Case Study

Kshema
Intel® Core™ Duo Processor

KSHEMA
Unified Healthcare Management

Enabling Quality Healthcare to All

Kshema* facilitates Tele-medicine and Tele-diagnostics in Rural Areas in Emerging Markets

Case Summary

Business Need: The delivery of quality healthcare especially in the rural area represents an untapped opportunity in India for technology products and solutions.

Challenge: Rural India continues to suffer from overall poor infrastructure, bad roads and poverty. This often translates into non-availability of skilled medical professionals in the rural healthcare centers as the medical professionals prefer staying in urban areas that have better infrastructure and also provide better employment opportunities.

Rural India also lacks good quality Pathology and Radiology labs. More often than not, the villagers have to travel long distances to get lab work done. One of the emerging trends that is solving this problem is Tele-medicine or Tele-diagnostics. Tele-diagnostics enables delivery of healthcare services like medical diagnostics, consultation and treatment remotely. For rural India, this would imply a dedicated healthcare platform that is cost-effective, power-efficient, rugged, reliable, scalable and remotely manageable. Further, it would need to enable high level of portability.

Solution: Kshema* brings healthcare services to rural areas by enabling a device that would allow remote diagnostics and consultation from doctors/pathologists located far away in the city. The hardware has been built for low power consumption and is powered by Solar Panels and UPS. The Intel® embedded processors enable KTwo* to meet the necessary requirements of high performance, low-cost, durability and reliability, enabling a wide range of possibilities.

Background: Key Problems in Indian Healthcare Delivery

The Government of India's medical infrastructure is supposed to provide healthcare to all its citizens through an extensive network of primary, secondary and tertiary health care centers. However, this network is plagued by manpower shortage, deteriorating infrastructure, low quality care and doctor absenteeism which makes it inefficient to render any quality healthcare services. These problems are briefly elaborated below.

Manpower Shortage

India is estimated to have about 600,000 doctors and about 1.6 million nurses, implying approximately one doctor per 1700 people. This translates to a resource gap of 1.4 million doctors and 2.8 million nurses for India, as per the WHO norms for developing countries. Similarly, there is also dearth of manpower among the paramedical professionals and other staffs. Around 41% of PHCs (Primary Healthcare Centers) do not have lab technicians and around 17% of PHCs do not have pharmacists. Even in the urban centers, this market consists mainly of small, unregulated players of questionable quality. These gaps in the demand-supply scenario become starker in rural areas as almost 80% of the doctors are concentrated in the urban areas.

Lack of medical infrastructure

India's hospital beds per 1000 population stands at a little over 0.7 as against the Russia's 9.7, Brazil's 2.6, China's 2.2 and the world average of 3.96. Furthermore, the hospital beds per 1000 population in rural India is only 0.1 and in urban areas it is 2.2. Diagnostics facilities, such as imaging diagnostics (such as X-Rays, CT scans and Ultrasounds) and pathology lab diagnostics (such as blood tests) both of which are critical for proper diagnosis and treatment of illness are almost non-existent in rural areas.

Access to infrastructure

The poor general infrastructure such as road connectivity and transport services in rural areas makes many of the healthcare facilities, public or private difficult to access throughout the year, to about a third of the villages. A villager seeking health care in a typical Indian village has to travel about 10 kms and spend an entire day to avail a healthcare facility. This scenario is the same for emergencies, acute or chronic illness as well as for the common ailments.

In Sum

The gravity of the situation and the challenge in enabling quality health care can be well gauged by the following statistics from the Ministry of Health and Family Welfare.

Table: Status of Health Infrastructure in villages

Infrastructure/ Services	% Villages
Connected with roads	73.9
Having any health provider	95.3
Having trained birth attendant	37.5
Having anganwadi worker1	74.5
Having a doctor (private & visiting)	43.5
Having a private doctor	30.5
Having a visiting doctor	25.0

Source: Ministry of Health and Family Welfare
1Anganwadi is a child care center in rural areas. It is manned by usually a female member of the rural community who has some formal or informal training. The center is involved in various government schemes such as pre-school and health education, maintenance of records of births and deaths, administration of pulse-polio drops, and the provision of supplementary nutrition to pregnant/ lactating mothers and children up to the age of six.

Though around 95 per cent of the villages have a health provider of some type, the majority of them is Anganwadi workers and can be categorized as health workers only under a very liberal definition of health care.

Embedded Technology Solutions using the right devices and designs can do much to enable the delivery of better healthcare given the above situations.

Embedded Solutions as an Enabler

In a country where both medical infrastructure as well as medical manpower is scarce, the gap between demand and supply can be bridged with technology. However, the right solution would need to address the following challenges in order to enable better healthcare to all citizens.

- **Cost of the Technology Solution:** India being a cost-conscious economy, any solution towards this direction requires cost-effective hardware and software modules, which in turn, could encourage the adoption of the solution.

