SELF-SIMILAR INTERNET TRAFFIC AND IMPLICATIONS FOR WIRELESS NETWORK PERFORMANCE IN SUDAN

Presented By
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Sudan


LIBYA
EGYPT
Halā'ib
SAU. AR.
Wādī Ḥalfā'
Port Sudan
Red Sea
Nile
Sawākin
Atbara
CHAD
Omdurman
KHARTOUM
Kasala
ERIT.
Al Fāshir
Wad Madanī
Al Qaḍārif
Al Ubayyiḍ
Kūstī
Nyala
White Nile
Blue Nile
Malakāl
ETHIOPIA
Wāw
C.A.R.
Bor
Juba
Nimule
Kinyeti
DEM. REP. OF THE CONGO
0 300 km
0 300 mi
UGANDA
KENYA
24
30
36
18
12
6

The Sudan General Information

- The capital city is Khartoum
- 34,475,690 (July 1999) estimated population
- Area 967,494 sq mi (2,505,813 sq km), the largest country in Africa, bordered by Egypt (N), the Red Sea (NE), Eritrea and Ethiopia (E), Kenya, Uganda, and the Democratic Republic of the Congo (S), the Central African Republic and Chad (W), and Libya (NW).

- The most notable geographical feature is the Nile River,700 kilometers across the country from the South to the north.

- Rainfall in Sudan diminishes from south to north; thus the southern part of the country is characterized by swampland and rain forest, the central region by savanna and grassland, and the north by desert and semi-desert.

The University of Khartoum

TOPICS

- Introduction
- Why we need to analyze internet traffic in wireless links?
- Transport protocol performance over wireless links
- What is self-similar traffic?
- Data Collection and Measurements
- Conclusions
- References

Introduction

- To properly model the performance of wireless data networks there must be a thorough understanding of the nature of internet traffic. Studies have shown that internet traffic is self-similar and heavy tailed in both local and wide area wired networks .

- Simulating this traffic cannot be done with Poisson models because these models result network designs which do not take into account the correct traffic behavior. The question is to determine whether wireless data networks exhibit the same behavior.

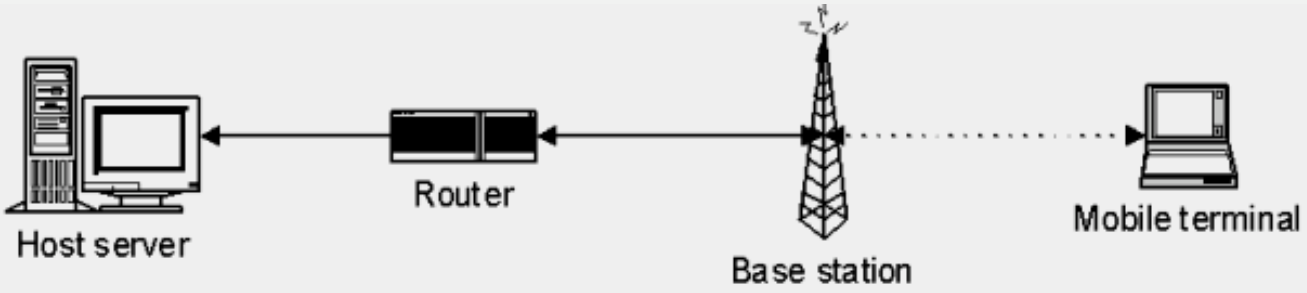
Why we need to analyze internet traffic in wireless links?

- Modeling assumptions affect our network design
- For the fast-changing and heterogeneous Internet, determining the relevant model for a particular research question can be 95% of the work!
- Users insist on having the same applications over wireless links with the same quality of service that they are getting over a wired link

Transport Protocol Performance over Wireless Links

- **Characteristics of wireless links that affect transport protocol performance**
  - Packet loss due to corruption.
  - Delay variation due to link-layer error recovery, handovers, and scheduling.
  - Asymmetric and/or variable bandwidth (e.g., satellite).
  - Shared bandwidth (e.g., WIRELESS LANs).
  - Mobility.

