CGNet's Information Architecture and the application of Alternative Networks in Chhattisgarh

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1. Abstract

In any information sharing society, the value of communication networks is immense. These networks, often perceived to be limited to the physical data transfer mechanisms that enable communication, can be extended to create stronger hybrid networks that facilitate more efficient and wide ranging communication.

CGNet is a group of individuals working in Chhattisgarh to enable community participation in the development of the state by empowering the community through information.

This project aims to define an alternate information architecture incorporating alternate network models and swarm intelligence concepts that can enable such a community to perform its tasks with efficiency and celerity.

2. Introduction to CGNet

CGNet is a group of people who are working in Chhattisgarh to promote community participation in development. The means that CGNet aims to employ to this end are community empowerment through information.

Conventional media is frequently unsuited for use as a tool of community information exchange, due to commercial concerns. To overcome this, CGNet decided to use the Internet as a medium for communication. The CGNet website, hosted by One World South Asia, is one of the first ever community sites in Hindi. It provides a cheap and freely accessible method of sharing information among the members of the community. CGNet initially planned the website as an e-PanchayatGhar, for members of the community to discuss community issues, voice their concerns and plan for the development of the community as a whole. The website's content is classified under a number of sections such as Agriculture, Media, Forestry, Minerals, Education etc. Each of these sections is semi-independently managed.

With the success of the website and the positive response from the community, CGNet perceives a need to expand the structure and scope of their work.

CGNet aims to establish a shadow cabinet in Chhattisgarh with the purpose of people empowerment and building community participation in development of the state. Such a community would require a means of efficient communication, in order to ensure that relevant information is shared across the community.

3. Chhattisgarh: The State

The state of Chhattisgarh in Central India was formed when sixteen districts of the former Madhya Pradesh were given separate state status.

Chhattisgarh has a population of 20.8 million, over one third of which is tribal.
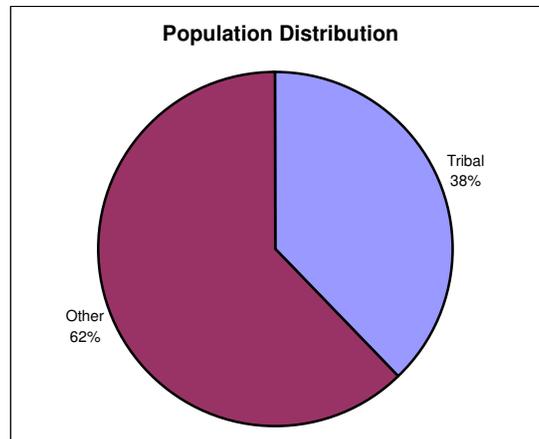
Figure 1Chhattisgarh Tribal Population
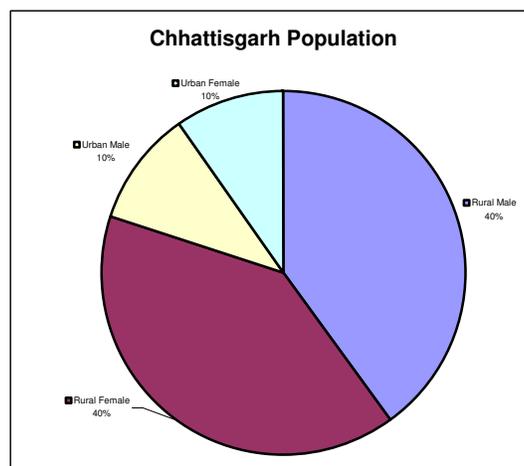
Figure 2 Chhattisgarh Population Composition

Chhattisgarh has always had a strong rural tradition, with only 20% of the population being in urban centers.

There has been a traditional concept of a gram sabha, which is a forum for members of the community to discuss issues and voice concerns relating to the community.

The gram sabha usually meets at a Panchayat Ghar, which is like a resource center for the entire community. CGNet is trying to develop the concept of an e-PanchayatGhar through their website.

Spoken Languages

The Chhattisgarhi language, part of the East-Central group of Indo-Aryan languages, predominates language in the region. The hill districts of the state serve as a home to the Gond peoples, who speak Dravidian languages such as Gondi. The official language of the state is Hindi. Any medium of communication must therefore be in Hindi or Chhattisgarhi in order to be most effective. Also, the target audience of CGNet is the rural segment, and therefore the language becomes all the more important since the majority of eductaion in the rural sector is in Hindi. The literacy rate in Chhattisgarh is about 65%, with the literate population distributed as shown below:

