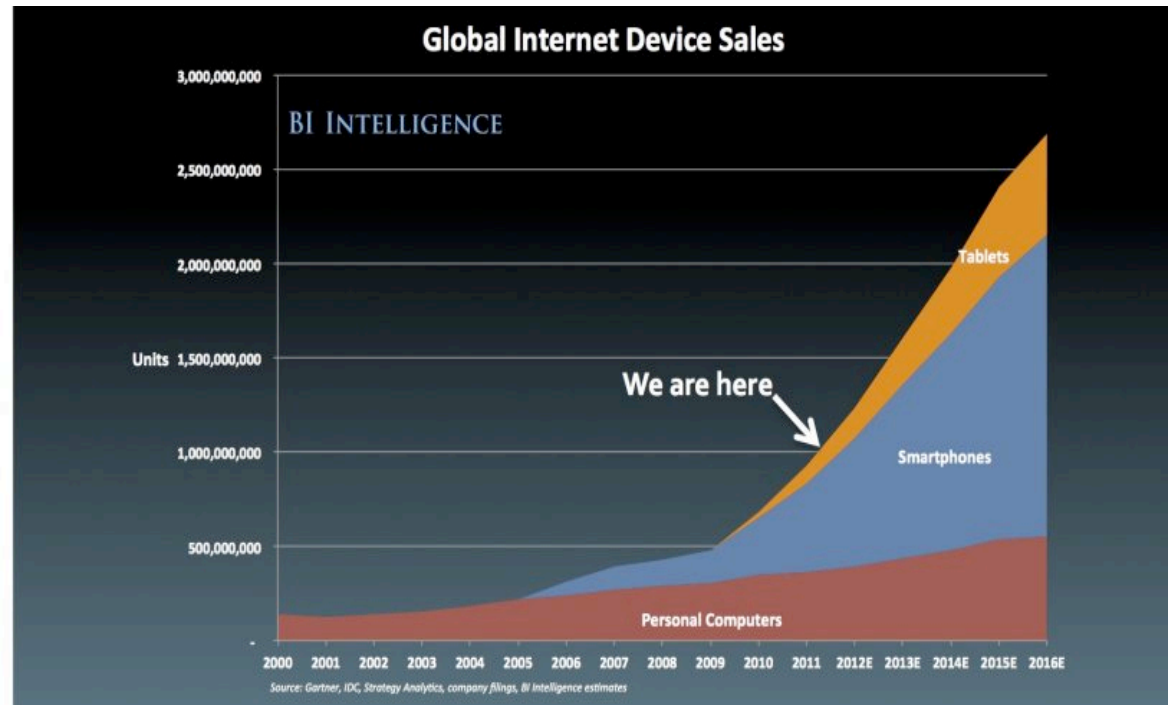


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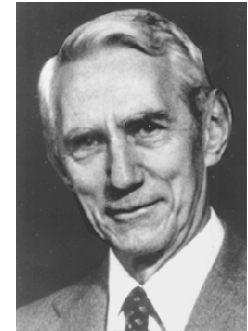


- Rise of the Machines: 50 Billion machines are ready to communicate (90% of humans already own a mobile phone)
- The cloud

# Past Two Decades

Communication engineers worked hard to improve efficiency of using radio resources.

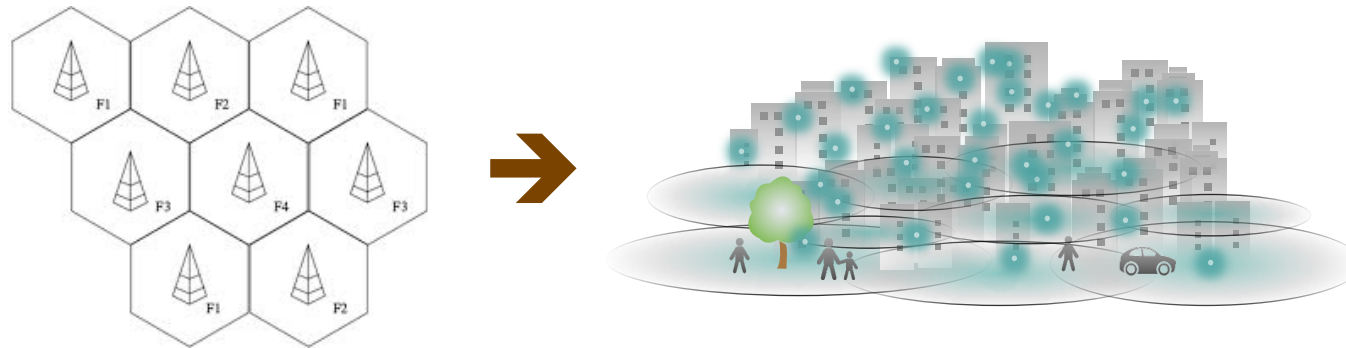
But there is a fundamental limit to the efficiency one can ever hope to achieve.



Going forward: increasing radio resources



# Three Approaches



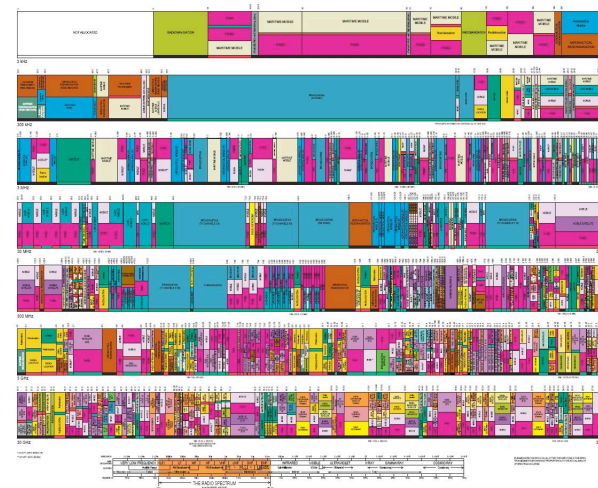
Network densification



More antennas

## UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM



Spectrum sharing



- ① Mehmet Yavuz: “1000x Wireless Data Capacity Increase by Small Cell Densification”
- ② Stephan ten Brink: “Industrial Perspective on Perception of Physical Layer Stagnation and New Research Avenues”
- ③ David Gesbert: “Handling Interference Using Distributed Cooperation”
- ④ Anant Sahai: “Radio Spectrum Management and Regulation”