Connecting the Disconnected: A Combination of DTN, CDN and TCP/IP Approach

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Abstract—The information technology plays a vital role in the development of every aspect of our lives. Internet, one of these many technologies, is the most utilized entity for accessing the ocean of information. But, many remote regions of the world are still deprived of these information available today. The prime reasons behind this deprivation being inadequate infrastructure facilities and remoteness of the concerned places. But these could be overcome by implementing Delay Tolerant Networks (DTNs), which is a supporting communication in a rather unorthodox way for the intermittent networks, where direct link at all times may not be available. This paper proposed a practical implementation of a network architecture by combining Delay Tolerant Networks (DTN), Content Delivery Network (CDN) using TCP/IP with the help of wireless connectivity enabled devices. The network scheme aim to be implemented in the third world countries where sometimes technological amenities are scarce.

Keywords—Delay Tolerant Network, Challenged Network, Message Ferry, Content Delivery Network.

I. INTRODUCTION

At this age of technology, most of the places in the world are interconnected via Internet. The people of developed countries have flawless, fast and reliable connectivity. But unfortunately, the scenario is not quite the same in most of the developing countries or the third-world countries, as the rural people here are greatly deprived of ocean of information available in today's Internet. Whereas, immense use of information technology could be a great catalyst for rural development.

The people, living in such disconnected scenarios, do not even get their fundamental amenities, let alone information and technologies. So they are somewhat detached from modern technologies. As for example, according to the Bangladesh Telecommunication Regulatory Commission (BTRC)(November, 2015), in Bangladesh, 65% of rural communities do not have Internet facilities to get necessary information [1].

This paper proposes a model to overcome the crisis of information and enhance the development of the concerned places. The people, in those areas, do not have access to the on-line newspaper, e-books, stock rates, current market prices and all other latest events happening around the world. People of every line of works are in need of updated information related to their respective jobs. A rural farmer needs to know the current market price of daily essentials in the city. He may need to know the appropriate time and state of the art rules of sowing, irrigating, fertilizing and harvesting to get maximum crop yield. A rural fisherman needs to know the fish market price for his business purpose, while a student at a remote village has the right to access the e-books and other educational materials available online just like an urban student.

Besides these, most of the rural people are not often technically sound even to operate today's state of the art communication technologies. This limitation creates one more challenge to ensure information availability among rural people. Thus, our prime objective is to bring the disconnected and technically less sound rural people under the network coverage, letting the deprived rural community to access desire information in due time.

Unsoundness in technical domain is one of the major barrier before our target clients to utilize the Internet facility. Therefore, providing the Internet facility at any how is not enough for our target clients. Rather a separate entity should be available before them to collect and serve their demand for information in a convenient way. Since most of the rural areas in developing countries do not have enough infrastructure

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Fig. 1: Ferry assisted multi-cluster delay tolerant network.

to provide Internet facilities, hence this is our cordial effort to put up the desire information towards our target clients by even tolerating long delays. Yet it is better to achieve desired content even experiencing long delay than getting nothing. Note here that in this proposed network real time data communication such as voice over or playing video may not well match.

The prime reasons behind this deprivation are inadequate infrastructure facilities and remoteness of the concerned places those cause delay in data communication because of discontinuation and disruption.

From this motivation we propose a combination of Delay Tolerant Networking (DTN) [2] model to make the disconnected rural community connect with the global resources. To implement our proposed model a smart application package is essential to collect and serve the demands of target clients in a convenient way which involves user friendly interaction for technically less sound communities.

DTN is a unique approach to computer network architecture that enables communication in heterogeneous networks and allows data transfer in situations where traditional networks are obsolete, i.e., where, physical end-to-end connectivity is not present. To communicate over long distances through time delays, DTN becomes the standard method nowadays. The fundamental technique of DTN referred to as the Bundle Protocol (BP) [3] is similar to the Transmission Control Protocol/Internet Protocol (TCP/IP) [4] that is the building block of the Internet. The big difference between BP and IP is that, while IP assumes a more or less smooth pathway for packets going from start to end point, whereas, BP has the capabilities to store the data and allows data communication through disconnections, disruptions, discontinuation, glitches, etc. The DTN architecture uses in-network or nodelevel storage to provide an overlay network. This nodelevel storage allows application messages (bundles in the DTN architecture) to be stored on DTN gateways (or nodes) for arbitrary lengths of time, while waiting for a forward path to become available. This clearly differs from the IP model where IP packets must be forwarded immediately, otherwise, dropped.