Literate Population Distribution
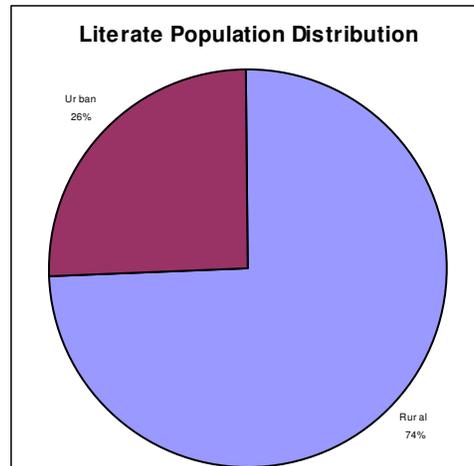
Urban
26%

Rural
74%

Figure 3 Literate Population Distribution

Despite the fact that the rural literacy rate is about 61% as opposed to 81% in the urban centers, the above graph shows that most of Chhattisgarh's literate population lives in rural areas, where the medium of education is usually Hindi.

4. Introduction to Alternative Networks

For any community aiming to share information efficiently with a view to participation in development, an efficient communication network is mandatory. Communication networks are usually perceived as being a set of hardware to perform the physical transfer of data and a set of protocols, which govern the transfer. However, in most definitions of communication networks the user's significance is somewhat suppressed. The individual using the network is perceived as an external agency, not really a part of the network. The developments that may occur as a result of human interaction with the system are also seldom taken into consideration at the time of design. The result is that the benefits from incorporating each user of the network as a network component are overlooked.

Alternative networks, which aim to diverge from the existing traditional network models, can be of many types. The common factor among all such networks is that they aim to de-centralize and make informal the process of communication.

5. Information Architecture for CGNet

The term information architecture is usually used to denote the hierarchy and structure of information, particularly with respect to a website. However, for the purpose of this discussion, I will be taking a broader view of the term and include the community and methods of communication, including infrastructure, in the information architecture description. Also, since CGNet works primarily through its website, hosted by One World South Asia, most of the principles outlined in this section can be directly translated into physical existence on the website. Any community aiming to participate in development or attempting to improve quality of living must first define how it intends to communicate relevant information among its members. Such communication would require an architecture and structure of information gathering and sharing. Under ideal circumstances, the existing communication setup should be adequate to perform well enough for the purpose at hand. However, in scenarios where the existing communication infrastructure leaves a large section of the community without access to information, an alternative architecture is warranted.

Any information architecture, which aims to deviate from the existing structure, must have salient points, which can be empirically tested and on the basis of which it can be declared to be more suitable than what is already in place.

In order to judge an information architecture, the following points may be considered:

• Is the architecture allowing information to be gathered from all relevant areas of community interest with appropriate emphasis?
• Is the architecture conducive to efficient dissemination of information to all members of the community, in a manner that empowers them to use it to maximum benefit?
• Is the architecture suitably pervasive in terms of connectivity, or are certain members of the community marginalized in order to conform to standards?
• Does the architecture sustain itself, or does it require external inputs, either monetary or regulatory, for it to run?
• Is the architecture scalable in the event of an increase in the size of the community?
• Is the architecture robust and reliable enough to be considered a serious aid to development or is it a drain on community resources?

Any architecture designed with these questions asked at every level of development should prove to be suitable for the purpose of supporting a community engaged in participation in development. In order to evaluate a given architecture based on the above criteria, the following salient features of the architecture must be considered

• Methods of Information gathering
• Method of dissemination of information to the community
• Communication infrastructure
• Relevance of communicated information to the community
• Effectiveness of architecture as an aid to development

5.1 Analysis of existing architecture

Having defined the metrics of evaluation of a given architecture, it is now possible to analyze the existing information architecture of Chhattisgarh.

5.1.1 Methods of Information gathering

The major part of information gathering in CG is at this time done either by professional newsgathering agencies or private organizations, which may or may not share such information, based on commercial implications. News and other information, which has specific relevance to the community is not collected efficiently. In addition to this, there is very little scope for cross checking of the information collected.

5.1.2 Method of dissemination of information to the community

The State government in Chhattisgarh has a number of ambitious information technology projects in the pipeline. The ChiPS society, which describes itself as the prime mover for IT and Biotechnology in the state is the body working with most of these projects. Some examples of state run IT initiatives are:

• CHOiCE: Online Information System, which proposes to empower citizens trough information. CHOiCE intends to assure last mile connectivity through wireless solutions.

• E-Gram Suraj: This is an MIS application, which is intended for use particularly by village administrations. Last mile connectivity here is intended to be assured through the Simputer concept using dial-up or CDMA based networks

- SWAN: This is a planned project to connect the entire state into one wide area network using leased lines, VSAT and WiMax technology.

Despite the optimistic possibilities in the future, at this time, these projects are yet to achieve their full potential. Even at completion they would at best provide a basic framework for information exchange. However, these projects would also require increased community participation for their positive effects on the state to be maximized.