- **Remote Access:** The solution must be accessible in remote locations so that the healthcare delivery is independent of the proximity between the patient and the doctor/ medical professional.

- **Power:** Given the lack of electricity and inadequate availability of electricity, the solution would need to have the capability to work on alternative energy sources.

- **Ruggedisation:** The access device would need to be rugged & reliable requiring very little upgradation & service support, given that the device would be primarily deployed in rural India.

- **Remote Manageability:** Given the spread of and accessibility to rural India, fixing any break-downs in the system can be very difficult. Hence, there needs to be the ability to diagnose and fix problems on the system remotely.

KTwo Technology Solutions, a company headquartered in Bangalore and member of the Intel India Design House Program, has developed a solution called "Kshema*", which is a unified healthcare management solution which will be useful in mitigating the current challenges and thereby providing focused healing to patients.

About the Hardware device:
The hardware device, which is based on Intel® Core™ Duo Processor and Mobile Intel® 945 Express Chipset Family, is a rugged and all-terrain dedicated device. It is designed to have low power consumption and is powered by Solar Panels and UPS. The device has Keyboard, Mouse and Webcam as well as Thermal Printer. It also has interfaces for USB, Wireless and Microscope. The device networks through the GSM-GPRS technology.

In terms of its functionality, this solution provides the following modules

- **Tele-Medicine:** This module would enable exchange of visual images, audio and data between PHC's and District/ City Hospital. With this facility, Specialists in Community Health Centers/ Taluk/ District hospitals can impart their diagnostic skills or prescribe appropriate medication to a critically ill patient in remote areas. Tele-medicine can also help in the training of medical personnel across the country and thereby improve its human resource in health sector, by making them abreast with the current developments in the field of medicine.

- **Tele-Diagnostics:** This module has the following sub-modules

  - **CytoSight*:** This module enables Tele-Pathology in the basic version. Here is how it works - A camera attached to a microscope captures the images of the 'Patient' sample placed under the microscope. It then transfers the images to the Kshema box. CytoSight's innovative imaging algorithm would capture impressions of the pathology sample from the microscope, analyze it and identify any disease marker cells. It then creates a report and sends it via email to the pathologist/physician situated in the urban areas for diagnosis. Currently, the embedded box can diagnose mass diseases like malaria, chikungunya, etc., which are mostly prevalent in rural areas. This module can also be extended to enable complex systems for use in Hematology, Cancer detection, Tele-Opthalmology and other diseases.

  - **TomoSight*:** This module facilitates Tele-Radiology by electronically transmitting Radiographic patient images and consultative text from one location to another.

  - KTwo's TomoSight makes the pre-captured X-Ray/ CT/ MR images available to the Radiologist, based remotely, to give expert opinion instantaneously, thus, bringing Specialist Radiology expertise available to any remote location.

How Kshema works

Doctor/Expert gives opinion back on the images sent by technician

Radiologist/Pathologist at the District Hospital in the City

Built in GSM/GPRS for Email & Chat

Powered by Solar

Printer for receipt

Technician in the Primary Healthcare Center in Rural Area

Kshema PARTNERING FOR WELLBEING

The above features (Cytosight/ Tomosight) would enable Mass Data Capture from the rural patients and alarm district authorities in case of disease outbreaks. This way it also supports disease surveillance.

Why Intel?

The Intel® embedded processor family was the immediate choice for the development of 'Kshema', as it offers the following advantages:

- Intel® processors and chipsets are optimized and validated to integrate with a wide variety of standards-based solutions from other developers, enabling faster time-to-market.

- High-quality graphic performance, which aids in the image processing and helps identify the disease marker cells.

- Small form factor and low power consumption makes it a portable solution

- Extended product life cycle of >7 years, which ensure long-term availability of parts for embedded medical devices.

- Intel® Integrated Performance Primitives (Intel® IPP) Libraries provide support for image processing algorithms. These libraries are optimized to work on Intel® architecture and thereby aid the performance of the overall solution.

- Remote manageability (available in some versions of the embedded processor/ chipset)

- Ease of Design: The availability of a comprehensive range of off-the-shelf solutions and the extensive eco-system provided by the members of the Intel® Embedded and Communication Alliance (Intel® ECA) simplifies the task of finding the right board-level solutions, OS and software for embedded products.

"Our development environment was .NET on Intel PCs. It made lot of sense to retain Intel® processors as part of target system particularly because, migration from development machines to target environment is seamless."

Anant Koppar
Chairman & CEO
KTwo Technology Solutions

During the making of the KSHEMA Box, not just the boards or software were available off-the-shelf but even the solar panel for uninterrupted power supply was easy to find through Intel partnership.

- Scalable performance to meet a variety of application and customer requirements; all based on a common instruction set architecture

- Proven, long-term product reliability and quality

- Strong Technical support provided by the Intel India Design House Program Team to help the KTwo Team during the development of their systems

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