In our specific DTN scenario, the Network Model is an example of the inter-cluster DTN as shown in Fig. 1. It consists of several isolated *clusters* (e.g. towns and villages) where, each consists of several nodes (e.g. houses/clients). In each cluster, nodes can directly communicate only with other nodes through WiFi within the transmission range. To collect data bundles from one cluster to distantly located another cluster, we apply the ferry-initiated message ferry scheme [5], [6]. The message ferry refers to as Movable Server in our scenario, collects clients requested data from the main Admin Server in the town with Internet connectivity and then transfers it to the villages (without Internet connectivity) by traveling in a round trip. Within a cluster, the movable server (i.e. the ferry) and several nodes (i.e. the clients) connect each other through WiFi and synchronize their data. In some cases, in a cluster, movable server connects one Local Server (special node), where, that specific node is responsible to store the data and deliver them to other clients/nodes within the cluster. Here, Ad-Hoc Network is used to connect the WiFi enabled wireless devices to each other. This networking technique allows practically establishing connectivity within a closed remote boundary using wireless equipped devices. In our proposed system, the WiFi enabled wireless equipped computing devices are used for its higher data transfer speed, ability to connect to multiple users and relatively better radio signals.

Our specific DTN scenario differs from the standard DTN scenario used for challenged network, where, the network has to rely on the opportunistic connectivity. In the contrary, in our ferry-assisted DTN scenario, the locations of clusters (i.e., distant villages) are permanent and the message ferry (movable vehicle equipped with wireless device) travels round trips in the predefined path to communicate nodes in each cluster. Here, nodes know the path and data delivery point of the message ferry as well as where and when to collect data from them. While the Ad-Hoc network connects the physically closed message ferry and one node (or server), it establishes the reliable end-toend connectivity between them. Then, the message ferry moves to another cluster and again establishes the reliable end-to-end connectivity between the physically closed node in that cluster. Thus, when we consider data communication between source (i.e., admin server) to destination (i.e., node in a distant cluster) the overall network does not have any end-toend connectivity, however, during data synchronization between message ferry and each specific node, there establishes a reliable end-to-end connectivity. This data exchanging between physically closed message ferry and each node through the Ad-Hoc network facilitates by TCP/IP protocol. Thus, we can utilize all the high performance advantage of TCP/IP protocol. Therefore, instead of using BP we use TCP/IP. It is advantageous in the current scenario, because most of the state-of-the art devices uses TCP/IP coherently which is easier to customize for the Ad-Hoc network. However, our system is fully adaptable with the Bundle Protocol (BP) and our system can be customizable and convertible for BP in anytime.

In our scenario, for better data delivery performance, the approach of Content Delivery Networking (CDN) [7] is also applied, where, movable server (i.e., message ferry) act as a CDN server. As for example, the CDN copies the pages of a website to a network of servers that are dispersed at geographically different locations, caching the contents of the page. When a user requests a webpage that is part of a content delivery network, the CDN will redirect the request from the originating site's server to a server in the CDN that is closest to the user and deliver the cached content. The CDN communicates with the originating server to deliver any content that has not been previously cached when connection is available.

Our primary contributions are as follows. Firstly, we have proposed a sustainable network model to connect the disconnected rural communities within themselves and with the global resources. Secondly, we have proposed a bundles of potential applications of information technology in rural development sector with their socioeconomic prospect. In this paper, in the network model, a combination of DTN and CDN is implemented among devices using wireless connectivity, where, data communication uses TCP/IP protocol. From these motivations we have proposed a sustainable network model to find a way to interconnect the rural villages which are detached from modern technologies, and give them autonomous solutions, so that the village people do not require any costly Internet connection or infrastructure to connect within themselves and with global Internet. The proposed network connects these disconnected communities by utilizing minimum technical tools and existing rural infrastructure. Moreover, use of proposed model is not only a cost effective solution but also a profitable and sustainable project for investors.