5.1.3   Communication infrastructure

Despite efforts by the Chhattisgarh government, as well as semi-private and private organizations, last mile connectivity still remains an issue in the state. Large sections of the community are cut of from broadcast media due to lack of infrastructure. Internet penetration is limited to the densely populated areas of the state. Rural and semi-urban areas are still lagging.

Radio, which could prove to be an effective method of communication in these circumstances, is inaccessible to the general public, since private use of radio waves remains a legislative issue. Information therefore filters down slowly at best to the community members who are located in the areas with limited connectivity. The government of Chhattisgarh has a project in the pipeline to improve connectivity in the state. This project intends to use a hybrid of leased lines, VSAT and WiMax technology to provide the connectivity to the rural areas. However, this project is still in the planning stage and still a long way from becoming usable in the state.

5.1.4   Relevance of communicated information to the community

The media coverage of community issues is pitiable in the area. A recent survey revealed the following:

- Coverage of crime stories was very high
- Articles and editorials seldom address social issues
- The impact of social issues is low, as a result of politicization
- Environmental issues are rapidly escalating in the state, but there are few articles in the press related to the subject
- The disparity between private and public education is resulting in the creation of class differences
- Health services are poor
- Only one newspaper publishes agriculture related news

As is obvious from the above, the relevance of information being disseminated in the public media is rarely relevant. That which sells as opposed to that which has meaning dominates broadcasted information.

5.1.5   Effectiveness of architecture as an aid to development

Since most of the information that the community can access is not relevant to development issues, the effectiveness and conduciveness of the existing architecture to community participation in development is yet to reach it's full potential.

5.2 Suggested architecture

In the present scenario, efficient communication is at best difficult and at worst impossible in the rural and semi urban sections of Chhattisgarh.
To combat this problem and to make the collection, analysis and delivery of information from and to the community needs to be organized in some measure.

For this purpose, CGNet proposes to create a shadow information architecture, which would complement the existing system and also provide a means for the community to determine which information they would find relevant.

5.2.1 Methods of Information gathering

For the community to benefit to the fullest from the alternate network, it is essential that members of the community be engaged in information gathering. However, traditional education being at a premium in the region, the training given to the community members would have to be imparted speedily and functionally, as opposed to the slower and more structured manner followed by the schooling system.

The information gathering process would have to be structured hierarchically, so that a suitably large number of community members is engaged in gathering the information at the grassroots level with minimal training, while compilation and dissemination of data would be done by smaller subgroups of the community who would be trained to a higher degree.

5.2.2 Method of dissemination of information to the community

The primary method of information dissemination to the community is intended to be through the Internet. The penetration of the Internet into the interior regions of Chhattisgarh will be a contributing factor in this regard. In areas where connectivity remains an issue, alternative network models employing wireless technology could be used. Since the Internet is a relatively cheap method of communication, this would make participation possible by all members of the community, irrespective of economic status. Also, with the Internet, another advantage is that commercialization has not set in to the point where revenue is at stake. Therefore, due importance can be given without prejudice to information relevant to the community.

Keeping in mind the strong oral tradition of the state, it would be expedient to have a substantial fraction of the content in audio form. Since private licenses for radio usage are not procurable easily, Internet radio could aid with this scenario.

The dissemination system could also be structured hierarchically, to make it more efficient and effective.

5.2.3 Communication infrastructure

The communication infrastructure required by the alternate architecture would have to take into account for the human element in addition to the existing technology. In addition to this, since connectivity remains at a premium in the region, the technical aspect would have to be re-examined and augmented where needed.

As a preliminary hypothesis, the use of wireless technology to connect previously unconnected regions could be considered. With a number of homebrew innovations emerging in wireless technology, this could possibly be made more cost efficient than the commercial solutions currently available.

Also, with the growing Information Technology industry in India, a lot of computer products, which become obsolete every year are discarded. The reuse of these components may also be possible within the architecture.

5.2.4 Relevance of communicated information to the community

Since community members will themselves be involved in the collection of the information to be disseminated, the relevance to the community would obviously be increased. This is one of the key features of the architecture.

5.2.5 Effectiveness of architecture as an aid to development

Since the information communicated would be by the community members for the community, the community as a whole would be better aware of options available. This would also provide a

platform for community members to express their needs and to emphasize those issues, which are important to them.

6. Definition of an Alternate Information Architecture

The most attractive fact about an alternative architecture is that it is extremely conducive to customization.