Wireless LAN using TCP



1. Host server establishes a TCP connection with mobile terminal and starts to send data

3. Missing acknowledgements trigger congestion control at host server (transmission window is reduced)

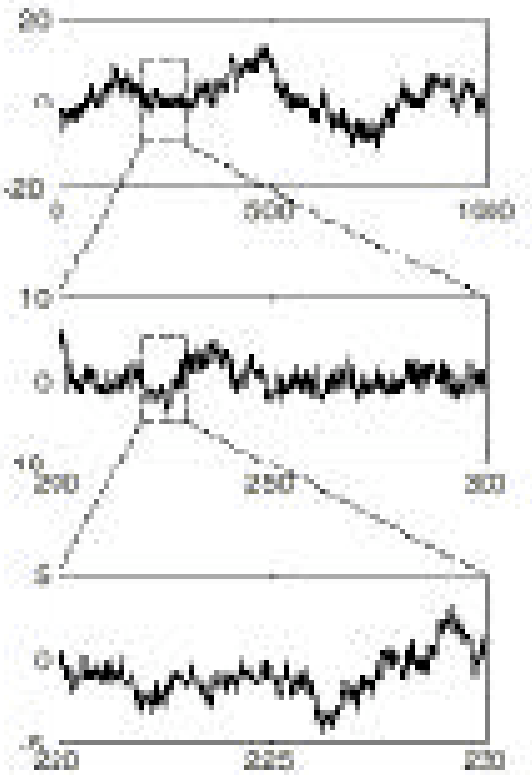
2. High bit error rate in the wireless channel

Self-Similar Data Traffic

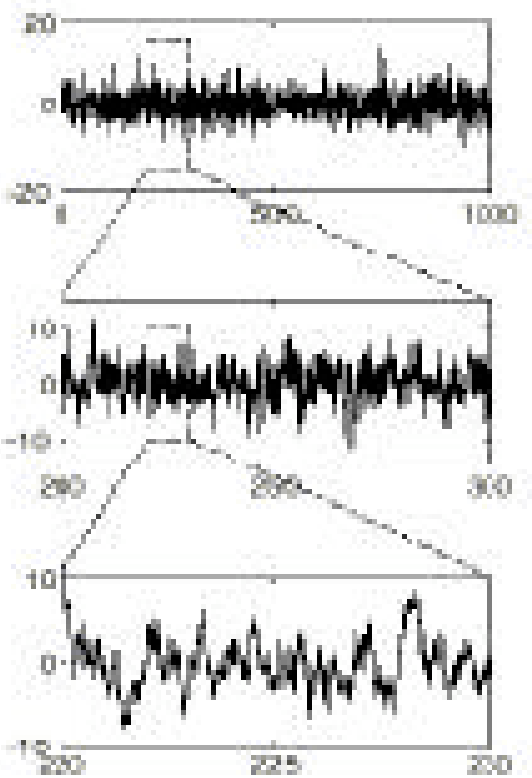
- A phenomenon that is self-similar looks the same or behaves the same when viewed at different degrees of “magnification “ or different scales on a dimension .this dimension can be space or time.
- Clusters are clustered
- Queue sizes build up more than expected from Poisson traffic.

- Self similarity has a profound impact on performance
- The higher the load on the networks, the higher the self-similarity.
- If high levels of utilization are required, larger buffers are needed for self similar traffic than would be predicted based on classical queuing analysis.

