Netsukuku

Close the world, ʇxǝu ǝɥʇ uǝdO

http://netsukuku.freaknet.org

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Abstract

Netsukuku is a P2P network system designed to handle massive numbers of nodes with minimal consumption of CPU and memory resources. It can be used to build a world-wide distributed, fault-tolerant, anonymous, and censorship-immune network, fully independent from the Internet.
Netsukuku does not rely upon any form of backbone router, internet service provider network, or any centralized system, although it may take advantage of existing systems of this nature to augment unity and connectivity of the existing Netsukuku network.

In this document, we will give a plain-english description of the theory behind the Netsukuku system, with a focus upon core concepts and capabilities.

1 The old wired

The Internet is a network maintained, operated and controlled by large corporations and governments. Each and every packet of data must traverse countless backbone routers via unending lengths of fibre, all under corporate or government ownership, and subject to their control.

The Internet Service Providers provide connectivity to the lowest rank of this pyramid, the end user. This is far removed from the ideal of a global user-based and decentralized network. The people can join the net only through the ISPs, and are subject to the filters and restrictions placed upon them. As a result, the Internet is not the same for everyone. In some countries, censorship or commercial filters, give their Internet users a very narrow view of the real breadth of the network.

It is well known that the Internet represents the ultimate means of access to information, knowledge and communication. More than 1 billion people[7] can connect to this massive and immensely valuable, yet centrally controlled, network. As impressive a statistic as this may be, the remaining 5 billion, lacking the economic resources necessary to assemble the networking infrastructure, are still waiting for the multinationals, which don't have strong commercial interests to supply a service within their reach. Their lack of connectivity is more than an inconvenience: without this tool, they are at a massive economic and educational disadvantage[8].

The Internet was designed to be a secure, distributed, and failure-resistant communication system of such quality that it would be appropriate for military usage. But now, paradoxically, the prolific organisation of Internet, has become a centralised structure relying on ISPs and many subsidiary systems. Consider, for instance, the case of the Domain Name System servers, which are managed by many of the same organizations responsible for providing Internet service (beyond simple consumer ISPs). The registration of a domain upon these servers is a privilege provided by InterNIC, a United States controlled company, who grants the right to sell single domain names to end users. The DNS is subject to all of the same issues as the Internet itself, if not more, and all the common Internet applications rely and depends on its central organization and correct behavior.

It is utopistic to bring more accessibility, freedom and privacy to the Internet as long as these efforts rely on the existing system. But a remaining option is still allowed: to conceive a system to rebuild from the ground up with a network, requiring support from none but those that use it. Such a system is inherently censorship-immune: as without any form of centralized backbone, any given node is unable to have any sort of widespread effect upon data originating elsewhere, or even form a clear idea of the content of data sent to it. Netsukuku is designed to build such a system.

2 The Netsukuku wired

The Netsukuku network is composed of nearby computers directly linked each other, and thus has no dependence upon the Internet, or indeed any existing network. The system augments level 3 of the OSI model with its own true distributed routing protocol. Netsukuku's distributed nature is emulated by the core services that are built upon it to replace those with similar centralization problems to the Internet, such as the previously discussed DNS, which is replaced by the introspectively-named ANDNA (A Netsukuku Domain Name Architecture)[4].

2.1 Gandhi

The most notable characteristic of Netsukuku is its fully distributed self-management. The network dynamically configures itself without any external interventions, or any form of central organizing authority, something commonly believed to be infeasible, if not outright impossible. All nodes share the same privileges, each making a contribution to sustain and expand Netsukuku. Of particular interest is Netsukuku's increase in efficiency proportional to the number of well-connected nodes in the network, meaning that more users will typically lead to even lower latencies and greater bandwidth available to all. This is the exact opposite of the current system, where more users simply add stress to the system, leading to long response times and slow data transfers. This makes the network almost self-improving, as each user of the network has incentive to improve the network's quality. Even he who consumes massive amounts of bandwidth stands only to benefit from adding more interconnections of greater quality to more nearby nodes, substantially improving the network for all.