The primary concepts that this alternative architecture will use are
- Layering
- Self Organization
- Self Sustenance
- Robustness and Self Healing
- Collective Intelligence

6.1 Layering Model for the Proposed Information Architecture

Layering is a concept that almost everyone who works with networks is familiar with.
For an alternate architecture model definition, it is possible to define customized layers
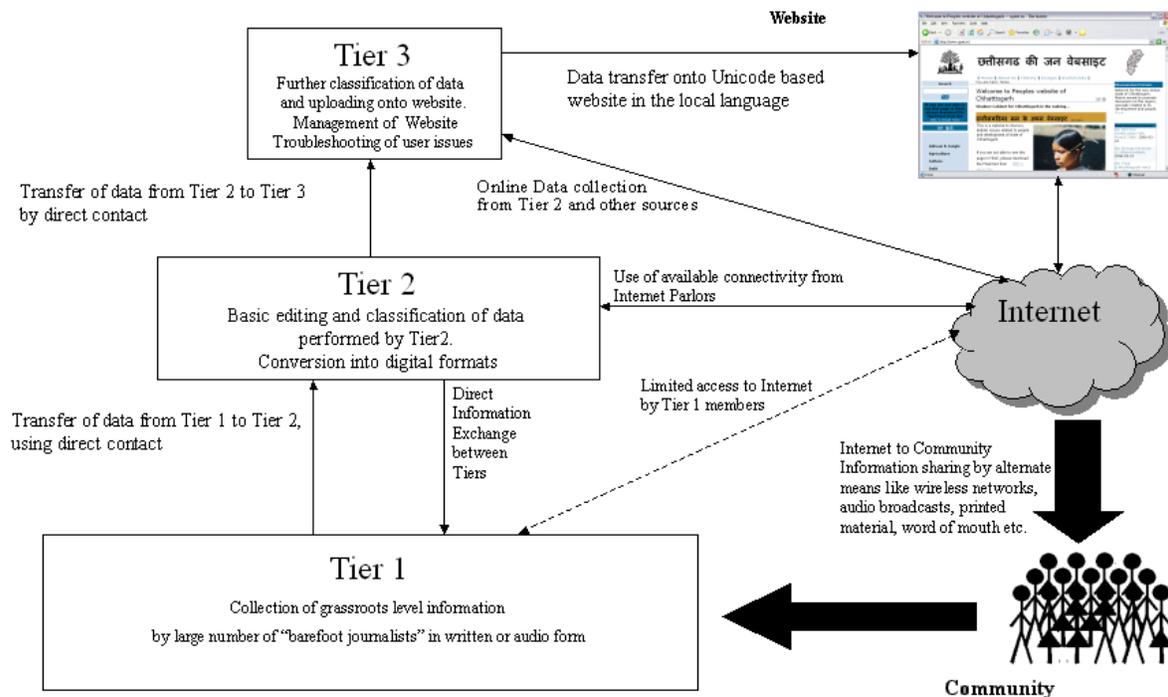
Figure 4. Proposed Information Architecture Schematic

The structure of the architecture is intended to be pyramidal in three tiers with the tier's functions described as follows:

6.1.1   Tier 1, Information Gathering

Grassroots level information gathering, by "barefoot journalists", who would be trained minimally. The data at this stage could be in audio form, or, if the "barefoot journalist" is educated to some basic level, then written formats could also be used.

The skills required by the members of this tier would typically include: a) an ability to recognize information relevant to the community, b) self-motivation and enthusiasm and c) basic aptitude towards learning.

The members at his tier could also be involved in making efficient use of the oral tradition of the region to disseminate information.

6.1.2   Tier 2, Compilation and basic editing

Compilation of information gathered by "barefoot journalists" into digital form and basic editing. This would involve conversion of audio material into text for dissemination on the Internet, basic editing on the text matter to ensure that relevance and consistency is maintained and finally categorizing the information. The skills required by members at this level would be a) ability to use a computer with reasonable proficiency b) ability to analyze large amounts of data c) basic aptitude for editing d) ability to recognize relevant information

Since this tier is intended to be involved in basic editing and compilation, a fundamental level of error checking would be required. Also on the information dissemination side, this tier would be responsible for some routing of the information to the various sections of the community.

The members at this tier would also be responsible for spreading awareness about the usage of the architecture to obtain information. They would be required to demonstrate the website use to other members of the community. In addition to this, they could be involved in the dissemination of audio-visual content in areas where literacy and connectivity is low.

6.1.3   Tier 3, Planning, Management and Dissemination

Collection of compiled data from Tier 2, classification of the data into different sections for easy user access and dissemination through the CGNet website. This level would involve some degree of technical know-how. The skills required for this tier would include a) ability to create and manage web content, b) basics of local language computing and c) ability to present information in a manner that can be effectively received and used by the community.

6.2 Self Organization

Self-organization is necessary in a community-based system because if a community-based architecture is organized by external agencies, then the purpose of self-empowerment is at risk. After an initial kickoff, the architecture should self organize and stabilize by virtue of its design.

The concepts of swarm intelligence can be used in this context.

Conventional particle swarm optimization relies on exchanging information through social interaction among individuals.