Self-Similar Data Traffic

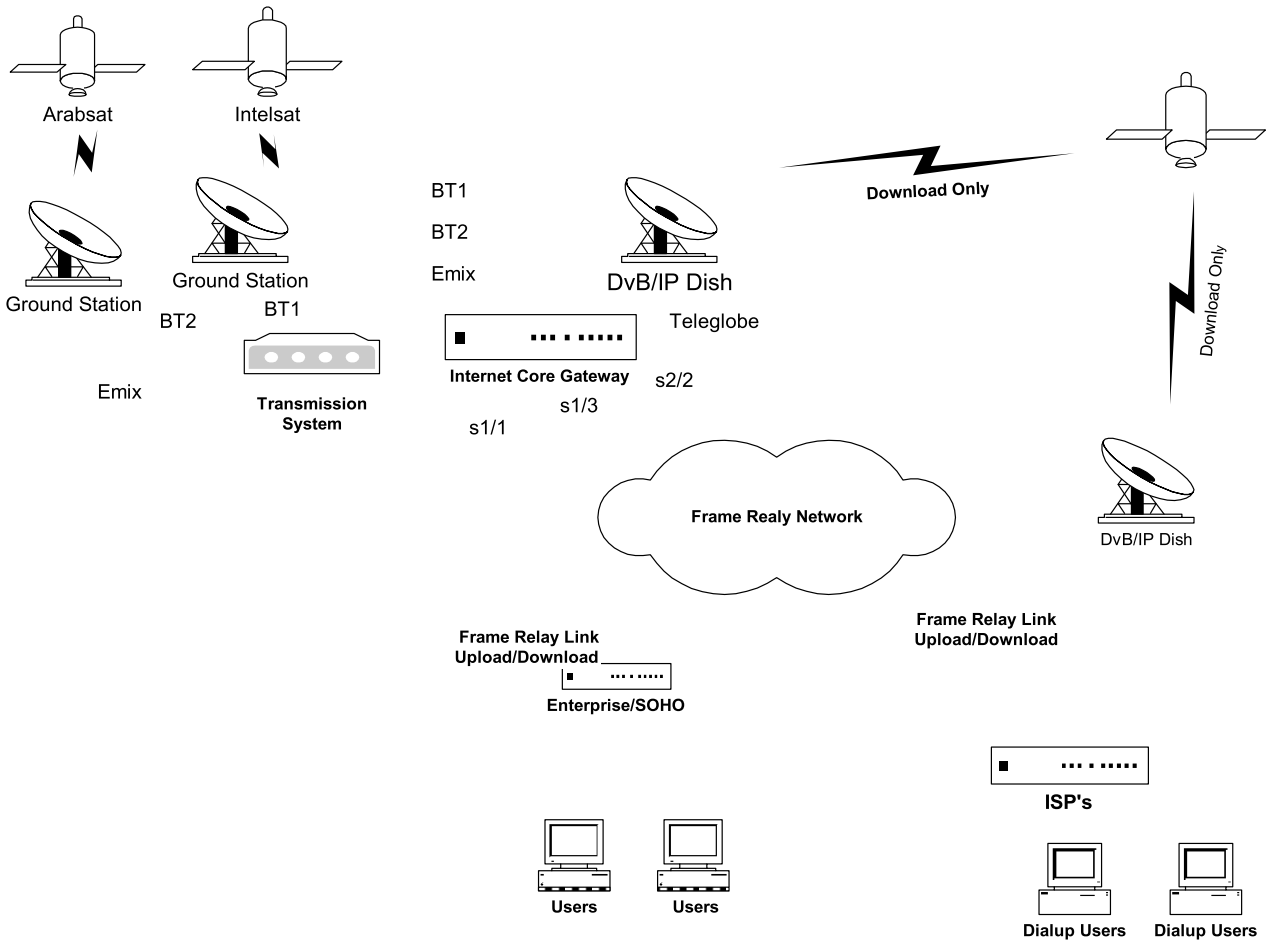


(a) Self-Similar Process



(b) Non-Self-Similar Process

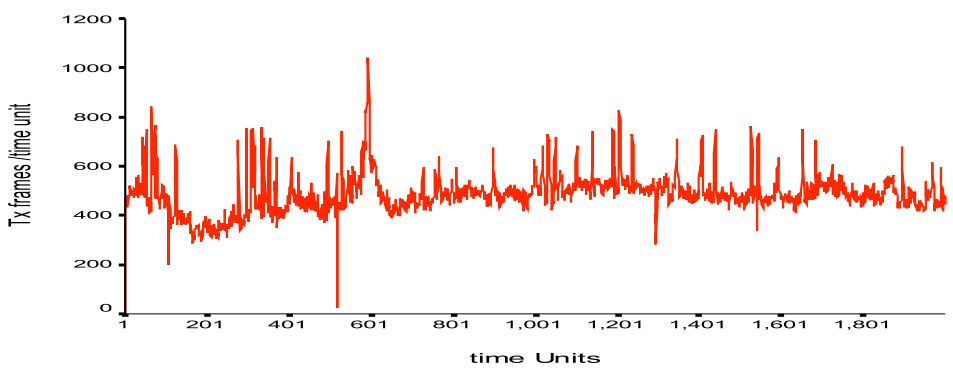
Data Collection and Measurements