This paper is organized as follows. Section 2 and section 3 describe the related work and our proposed network model by illustrating the plans for the project, respectively. In section 4, we present the data flow mechanism and in section 5, we describe software entity. Some unique features of our proposal are also stated there. The Community needs for a number of prospective application for Socioeconomic development of rural communities and requirements for implementation are presented in section 6 and 7, respectively. Finally, in section 8 the future goal and work ideas are stated following with the conclusion of this paper in section 9.

II. RELATED WORK

Many unorthodox and unique alternative schemes are proposed to connect the disconnected communities [8], [9]. Among them many are tested or in the process of being tested as for example- Bytewalla [10], [8], DakNet [11], 7DS [12], SNC [13], SWIM [14], Motopost [15]. DakNet [11] uses linux operating system based computers with Wi-Fi router attached to buses which travel among villages. Here, e-mails are downloaded to the villages and uploaded for transfer to the Internet or to other villages along the bus route. On the similar kind of bus network, a system of throwboxes [16], [17] was implemented to extend the capacity of the DTN. Besides, KioskNet [18] is a network of rural Internet kiosks that render data services in remote regions where, vehicles with on-board computers transport and exchange the data between the kiosks and gateways connected to the Internet. On the other hand, Cinema-in-a-backpack [19] deliver educational and entertainment movie in remote villages similar to DakNet [11]. Besides, TACO-DTN [20] is a content-based dissemination system composed of fixed and mobile infostations that allow mobile users to subscribe to media contents for a period of time. Also, Campus bus networks designed to serve college commuters are proposed in [21], [22], [23]. In may be noted that a significant number of disconnected rural communities are getting connectivity by various telecommunication companies. Though, they are offering many Internet schemes before them, still it is expensive and un-affordable for majority of disconnected communities.

In most of the related works they use BP (bundle protocol) which limits the mass adaptation with existing devices available there. Moreover, for better data delivery, so far of our knowledge, none of them consider the smart management of content delivery offers by CDN and/or per individual user account management. Furthermore, very few of them specifically address potential user applications, their applicability, prospect related to the village people associated with the system. Our research paper incorporate all the above facilities by focusing on the technically sound less community.

III. NETWORK MODEL

The proposed network establishes connectivity by implementing the combined concept of DTN, CDN and TCP/IP. It employs wireless equipped smart devices (for example smart phone, tablet) works in storecarry and content delivery fashion. However, unlike traditional DTN end to end connectivity between any two communicating devices is possible in the proposed network. Hence, the proposed network allows data transfer among wireless equipped devices employing TCP, a standard transport layer protocol. However, since we are considering a challenged network situation or alternative to Internet system, real time communication is compromised.

The basic idea of data transfer mechanism is illustrated in Fig. 2 and explained by following points.

- 1) When two wireless equipped devices are within transmission range, they create wireless Ad-Hoc network. Thus, data transfer takes place.
- 2) When they are out of the range, no data transfer occurs.
- 3) When a third wireless device is placed between these out of range devices, they can transfer data through that or among themselves.
- 4) When an wireless device is placed inside a house, or a vehicle or a building, then that house, vehicle, building can transfer data among themselves.



Fig. 2: Fundamental idea of the proposed networking model.

5) While one of the connecting device is placed inside a moving object, connectivity range among the disconnected devices increases in a great extend.

The proposed network stands on basic two components to be in full function.

A. End User

An Individual from disconnected community possessing a wireless equipped device (e.g., smart phone, tablet), is referred to as end user in our proposed network. However, such devices do not need to be highly capable in computing and storing. Hence, these are usually cheap in price and affordable for our target users. As for example, any affordable android smart phone can be used as end user device. An end user places his/her demand for information to an appropriate server and collects desire information from that server.



Fig. 3: Role of different servers.

B. Server

A wireless network interface card equipped computing device with moderate computing and storage capabilities acts as a Server in the proposed network. It is responsible for one or more of the following duties.

- Collecting user queries and data.
- Carrying user queries and data.
- Processing user queries and data.
- Delivering user desired data.

Thus, the proposed network requires following three category of servers.