Often the behavior of flocks, swarms and insect colonies, arises through interaction between the individuals in the collective and through interaction with their environment.

Conventional particle swarm optimization relies on social interaction among particles through exchanging detailed information on position and performance. In the case when each individual does not know or cannot communicate its own performance, both social interaction and environmental interaction is required

In conventional particle swarm optimization, each iteration results in the calculation of a fitness value for each individual, by virtue of a given position and velocity. Then based on the local, global and recorded personal best fitness values of the particle and its neighbors, the velocity and position of the particle can change.

For the proposed information architecture, an adaptation of this method finds application in the areas of work distribution and inter-tier movement of members.

For each tier, there would be certain criteria for determining the fitness values of the members. Based on periodic peer reviews, these would be measured and appropriate reallocation and movement of members would take place.

In addition to the particle swarm technique for optimization the ant colony model, particularly with regard to foraging behavior, can be used to formulate the tasks that the individual community members would be engaged in.

Ants are able to find the shortest path to a food source by laying and following trails. Individual ants emit a chemical substance, a pheromone, which then attracts other ants.

In a simple case, two ants leave the nest at the same time and take different paths to a food source, marking their trails with pheromone. The ant that took the shorter route will return first and this trail will now be marked with twice as much pheromone as the trail of the other ant, which took the longer path and has yet to return to the nest. The other ants will be attracted to this trail more than the other one. As more and more ants follow the trail, more pheromone is left there, making it the route of choice for all ants in the range of the pheromone. This increases the efficiency of the entire colony, despite the individual ants following very basic rules

In place of food, the foraging members in this case would be collecting information. They would also be involved in disseminating information by the same mechanism, i.e. making use of traditional oral means as far as possible and spreading awareness about the use of the Internet as an information storehouse, by way of the CGNet website.

6.3 Self Sustenance

Since the training required is functional and minimal in nature, members can themselves involve more people for the first tier. For other tiers, where skill requirements are higher, members from lower tiers who have experience can be promoted.

For infrastructure sustenance, initially the architecture will be aimed primarily at cost effectiveness. Once the subset of the community involved in the architecture is suitably large, advertising could be one method of obtaining revenue. The most obvious risk of advertising is that once commercialization sets in, the relevance to the community might be threatened. However, the fundamental design of the architecture being such that the community itself is collecting the information relevant to itself, the monitoring and assurance of relevance would be the onus of the community.

The value to stakeholders would be ensured, since if an entire community is involved in the collection of information, an advertisement becomes merely another piece of information that the community members share among themselves. If the size of the community is suitably large, the advertising would be that much more effective.

In addition to this, since information exchange would automatically broaden the horizons of all the participating community members, implementation of new ideas for self-sufficiency can be implemented more effectively.

6.4 Robustness and Self Healing

The large number of people involved in the architecture would ensure that if any of the constituting members of the architecture were unable to perform their task appropriately, the other members would be able to distribute the load in order to ensure that the flow of information is maintained. The scenario is similar to a distributed computing environment where no single point of failure is allowed.

The ant-colony model of swarm intelligent systems is useful for reference in this context. With an ant-colony like approach, certain members of the community specialize in certain aspects of the work to be done. However, in circumstances when a stress is exerted on the community, any member can take up any task that is not being performed adequately as a result of a deficit in the number of members specializing in that particular task. For example, if a set of "barefoot

journalists" in a particular region is unable to engage in information gathering, members from other regions or tiers could move in and do the job.

6.5 Collective Intelligence

As with most swarm-based systems, the alternative information architecture would be expected have emergent collective intelligence. Despite the individual members would be engaged in tasks with short-term goals with simple metrics, the entire architecture would eventually take on a definite directionality.

7. Practical Implementation

7.1 Training

For the initial kickoff of the architecture, the members would require some basic training. This would be done over as short a period as feasible, with periodic reviews to ensure efficiency. The proposed training plan is as follows:

7.1.1 Training, Tier 1

Training in the first tier would be primarily to ensure that the concept of relevance is clearly defined. This would require building on the existing instincts of the members being trained and merely fine-tune them to the point where they are able to recognise relevant information without undue effort.

The members would also require basic training on handling audio recording and playback equipment. Since basic recording equipment is no longer particularly expensive or difficult to use, this should not pose a problem.

The areas covered for this tier will be:
- Basic Information Gathering Skills
- Audio recording and playback equipment handling
- Practical sessions on interviews, news writing, feature writing, investigations etc

7.1.2 Training, Tier 2

Tier 2 training would require the involved members to be formally educated to a certain extent. The training in this tier would be mainly aimed at ensuring that relevant information is not lost while editing. This would mean bridging any existing gaps between the thought process and relevance evaluation between the members in Tier 1 and Tier 2. Group discussions involving members from both Tiers would appear to be a good method to ensure this.