This total decentralisation and distribution allows Netsukuku to be neither

controlled nor destroyed: the only way to manipulate or demolish it is to knock physically down each single node composing the network, making any form of attack or takeover attempt completely infeasible.

2.2 No name, no identity

Netsukuku allows anyone, in any place, at any moment, to connect directly to the network without need for paperwork or subscriptions. All the elements of the net are highly dynamic; nodes can come and go at will, needing to retain no inherent identifying characteristics, making identity and even route immensely malleable concepts. The IP address identifying a computer is chosen randomly, making it impossible to associate it with a particular location. Furthermore, because the routes are composed by a huge number of nodes, it becomes a wholly infeasible task to trace a specific node by its traffic. Finally, traffic is protected by a strong cryptographic layer[5], which guarantees unparalleled security and anonymity for any connection.

2.3 So, what is it?

Netsukuku is a peer to peer or mesh network built on top of it's own dynamic routing protocol. While currently there are many dynamic routing protocols, most are, unlike Netsukuku, incapable of managing networks of significant size. To continue comparison, Internet backbone routers are managed by another set of functionally similar protocols, including OSPF, RIP, and BGP. They use classical graph algorithms designed to find out the best path to reach a node in a given net-graph, making for reasonably efficient routing. Unfortunately, all of these protocols must consume massive amounts of computational resources to function on a network of the scale of the Internet, and must exist on special dedicated machines. So great are the physical requirements of these unique (usually even purpose-built) machines, that decentralization is not only politically infeasible, but also economically impossible.

The Netsukuku protocol structures the topology of the network in different layers of a compact hierarchy[3]. The QSPN[2] algorithm, designed for this specific situation, is then used to determine routes. Since the topology is characterized by an high degree of self-similarity, only the basic pattern must be stored. This compression level grants the ability to store the entire network map in just few kilobytes. On the other hand, the QSPN algorithm must be executed not by any central routers, but instead by the nodes of the network. The component nodes perform this duty simply by generating, propagating, and parsing Tracer Packets (TPs), an activity that consumes very few computational resources.
For more information, please refer to the technical documentation: [3], [2].

2.4 The wireless

The cheapest and most convenient medium to establish physical connections between typical urban nodes is radio, incarnate as WiFi and similar technologies. In a scenario of widespread adoption, a new Netsukuku user need do little more than install an antenna within range of other local nodes, linking themselves into the network, and configure his computer to take advantage of it. Today

there exist a wide variety of WiFi technologies and similar which allows wireless connectivity between nodes even several kilometers distant. Even with common consumer technologies, an entire city can be easily covered by placing a single node in each neighbourhood.

Unfortunately, there will inevitably remain cases where geography or distance prevent a direct radio link. In these situations, or even in many cases where a long range radio link is feasible, a high-bandwidth low-latency connection more along the lines of a fiber bundle can be highly desirable, perhaps for connecting distant cities. However, such a solution is extremely costly, and is out of reach of a typical grassroots effort. If and when Netsukuku becomes widely prolific, such projects might be sponsored by cities or governments, but in the meantime, we are unlikely to see much of that. Therefore, as a stopgap measure, it is possible to replace missing physical links by tunneling over the Internet[6], a practice that should be discouraged in the long term, but which makes a global Netsukuku network vastly more feasible in the immediate future.

References

[1] Netsukuku website: http://netsukuku.freaknet.org/

[2] QSPN document: http://netsukuku.freaknet.org/doc/main_doc/qspn.pdf

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[5] Carciofo NTK_RFC: http://lab.dyne.org/Ntk_carciofo

[6] Internet and Netsukuku: http://netsukuku.freaknet.org/doc/main_doc/inetntk.pdf

[7] Miniwatts Marketing Group Internet Statistics: http://www.internetworldstats.com/stats.htm

[8] The "Digital Divide" refers to the gap between the developed world and the developing world about the effective access to digital and information technology: http://www.digitaldivide.org/dd/index.html

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