1) Admin Server: A computing device directly connected with high speed Internet connection and possessing high storages and computing capabilities works as Admin Server. It is installed at the nearest urban area where high speed Internet connection is available. Availability of bulk of sequence of data and global Internet facilities allow the Admin Server to process the user queries and to present meaningful informations for end users. However, such processing requires few manual operations accomplished by one or more human operators. Therefor, the proposed network requires employing one or more human entities to coordinate the processing of user queries employing the Internet facility. However, processed data are delivered to Movable Server by establishing an Ad Hoc network while it comes within its transmission range. It launches a reliable TCP connection while establishing the Ad Hoc networking between them. It is to be noted that, Admin Server plays the role of a client device while it receives row data or user queries from Movable Server.

2) Movable Server: Server carried by the Message Ferry act as Movable Server in the proposed network. Availability of different motor or non motor vehicles in any disconnected communities is utilized in the proposed network. These vehicles are used to carry the Movable Server across the disconnected villages. Any traditional vehicle used in Intra-village transportation can be also utilized for this purpose. Thus, utilization of available resources from disconnected communities are adopted. However, cost of power consumption by Movable Server can be minimized by fitting a solar panel on vehicle's top. Therefore, uninterrupted data delivery can be facilitated in case of power failure or any disaster scenario.

Movable Server roams around the disconnected villages for collecting user query and delivering processed information. It collects furnished data from Admin Server and delivers those to appropriate Local Servers. Moreover, collection of row data or user queries from Local Servers and delivery of those to Admin Server also belong to its responsibilities. While passing through any Local Server or Admin Server, it waits for a significant amount of time to deliver and collect respective information. Once a reliable TCP connection is established between these connected devices, data transfer goes on until it goes out of their mutual transmission range. However, Movable Server also behaves like a client while it collects information from Admin Server or Local Server. Note here that if required secure communications can be provided by Transport Layer Security (TLS) [24] or Secure Sockets Layer (SSL) [25] to secure all communications between the server and clients and to provide privacy and data integrity between them.

3) Local Server: A server owning moderate storage and minimal computing capabilities take the role of a Local Server in the proposed network. it is placed in a general meet point of a certain class of disconnected community people. It serves the end users directly by delivering the desire information and collecting user queries. It establishes a reliable TCP connection with the Movable Server, while Movable Server comes within its transmission range. Once connection is established, Local server acts as client with respect to



Fig. 4: Work flow of the proposed network model.

Movable Server. Thence, it collects processed data and deliver user queries to Movable Server. Fig 3 depicts the role of these servers.

End users collect and store desire information from nearest Local Server by reaching within the transmission range of Local Server. Thence, an Ad Hoc network is established employing TCP connection. However, A Local Sever also projects few important information on it's display board or wider screen. Thus, people from disconnected communities get important and general information without having their own devices even.

Lets have a practical scene of the proposed network where, rural businessmen willing to know the market price of rice and farmers desire to know perfect time of employing different insecticides, place their respective queries to the nearest Local Server. These queries will be processed by Admin Server and will be available at that Local Server according to the mentioned principle. However, these businessmen have to collect inquired information from that Local Server along with those farmers whose demands belong to different domain of interest. However, performance of such data delivery procedure at a Local Server puts down in highly dense community as data from all domains are placed together. Thus, the efficiency of the whole process degrades, since dealings of all category of data together create complexity in Local Server and inflexibility for end users.

To elevate the network performance, the proposed network introduces the use of multiple Local Servers in a single disconnected community. Where each server will be dedicated for a particular domain of interest. The proposed network proposes following categories of Local Servers.

- i) Local Server at School,
- ii) Local Server at Hospital,
- iii) Local Server at Sports center,
- iv) Local Server at Business center,
- v) Local Server at Entertainment center, and
- vi) Local Server for Miscellaneous purpose.

IV. DATA FLOW MECHANISM

The Movable Server travels to all the Local Servers and uploads user queries as well as row data and delivers already processed data to different Local Servers based on the domain of data. the proposed network uses identification keywords to distinguish between the domain types. Processed data are transferred to the appropriate Local Servers depending on matched keyword. Fig. 4 describes all the Local servers. People desire for particular domain of information collects form respective Local server. Hence user density is lessened and message exchange takes place with higher speed and reliability.