Apart from relevance evaluation, Tier 2 members would also be required to assimilate the basics of audio editing and audio to text conversion. Since Indian language computing is also gaining momentum, this would involve learning basic usage of software that can work with Indian languages.

Efficient usage of the Internet, with the infrastructure available, would also be a part of the training.

The areas covered for this tier would be:
- Basic news editing
- Use of Indian Language software
- Efficient use of Internet via available means e.g. Internet parlors and Government Internet centers
- Finding useful and relevant information on the Internet
- Background sessions on subjects from rural India as Health, Agriculture, Forest, Education, Panchayats, PDS, Schemes for Tribals, Dalits, Mining, Industry (impact on people), Environment, Water, Right to Information etc

7.1.3   Training, Tier 3

Tier 3 training would require some pre-requisite knowledge of computing.

Since members in Tier 3 will be managing website content and handling administration of the entire network, the training would have to include elements of computer networking, infrastructure management, content management, basics of systems administration and so forth. Since the architecture is intended for use by the community and with knowledge of English language at a premium, support of Indian languages at this level is essential.

Troubleshooting Indian language computing applications across the architecture would also be the responsibility of Tier 3 members.

For this to be possible at least a few of the Tier 3 members must necessarily be technically oriented and preferably in a profession that uses technology.

The areas covered for this tier would be:
- Website content management
- Website infrastructure management
- Web Server administration basics
- Computer Networks basics
- Use of Indian language software for the Internet
- Search Engine Optimization for greater visibility
- Troubleshooting techniques for user support
- Audio editing and streaming content basics

7.2 Networks and Connectivity

To ensure that existing infrastructure within the state is optimally used and for a composite network that can be scaled and expanded as needed, the architecture must take into account the potential challenges such as poor penetration into interior regions and connectivity issues which are rampant even in the cities.

7.2.1   Wireless Networks for low penetration areas

In areas where wired communication is at a premium, wireless communication could be considered as an alternative. Keeping those cities with connectivity as nodal points, the network architecture could be expanded into the interior regions gradually, with the placement of wireless hotspots in buildings such as primary schools, panchayat ghars and police stations. This would ensure safety of the equipment, while at the same time creating a community meeting-place for people to meet and discuss issues.

The underlying principle behind the idea of usage of WiFi for connectivity in the low penetration areas is that of viral networks.

Viral networks derive directly from the end-to-end principle on which the Internet is based, i.e. the intelligence is in the end nodes with the network itself maintaining as little state as possible.

Very little optimization of real planning has been done in the case of the Internet, yet it remains an extremely robust and self-propagating system. Every day, as more nodes are added the Internet increases in size and reach, in the manner of a viral outbreak. With each new addition, more technical capacity is added to the system as a whole, promoting mutations within the structure to ultimately result in self-organization, which converges of its own accord.

The Internet works on the principle of "best-effort" packet forwarding. This principle has kept the Internet open to innovation by reducing the architectural impact and cost or risk imposed on the development of any new application; applications could start small and propagate by pure

popularity, no core change was needed, and no innovation had to be debugged well enough to ensure that it had no adverse impact network integrity.

If this principle can be kept alive in the case of the network model used by the alternative information architecture proposed for CGNet, then the only optimization required would be people oriented. The technology could be left to evolve itself, with only nominal supervision and direction.

In a paper presented at The Exchange, 2004, Andrew Lippman of MIT defined a viral network as one that satisfies the following three criteria

- It scales almost without bound
- It can grow incrementally
- Each new element adds technical capacity to the overall system.

This is considered a radical concept in that convention proposes that a communications system has limited capacity, which is divided among participating communicating elements — additional nodes subdivide available capacity rather than increase it. This lack of scalability is perhaps the most stringent restriction on system design, regulatory practice and economic development. However in the case of viral networks, this problem is mitigated.

Work has been done in this regard on intelligent radio systems. However, radio being an unavailable avenue due to legal issues, an alternative could be a WiFi network of a similar nature. The costs could be reduced with the use of homebrew directional antennas. However, this would require further analysis and study to be conclusive.

Whether or not WiFi is used, the viral network concept of scaling can still be applicable in order to ease integration as well as to develop a scalable system. The increase in scalability would be dramatic for such a network. However, regulatory bodies would have to take a somewhat more open-minded stand towards such networks than exists at present. A system of such great scalability, where elements can be freely added, opens up a whole host of new opportunities and therefore requires new approaches to regulation.

7.2.2 Internet Parlor optimization for Urban and semi-urban areas

In areas where Internet coverage exists, Internet parlors can be used to great advantage. Involving Internet parlor owners in the information architecture, particularly in Tier 2, could be extremely beneficial.

