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Architectural Overview of Delay Tolerant Network

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Abstract

This paper discuss about the current design of the Delay/Disruption Tolerant Networking (DTN) Architecture and also deals with some open issues regarding the architecture. At present we had achieved some stability within the design, but somehow additional experience is required to understand the concept of long ongoing transmissions at long running operational environments as well as to know the architectural complexity.The parameters including congestion, routing scenarios, security, and transmission path were still considered as active research area to develop a DTN protocols in efficient manner.

Keywords: Delay Tolerant Networking, Disruption Tolerant Networking, Network architecture, protocols.

Introduction

Delay-tolerant networking (DTN) is an efficient approach to computer network that addresses the technical issues in heterogeneous network which is lack in continuous network connectivity. For example operations on extreme terrestrial environments, or planned networks in space .It is designed to operate effectively over extreme distances such as those encountered in space communications or on an interplanetary scale. Long latency sometimes measured in hours or days are inevitable ion such environments. Similar problems can also occur over more modest distances when interference is extreme. It requires hardware that can store large amounts of data. These types of media must be able to survive extended power loss and system restarts

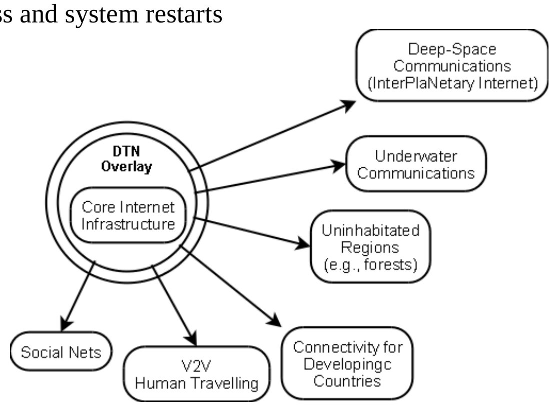

Fig-1 Representation of an geographical distribution of DTN

The concepts behind the DTN architecture targeted at tolerating long delays and interrupted communications over long distances (i.e., in deep space). At this point , there was some work of an architecture for the *Interplanetary Internet* (IPN). By 2003 March, when the first draft of the eventual RFC 4838 was published there was an intention to extend the IPN concept to other types of networks, including terrestrial wireless networks. These types of wireless networks suffer a lot by disruptions and delay, and the DTN architectural emphasis grew from scheduled connectivity in the IPN case to include other types of networks and patterns of connectivity.

The major critique to DTN architecture is the lack of an end-to-end reliability mechanism and lack of error detection at the bundle layer. Other points of concern include time synchronization, fragmentation, and meta-data parsing complexity.

Basic Architectural View

The DTN architecture was designed to provide a framework for dealing with the sort of heterogeneity found at sensor network gateways. DTN use a multitude of different delivery protocols including TCP/IP, raw Ethernet, hand-carried storage drives for delivery.An end-to-end message-oriented (overlay) layer called as the "bundle layer" which lie above the transport layers on which it is hosted. DTN nodes are present here ,i.e devices which implement the bundle layer. The bundle layer forms an overlay to help combat network interruption.

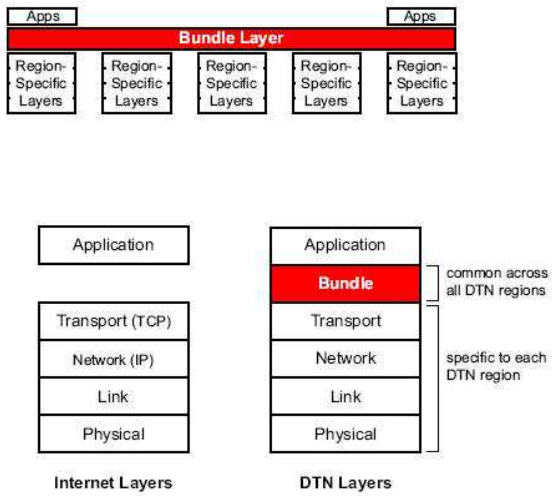

Fig-2 Bundle layer

A reliable hop-by-hop transfer delivery and optional end-to-end acknowledgement is also possible greatly. The bundle layer provides similar to the internet layer of gateways functions. Both provide interoperability between underlying protocols specific to one environment and provide a store-and-forward forwarding