A. Content Delivery Mechanism

The proposed network includes an efficient content delivery procedure which synchronizes the information contents among the communicative devices. Once an connection is established, content delivery unit at server side compares the contents present at both of the storage devices. Thence, it synchronizes both storage devices with updated and latest one. However, for smarter and faster data delivery proposed scheme applies the concept of caching and redirecting the requested contents from closest server instead of admin server if possible.

B. Storage Management

Storage management in all these servers is an important issue, since information are not delivered to intermediate recipient immediately. A priority queue mechanism manages this aspect efficiently. Moreover, processed queries for individuals are kept secret to restrict unauthorized access. A server deletes the successfully delivered resources from it's own storage device. However, frequently asked category of data are preserved for future usages till a fixed period is elapsed. Priority queue mechanism also handles this requirement. Thus, a server can instantly serve few queries and works as a on line server.

V. SOFTWARE ENTITY

Each devices of the proposed network requires an efficient software entity. However, the behavior of software entity may be different at different devices.

A. Software Entity at Server

Establishing reliable end to end connectivity, uploading and delivering concerned information are the key responsibilities of software entity at server. Minimizing the power consumption and implementing different autonomous features are the important issues which need to be considered while developing this software entity. However, every single actions of this software entity is completely autonomous. Moreover, Each Local Server presents attractive application/s before concerned community by manipulating the gathered or row data data.

B. Software Entity at End User

A simplest software to establish reliable connection with a particular Local server, collecting desire resources from them and presenting those in a suitable format before the end user are the duties of this software entity. However, minimum and friendly user interactions are the most important issues relating this software entity.

VI. COMMUNITY NEEDS

The proposed network can be implemented in various aspects of the disconnected communities. However, most of the following aspects don't require real time service of desire information. Hence, the proposed network concept is mostly applicable instead of the real time Internet. Elaborate descriptions are present in following subsections.

A. Serving Rural Youth

1) Disseminating Etiquettes in Youth: Proposed network can be utilized for boosting social ethics and spiritual value among rural youth. Documentaries on social and spiritual etiquettes can be projected or delivered to rural youth by availing those in a Local Server at Sports center. These resources can be downloaded by administrative server and delivered to all Local Server at Sports centers. On the availability of sufficient information, a number of trainings can be conducted on electronics, solar home systems, mobile phone repair, fisheries, looms, carpentry, breeding cows and goats, milk production, growing seedlings, setting up nursery, small businesses, tailoring, potteries, pickles, chalk, pure drinking water, etc.

2) Enlarging Employment Opportunities: Proposed network can also play a role to extend the employment opportunities to disconnected youth community. They can get access to the information pool relating job opportunities.Moreover, on line application form for college and university admission and job can be downloaded and provided to end users. Local Server at Sports center can be utilized in this purpose.

B. Serving Rural Women

To Promote and strengthen the rural women folk, the proposed network can be incorporated by providing appropriate audio visual contents or educational documentaries to raise consciousness in the following major areas: health, childcare, sanitation, cleanliness, proper cooking methods, handicrafts, making pickles and similar other activities. Local Server for miscellaneous purpose can be utilized for this purpose. Availability of such resources at Local Server can allow it to project those on its wide screen or deliver those to end users.

C. Promoting Health, Sanitation and Medicare

People of the village and rural areas mostly know a little about health and sanitation. As a result they are

easy prey to different malicious and seasonal diseases. But a little concern can prevent these things.

1) Availing Health Care: Rural hospital authority sometimes may feel the necessity to consult with specialized doctor regarding critical patients or exceptional medical cases. Hospital authority can upload the clinical health status of critical patients in its Local server. However, availability of remote diagnostic testing facility (RDTF) in hospital can make the total process very efficient. It might include a specific vital sign, such as blood glucose or heart ECG or a variety of indicators for distant patients. Once the health status is uploaded, Movable Server can deliver those to destined Local server or Admin server. While the experts are out of the proposed network scope, Admin server can deliver these content employing global Internet facility. However, The experts can then check the symptoms and prescribe accordingly, which are delivered in reverse way.

2) Raising Health and Sanitation Awareness: The symptoms of the common diseases and their cures can be downloaded by administrative server and given on a Local Server at hospital. Those can be projected on wide screen available at the Local Server even.