Internet parlors in the region could be motivated to install Indian language computing software, in order to enable community members to use the features of the CGNet website efficiently. Since the architecture is intended to scale, more community involvement would result in increased revenues for Internet parlor owners who are Indian language enabled. Concepts of standardization and franchising could be involved at a later stage to fine-tune the Internet parlor usage in the state.

7.3 Software Issues

A majority of the software in use by a large section of users in the region is not registered, which could later pose an issue of legitimacy. In order to avoid running into legal issues, it is recommended that as far as possible, Open Source software be used within the architecture. Apart from intellectual property issues, the added benefit of Open Source software is that it is highly customizable and can be adapted to suit the exact purpose, with least wastage of resources.

However, this is a long-term goal, and in the current context hybrid scenarios can be used as a basis for a kickoff of activity.

7.4 Website

The CGNet website, which is already operational would be the repository for all information collected. The dissemination of information would begin at the website. Once the architecture is in place, the site could be further developed on the lines of an *e-Panchayat Ghar,* which would

publicly address issues relevant to the community. The website would require management of two distinct kinds

7.4.1 Content Management

This sort of management would require ability to analyze large quantities of text and audio data, and to classify it for different sections of the website. In addition to this, in order to maintain community participation, the content would have to be dynamically maintained. This would mean periodic site reviews and updates, analysis of user polls and corresponding action with regard to content and keeping abreast of the trends in community interest. The community members who are involved in this type of management would need to be trained in the usage of content management tools and also should be able to analyze data effectively.

7.4.2 Technology management

This would require management of the site infrastructure, such as server administration, traffic management, uploading content and ensuring availability and accessibility etc.
This type of management would also require troubleshooting of user issues, such as inability to view the language fonts, poor quality of audio etc. The community members responsible for technology management of the website would have to be able to come up with quick fixes for such issues. This would imply a somewhat in-depth knowledge of the technology being used, which can be obtained first through training and then by experience.

7.5 Periodic reviews

The CGNet group, which works primarily over the Internet, meets periodically. In addition to these meets, there would need to be some form of periodic check of higher frequency, in order to ensure that the particle swarm optimization principles outlined in section 6.2 can be implemented. Each of these reviews would act as a single iteration in the optimization algorithm, where peers would review their own performance and the performance of other community members, based on the metrics agreed upon for each tier.
This would enable calculation of a fitness value for each member in his current position in the architecture. Based on the maximum fitness values of a given tier, movement of members within a tier or between tiers could be planned and implemented, with optimization as the goal.
At any given level the contributing factors to the fitness values could be classified as additive or multiplicative. Additive components would be those, which would add value and which could be learnt. Multiplicative components would be those which would require some inherent qualities, or would be mandatory, i.e. the absence of which would make the member being evaluated unfit for the particular tier.
Possible mathematical formulae for the evaluation of fitness values at different tiers could be as follows.

7.5.1 Peer Review for Tier 1

At this level the primary criteria for review of the members could classify as

Additive:
A: The ability to perceive the relevance of an information item to the community
Since this is learnable, this component can be taken as additive with values lying on a scale of 1 to 10, i.e. $1<=A<=10$

L: Ability to read and write
Since this component would be an added bonus, this can also be taken as additive, with the value range being: $1<=B<=10$

Multiplicative
D: Ability to learn to handle some form of data collection equipment

Since without an ability to learn the handling of data collection equipment, the member cannot collect data, it would imply that this should be a multiplicative component, with values in the range: 0<=C<=10

W: Willingness and physical ability to participate in the information gathering process
Willingness and enthusiasm would be essential to the information gathering process. Therefore this could also be given a value in the range: 0<=D<=10

Fitness Value Calculation
With the metrics defined as above, the fitness value F_m of member m could be calculated as

$$F_m = (A_m + L_m) * W_m * D_m$$

7.5.2 Peer Review For Tier 2

At this level the primary criteria for review of the members could classify as

Additive:
A: The ability to perceive the relevance of an information item to the community, 1<=A<=10

E: Information Editing Skills
Since good editing skills would be an added advantage at this level and since they can be learnt, the editing skill can be taken as an additive with the range: 1 <= E <= 10

Multiplicative
C: Access to and ability to use a computer
Since without computing ability, the member cannot analyze and organize the large expected volume of data, it would imply that this should be a multiplicative component, with values in the range: 0<=C<=10

W: Willingness and physical ability to participate in the information gathering process
Willingness and enthusiasm would be essential to the information gathering process. Therefore this could also be given a value in the range: 0<=D<=10

Fitness Value Calculation
With the metrics defined as above, the fitness value F_m of member m could be calculated as

$$F_m = (A_m + E_m) * C_m * W_m$$

7.5.3 Peer Review For Tier 3

At this level the primary criteria for review of the members could classify as

Additive:
A: The ability to perceive the relevance of an information item to the community
Since this is learnable, this component can be taken as additive with values lying on a scale of 1 to 10, i.e. 1<=A<=10