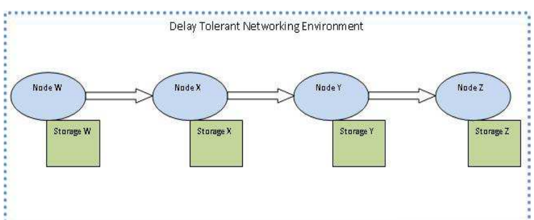

Fig-3 Delay Tolerant Networking Environment

Different Architectural Perspective of DTN

There are different types of architectures that has been implemented for DTN that includes various parameters. The parameters took major role for providing a different architectural view.To improve the parameters efficiently there is a heavy need to improve in the architectural perspective.

Based on different parameters here we are going to see some architectures which improves the parameter efficiency.Before that, here is a brief explanation about the two types of catagories of DTN called as Terrestial and Space DTN.

A.Terrestial Dtn

Many earth based applications which need to survive and communicate in harsh environments such as tracking of wildlife, military operation applications, underwater communication, enhancing Internet "hotspot" connectivity implements the DTN technology. All those environments have a common thing, a large amount of delay in transmission that encourages data storage at nodes in the network. A DTN-enabled application send messages called as Application Data Units, at the bundle layer ,the ADUs are transformed as "bundles" which is then stored and forwarded by the DTN nodes. Bundles can be broken into fragments and reassembled whenever it is required. The End point Identifier (EID) identify a bundle source and destination. The DTN also implements end-to-end reliability. Time synchronization and time stamps become important for DTN networks in order to identify bundle and fragments for routing. Although Delay-Tolerant Networking is new as an independent research field, it has number of prototypes which target real evaluation of protocols, designed for terrestrial DTNs (e.g., DakNet ZebraNet UMassDieselNet.

There was a Architectural Enhancements for Terrestrial DTNs, Limited connectivity in terrestrial Delay-Tolerant Networks is directly related to limited network capacity. There are ways to increase the available network capacity by increasing connectivity opportunities.

Three main ways has been identified

1. Adding extra infrastructure elements
2. Exploit alternative communication technologies for data transmission
3. Mobility Exploitation.

There are some enhancements specifically done for terrestrial DTN architectures. The below table shows some of the enhancements.

Table I
Architectural enhancement of teresstial dtn

S.No	Architectural Enhancement	Proposal
1	Adding Extra Infrastructure Elements	Throwboxes, Robots, Data MULES
2	Exploiting Non-Random Mobility	Message-Ferries Message-Ferries
3	Using Alternative Com-munication Technologies	ParaNets, Infostations, Second Bluetooth, Second Bluetooth

B.Space Dtn

The important motivation for DTN use in space communication results from making IPN a real networking environment. In space DTN architectures ,there is a full connection delays can be huge. The Bundle Protocol uses the 'native' to communicate within the Internet. The Convergence Layer Adapter (CLA) forms an interface between the Bundle Protocol. A bundle node can sends or receives data. The bundle endpoint is a group of bundle nodes that can offer Bundle Protocol functionalities and they identify themselves with a single string - "bundle endpoint id". The Bundle Protocol data unit is called as a "bundle" and it contains at least 2 or more blocks of protocol data. The former is called the primary bundle block and it may be followed by sequence of Bundle Protocol blocks.