D. Elevating Educational Facilities

Education resources can be collected by Admin servers and delivered to all Local Servers at different schools. Gradual collection of such resources enriches the resource pool at every Local server at school. However, local resources (e.g. lecture material prepared by local resource personnel) can be distributed among Local servers at schools to further enrich the resources pool.

1) Off-line e-Library: Electronic copy of different books can be made available to disconnected students by means of our proposed model. All text books of primary and secondary level and books of different writers on different topics can be uploaded on Local servers at different schools. These may be downloaded on demand and won't be necessary anymore to collect from Admin Server.

E. Promoting Business and Commerce

Accessibility of appropriate and up-to-date information by disconnected business communities works as a great catalyst in maximizing their scope and prospect. Availability of state of the art information helps the disconnected rural businessmen to become more concerned and skilled. An disconnected businessman can avoid unexpected loss and cheat whenever he/she is informed of latest state of commodities in neighboring village and city markets. Thus information is valuable asset to promote the financial state of rural businessmen in a great extent.

Remarkable progress of business and commerce in disconnected communities can be achieved with minimal cost by employing the the proposed network. Each Local Servers at business center can gather business and commerce related row data from respective individuals. However, once all the row data are grouped together and processed at Admin Server, a summarized information is prepared. This summary report represents the overall businesslike picture of disconnected communities. Availability of such picture before disconnected businessmen has immense positive impact on their business. In the following sections we have remarked a number of promising application of information technology to promote business and commerce at disconnected communities.

1) Remote Access on Neighbor Markets: Disconnected businessman can virtually access their neighbor markets by utilizing the power of Local Servers at business centers and Admin server.

Different Agricultural or livestock or any other type of products are transported to the district cities for selling purpose. Usually the farmers have not much of saying regarding price, as they don't know about the prices in neighboring villages or cities. However, Local server at each business center can get the summary report of neighbor markets. Thus they can place their right demand before the wholesale buyer. Each business center can upload it's local prices from it's local producers. Local Server can announce the average price of the last seven days instead of daily price for minimizing the complexity of the procedure. Up-to-date and accurate information regarding trading transaction can illuminate the status representing what sort of products more are demanding in which areas. Thus, the rural vendors can ship their respective products to the right place.

2) Optimizing the Business Purpose Transportation: Accessibility of Information concerning products availability at different business centers can allow an Admin Server to prepare a business purpose transportation list. However, Admin Server requires the maps of the nearby villages from where intra village distance can be calculated. The fact is that, some of the business centers offer more prices and some less. A vendor should go for the big amount. However, there may be several areas located at different distances which may offer the same price. Hence the picking up the minimal path is the wise option for vendors. As a consequence a navigation system can be much beneficial to disconnected vendors which can present the best possible destinations and current product prices there. The vendors may select the minimum distant destination to ship their products. Local Server at business center can serve this facility by implementing the proposed network.

3) Offering Off-line Marketing: A database of products currently available in different communities, their quality and relative prices can be uploaded in every Local Server at business center and then manipulated in Admin Serer. Summarized reports are then delivered to all Local servers. Hence, any vendor can select an efficient strategy as per his criteria before purchasing certain products.

However, not only purchasing or trading is performed on the markets but also reselling and exchanges are also done. Disconnected businessman can upload the advertisement of their products detail on nearest Local server at Business center. So these information can be categorized under the reselling or exchange category. However, these sort of information and transactions don't need to be real time. Hence, the proposed network concept is absolutely appropriate.

F. Lifting Agricultural Development

Most of the developing countries mostly relies on their agricultural sector. This is the main driving force of these countries. But they are victims of nature and no more less, lack of proper knowledge. Though the agriculture department is working relentlessly to provide them with the proper help, but still farmers are sometimes victims of drought, heavy rain, hail storms etc. Most of the times the lack the knowledge of modern farming and they do it the traditional way. So the output is less.

For this, the instructions and videos of modern farmings can be a savior. They can learn how to protect the crops from different threats like-pests. They can also learn how things are done in the technologically advanced world. Proposed Model provide a basic structure to implement a number of promising application, which benefits the agricultural development in a disconnected community.