M: Creativity in Website Design and Management
Since this component would be an added bonus, this can also be taken as additive, with the value range being: 1<=M<=10

T: Troubleshooting ability
Troubleshooting would come with experience and would be an added quality to be cultivated.
The range of evaluation would be: 1<=T<=10

Multiplicative
C: Familiarity and comfort level with computers
Since without an familiarity and comfort with computers, the member cannot contribute to the
management of the website, it would imply that this should be a multiplicative component, with
values in the range: 0<=C<=10

I: Information management aptitude
This would be a must for anyone involved at the Tier 3 level. The aptitude could be calculated
based on performance and on the basis of basic tests. The range would be: 0<=I<=10

W: Willingness and physical ability to participate in the information gathering process
Willingness and enthusiasm would be essential to the information gathering process. Therefore
this could also be given a value in the range: 0<=D<=10

Fitness Value Calculation
With the metrics defined as above, the fitness value F_m of member m could be calculated as

$$F_m = (A_m + M_m + T_m) * C_m * I_m * M_m$$

Based on the fitness values, the members in different tiers could realign their priorities and
planning to maximize efficiency. Each member would take stock of the best fitness values in
his/her immediate surrounding. The member would also keep track of his/her own best fitness
value across reviews. At each review the member would compare his/her fitness value with the
other and accordingly modify his/her goals and methods with the aim of reaching the best fitness
values that he/she has recorded.
If a member were already at the best position, then he/she would be tested for movement into the
next tier. Each tier would have a threshold fitness value associated with it based on the average
fitness values of the members in it. An algorithm could be formulated for the review process with
the iterations defined as below

7.5.4 Algorithm for Review

Set threshold values of fitness for each tier as F_{Ti}

Initialize an initial set of members for each tier (initial training)

Assign a set of goals and methods to each member

For each tier T_i

       For each member m in T_i

       Calculate the fitness value F_m according to the formula for T_i

          If $F_m < F_{Ti}$
             Demote member to lower Tier T_{i-1}

If F_m > Personal Best, P_{best}
$$P_{best} = F_m$$

If F_m > Local Best, L_{best}
$$L_{best} = F_m$$

If F_m > Global Best, G_{best}
$$G_{best} = F_m$$

Modify the goals and methods of the member so as to move towards the best values

If no modification is required
Test for movement to next tier, T_{i+1}
Move member to next tier

Re-evaluate threshold values of Fitness F_{Ti} for each Tier as

$F_{Ti} = \sum (F_m)$ where member **m** belongs to Ti / number of members in **Ti**

Test for deficit in number of members and increase as required

End Loop

7.6 Popularizing Usage

Since this is a community-based architecture, it would be expedient to integrate the architecture into the community as it grows, rather than create it first and then integrate it.
The viral networks principle can be applied here. Initially a pilot project of a smaller region could be planned. From there, more members could be added, thereby expanding the network outwards, in the manner of a viral outbreak.

8. Research Areas

8.1 Formulation of Processes

The best processes for initial training would need to be worked out. This would require some pilot experiments with the community to understand the mindset of the members.

8.2 Swarm Based Optimization Application

The metrics of swarm based optimization as applicable to the Information Architecture need to be formalized. Also, exact procedures for members to follow under the ant colony module for data collection would need to be laid out.
This would require some statistical analysis and sample testing in the region.

8.3 Technical Aids To Connectivity Enhancement

The following areas need to be explored as possible methods of improving connectivity
- Wireless networks in low-connectivity areas, with the range and terrain issues considered
- Mobile technology for network access

This would need some monetary input for experimentation in the region with live equipment

8.4 Entrepreneurship opportunities

With tribal artwork and handicrafts already established as a major cottage industry in the state and e-commerce becoming the de-facto standard for the world market, the possibilities of monetary gain for the community members also open up. In addition to existing industry, with more information and exposure, new ideas for entrepreneurship could also be considered.

9. Conclusion

With rigid formalized systems failing easily all over the world, adaptive and flexible systems are now needed to perform the functions of the real world.

The information architecture planned for Chhattisgarh, outlined in this paper is intended to be adaptive and flexible to a high degree, by taking into account the human unpredictability factor. With the Chhattisgarh government looking favorably at IT initiatives and the perceived requirement for a structured community information exchange system, the time is ripe for a move of substantial proportions.

No structure can function without a solid architecture. The use of novel concepts such as swarm intelligence and alternative network models could increase the efficiency of the architecture manifold.

Based on the above proposal a more detailed plan can be drawn up and used to create an information system that would empower the community with the ability to define clearly their own path of development.

In time, this architecture may prove to be the first step towards a healthier, enlightened and prosperous community.

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