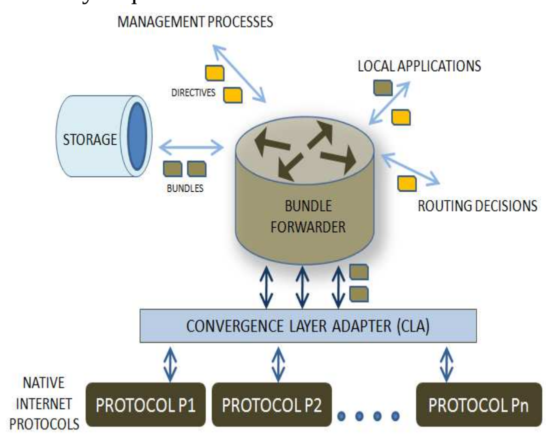

Fig-4Bundle Forwarder

C. Aggregation of bundle layers.

Here multiple DTN bundles are aggregated within a data transport block, which resists the space channel asymmetry that has been a major controversy for several years. An experimental investigation of whether or not the multiple DTN bundles aggregation within a data transport block has performance acts as an advantage. The investigation focuses on a space SoS inter networking scenario , which is characterized by an asymmetric data rate. A new model is developed for the minimum number of data bundles that should be aggregated in a (LTP) Licklider transmission protocol block to avoid delay of acknowledgment transmission , which is caused by channel asymmetry in the space SoS inter networking system. In this view, BP bundles are passed as service data units to LTP for transmission and they are encapsulated in LTP blockwhich is fragmented into LTP data segments according to the underlying link service MTU and the segments are encapsulated at link layers.

The segments received at the receiver are used to reassemble the original blocks. As each transmitted block is reassembled, the reception status of that block is returned in an RS that serves either as a positive acknowledgment or a negative acknowledgment.

The sequence of LTP segment exchanges undertaken to affect the successful transmission of a single block is termed a session. NBS defines the maximum amount of data allowed for transmission per second

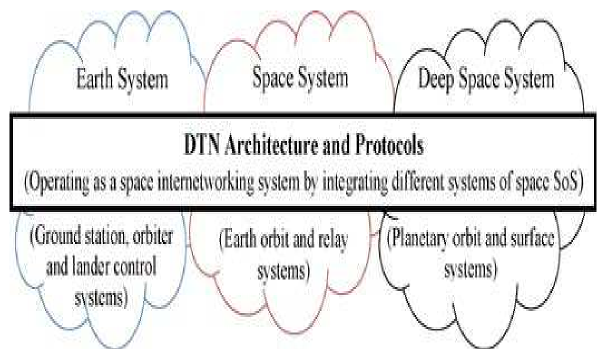

Fig-5 DTN Architecture and Protocol

D. Interplanetary Overlay Network (ION)

Interplanetary Overlay Network (ION) is widely used in Interplanetary environments. It is open source, modular, easy to modify and it can also plug in our own routing protocol. It has the bundle protocol as in along with the CCSDS File Delivery Protocol and the (LTP) found in IRTF RFCs 5325. But there are some constraints:

1) Data transmission is very slow and highly asymmetrical in Deep space communication.
2) Radiationhardened is the property of Flight computer that operate efficiently in harsh space conditions. Considering this characteristics it makes the processor speed several times slower.
3) Data is transmitted in the form of bundles always. So per-bundle processing overhead must be kept as minimum.

E. Comparision of Architectures

The Delay-Tolerant Networking Architecture was initially proposed as, approach to make the Interplanetary Internet as a possible networking environment. The main aim was to implement a network of networks which should be universal.

Here, most effort was put on interconnection and interoperability issues, the definition the Bundle layer itself and its forwarding capabilities with regard to custody transfers, naming and addressing schemes and store-and-forward capabilities of intermediate nodes.

In earlier, it addresses important issues relating to the design of network protocols for challenged environments, in general and proposes that the DTN architecture should form an overlay that will embrace all potential challenged environments.

Recently, there was a review that efforts and approaches of the IRTFDTNRG. The initial architecture was concentrated in the deep-space communication and poorly target into terrestrial DTNs due to lack of flexibility in design.

There are still some important issues that need to be investigated further which include routing, security and congestion management and control. This table describes the several architectures and its purpose.

Table ii
Comparision of architectures

S.No	Architecture	Purpose
1	IPN	Space Exploration
2	ZebraNET	Wildlife Tracking(Biological Interest)
3	Haggle	Social and Pocket Switched Networks
4	DakNet	Connectivity to Developing Countries
5	DieselNet Driv-eThru	Vehicular DTNs Road Comms

Conclusion

A novel explanation of DTN and its architectural perspective has been clearly described. Comparing the different architectures including space and terrestrial DTN its clearly understand that bundle layers play a vital role . Here recent architectures-aggregation of bundle layers and Interplanetary Overlay Network (ION) are also discussed with some constraints .These constraints are still an open challenge in DTN architecture. The comparison of architectures details describes about the parameters and the applications involved in it.