- i) Arising Agricultural Awareness.
- ii) Providing Remote Treatment to Livestock.
- iii) Facilitation for Better Cultivation: Analysis on local weather condition and row data collected from the agricultural fields related to crops present condition can lead to accurate and efficient guidance. Thus it could greatly influence the better cultivation procedure for disconnected farmers. Deployment of necessary and relatively low price sensors in crop fields can bring new dimension in better cultivation. On the availability of deployed sensors, the proposed network can employ its Movable Server to collect row data from sensors. Gathered row data can be refined by Admin server to present meaningful information, which holds significant value before cultivators.

G. Promoting Rural Transportation

1) Remote Access in Bus Terminal : The bus tickets can be even booked in off-line by disconnected end uses.

2) Navigational Purpose: local map and local information can be placed at Local Server for miscellaneous purpose or any Local server closer to the entrance of the a village or a town. Hence, when an outsider comes to a newly visited village he/she can collect those by establishing an Ad-work network with Local server. Availability of this basic information about the area and landscape can help him/her to be navigated through the village or town.

3) Off-line Position Tracker: the proposed network can even provide an off-line position tracker in a disconnected village. The global positioning system (GPS) uses satellite connections for tracking a position. In our case, getting positions and directions in a local area requires the deployment of local location identify sensors at different strategic pints. To certainly locate a position it need at least three references. So if we deploy the sensors, when a person comes closer to them, the end users device can automatically triangulate its position with reference to the sensors. This way, the proposed network can navigate, get directions and see where we stand in an unknown area. No internet or Satellite connection is needed here.

H. Elevating Rural Communication

1) Interconnection within Villages: If an end user wants to send any text or recorded voice message,

he/she can send it to the Local Server at entertainment center. However, to facilitate this, each of the Local Servers requires to maintain a list containing end users currently associated with it. Thus, the cost of Internet or traditional connectivity can be bypassed.

2) Off-line Community Network: In today's virtual world, we socialize with other people via different social networks like- face book, tweeter, linked in etc. But for the regions without infrastructure, this facility is hard to get. Local Server at entertainment center can be utilized to facilitate such feature. Comments, pictures even videos can be shared by employing the proposed network, not instantly, but with a delay. Similarly e-mails can also be shared.

3) Information Dissemination: National important news, news for the local community, news bulletins can be conveyed by Movable server and stored on Local Sever at Entertainment center.Notifications can be sent in advance for the national and other religious holidays.

4) Weather Forecast: Weather forecast is a crucial event, especially for the crop farmers, fishermen at sea and the coastal area populations. So this thing has to be delivered in real time. But for the intermittent network we have no other choice. So for the regions where conventional network is not present like islands, hilly areas, the proposed network concept can be used as an alternative.

Local Server for miscellaneous purpose can announce this information once it receives updated forecast collected from Internet by Admin Server.

VII. REQUIREMENTS FOR IMPLEMENTATION

Implementation of the proposal in intermittent communication scenarios, some special and some general facilities have to be ensured. Some of these facilities are:

- i) Training the volunteers: A group of enthusiastic and energetic young boys and girls have to be selected first from among the local community, who would be given proper training by the skilled trainers so that they attain computerliteracy and become ready to impart training to others. Later, this group would take up the responsibility of training and coaching the various local groups of people to continue or sustain the process.
- ii) Proper equipments: Vehicles, mobile devices, technical support, power supply, etc.

- iii) Funding and space allocation: Proper funding for the project, adequate space for setting up different Local Servers.
- iv) Security facilities: Proper hardware and skilled manpower for preventing cyber crime, blocking harmful and inappropriate contents while requesting for a search.

VIII. FUTURE WORK

This proposal emphasizes on the idea of a DTN and CDN network that interconnects a village without Internet facility. But routing protocol, security protocol, data acquisitions, calculations etc. are yet to be done. Our future goal will be implementing this proposal on real world scenario and make modifications of the problems encountered.

IX. CONCLUSION

This is a proposal intended for the complete plan of making a rural village autonomous in terms of communication and data transfer. With the practical implementation of this proposal and further research, we may someday attain a perfect network through which a local community can transfer data, connect within themselves and use the concept in other aspects in a more sustainable way.

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