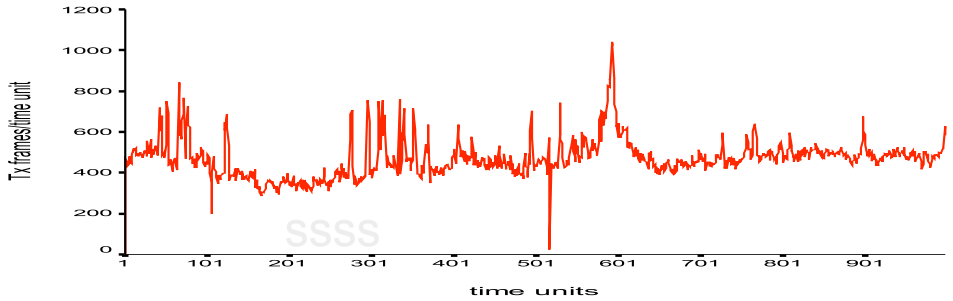


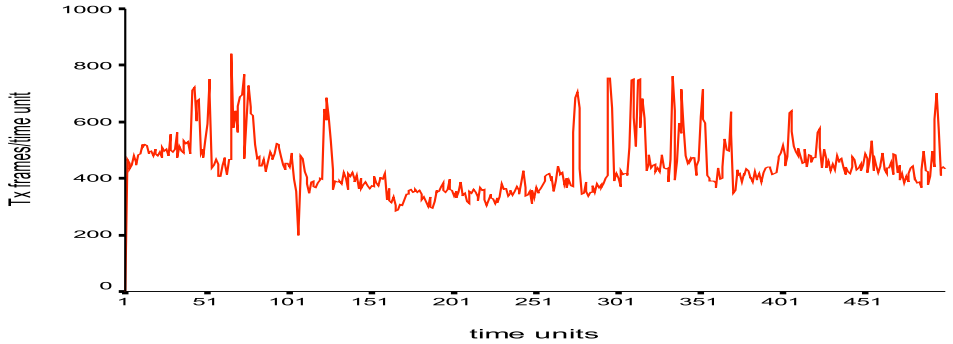
- MRTG (Multi Router Traffic Grapher) is the software used for the collection of the data
- Collects the traffic from the internet gateway router