References

[1] K. Fall, "A Delay-Tolerant Network Architecture for Challenged Internets,"in Proc. ACM SIGCOMM '03. New York, NY, USA: ACM Press, 2003, pp. 27–34.

[2] V. Cerf, S. Burleigh, A. Hooke, L. Torgerson, R. Durst, K. Scott, K. Fall, and H. Weiss, "Delay–Tolerant Networking Architecture," Internet RFC 4838, April 2007.

[3] K. Scott and S. Burleigh, "Bundle Protocol Specification," Internet RF 5050, Nov 2007.

[4] S. Farrell and V. Cahill, Delay– and Disruption–Tolerant Networking Artech House Publishers, 2006, iSBN: 1-59693-063-2.

[5] I. Akyildiz, Y. S. W. Su, and E. Cayirci, "Wireless sensor networks: survey," Computer Networks, vol. 38, pp. 393–422, 2002.

[6] K. Fall, W. Hong, and S. Madden, "Custody Transfer for Reliable Delivery in Delay Tolerant Networks," Intel Research Berkeley, Tech. Rep. IRB-TR-03-030, Jul 2003.

[7] E. Duros and W. Dabbous, "Supporting unidiretional links in the internet," in Proceedings of the 1st International Workshop on Satellitebased Services, 1996.

[8] J. H. Saltzer, D. P. Reed, and D. D. Clark, "End-to-end arguments in system design," ACM Trans. Comput. Syst., vol. 2, no. 4, pp. 277–288, 1984.

[9] D. Clark, "The Design Philosophy of the DARPA Internet Protocols," in Proc. ACM SIGCOMM. Stanford, CA: ACM, Aug. 1988, pp. 106–114. [Online]. Available: citeseer.ist.psu.edu/clark88design.html

[10] M. Seligman, K. Fall, and P. Mundur, "Alternative custodians for congestion control in delay tolerant networks," in Proc. ACM SIGCOMM Workshop on Challenged Networks. New York, NY, USA: ACM Press, 2006, pp. 229–236.

[11] W. Zhao, M. Ammar, and E. Zegura, "Controlling the mobility of multiple data transport ferries in a delay-tolerant network," in Proc. IEEE INFOCOM, 2005, vol. 2, pp. 1407–1418.

[12] L. Zhong and N. K. Jha, "Energy efficiency of handheld computer interfaces: Limit, characterization and practice," in Proc. ACM MobiSys, 2005, pp. 247–260.

[13] K. Fall, "A delay-tolerant network architecture for challenged internets," in Proc. ACM SIGCOMM, 2003, pp. 27–34.

[14] H. Jun, M. H. Ammar, M. D. Corner, and E. Zegura, "Hierarchical power management in disruption tolerant networks with traffic-aware optimization," in Proc. ACM SIGCOMM Workshop CHANTS, Sep. 2006, pp. 245–252.

[15] T. Liu, P. Bahl, and I. Chlamtac, "Mobility modeling, location tracking, and trajectory prediction in wireless ATM networks," IEEE J. Sel. Areas Commun., vol. 16, no. 6, pp. 922–936, Aug. 1998.

[16] N. Mishra, K. Chebrolu, B. Raman, and A. Pathak, “Wake-on-WLAN,” in Proc. Int. Conf. WWW, 2006, pp. 761–769.
[17] W. Ivancic, D. Stewart, L. Wood, C.Jackson, J. Northam and J. Wilhelm,“IPv6 and IPSec Tests of a Space-Based Asset, the Cisco router in Low Earth Orbit (CLEO)”, NASA Technical Memorandum 2008-215203, May 2008.
[18] L. Wood et al., “Saratoga: A Scalable Data Transfer Protocol”, Network Working Group, IETF, http://tools.ietf.org/html/ draft-wood-tsvwg-saratoga-09#page-4, September 26, 2011.
[19] R. M. Jones, “Disruption Tolerant Network Technology Flight Validation Report, DINET”, JPL Publication 09-2, NASA, February 2009.
[20] S. Burleigh, “Interplanetary Overlay Network: An Implementation of the DTN Bundle Protocol”, Consumer Communications and Networking Conference, 2007. CCNC 2007. 4th IEEE, pp. 222-226, January 2007.