Internet Statistics in Sudan

Traffic Behavior on different Time scales

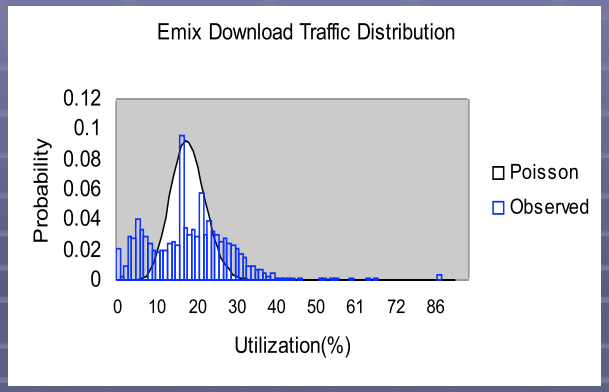


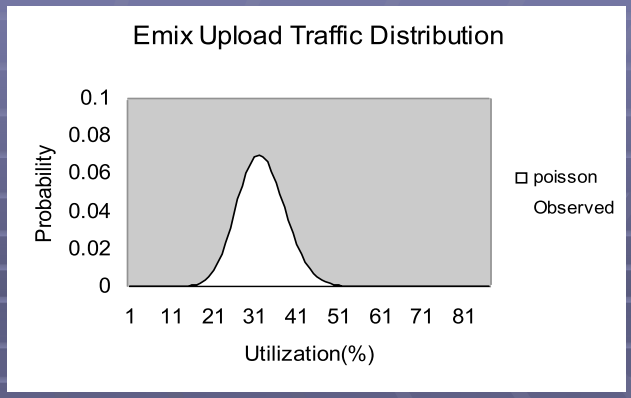


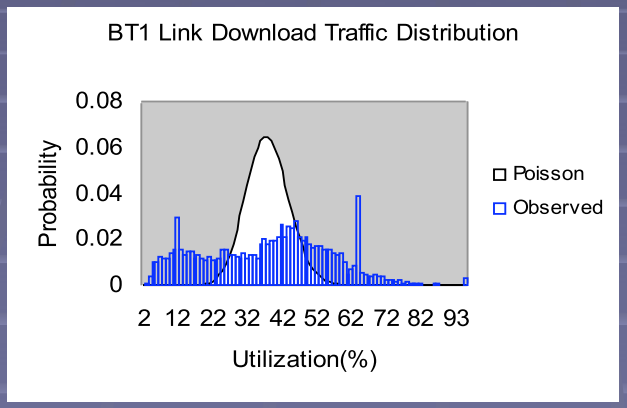


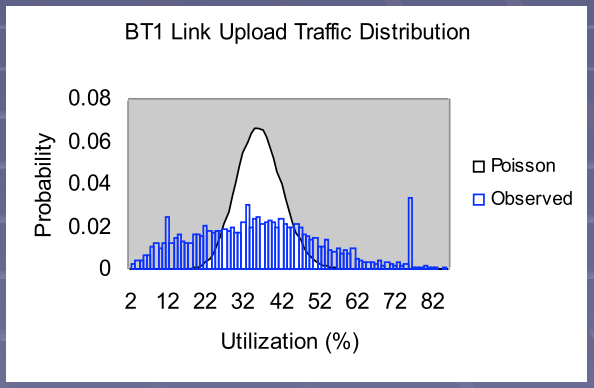
Internet Statistics in Sudan

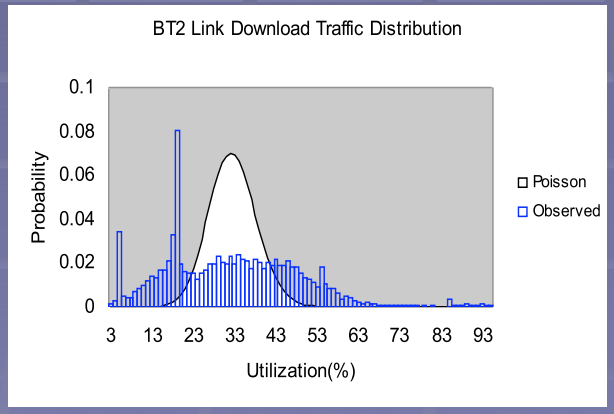
Traffic Distribution compared with Poisson distribution

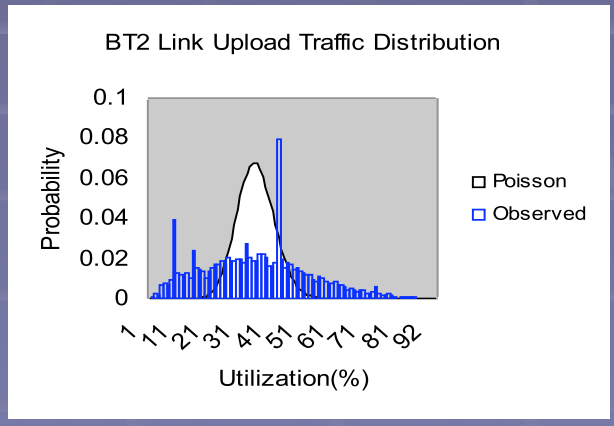












Conclusions

- Modeling assumptions affect our network design
- Internet traffic is self-similar and heavy tailed.
- Users insist on having the same applications over wireless links with the same quality of service that they are getting over a wired link.
- Wireless links affect transport protocol performance.

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THANK YOU