FEASIBILITY REPORT

W-CDMA Based Smart Energy Metering and Billing with Android Control

OVERVIEW OF REPORT

This report will discuss feasibility of project that what options are most beneficial and why these options are preferable in this scenario. It also mentions that weather this project is doable in these conditions or not.

EXECUTIVE SUMMARY

Pakistan is progressing towards development, and from the technological point of view it's still lacking in many fields compared to other countries of class C. The developed technologies like smart meters are old but still there're not enough skills and information here to provide a better solution for its designing and implementation.

We want a platform and more developed methodology to evade the bugs founded in last researches. This will impact the stakeholders, from both management and consumer point, it's hard to develop this type project from a small scale to meet the latest research, to benefit the utility and consumers.

STATEMENT

Traditional system of energy metering and billing is economically unviable, requires a lot of labor and is technologically old. Discrepancy may creep into system because of human errors and limitations and consumers can't avail their data everywhere in this connected world. To eliminate these traditional links, we have to develop an advanced networking-based technology.

PROJECT BUISINESS REQUIREMENT

Research on circuit designing of pre-built digital meters in Pakistan is already done. The additional procedure of research is to find a way to add microcontroller and communication part. We'll use a feasible Arduino type for project to meet the needs, the type and model is still tentative. Programming solutions are required and that requires time for project as logic and algorithm building still needed research. By using the last methods, we can design an appropriate algorithm for better power analysis to technologically improve the interface for consumers. The communication part expensive and requires more time and managerial skills.

ASSESSMENT OF OPTIONS

This section provides the detailed overview of options we have and what should use. The option should be most preferable among others, for this specific project.

AVAILABLE OPTIONS FOR PROCESSING

We can simply use AVR processors available in market like famous PIC, but it'll make things complex as we have to start things from scratch like, first we need to build a structure for this controller and then need to build header files for each peripheral we have to attach. So, we are going to use Arduino controller model, and processors embedded in these controllers are made by Atmel (now acquired by microchip_ PIC manufacturers) processors. That'll decrease the complexity and save time to build the project by the end of year.

Board Name	Frequency (MHz)	Flash (kB)	SRAM (kB)	Digital I/O Pins	Analog Pins	Processor
Arduino Esplora	16	32	2.5	--	--	Atmega32U4
Arduino Zero	48	256	32	14	6	ATSAMD21G18A
Arduino Yun	16, 400	32, 16x1024	2.5, 64x1024	14	12	Atmega32U4, Atheros AR9331
Arduino Leonardo	16	32	2.5	20	12	Atmega32U4
Arduino Uno	16	32	2	14	6	Atmega328P
Arduino Ethernet	16	32	2	14	6	Atmega328P
Arduino Pro	16	16, 32	½	1414	6	Atmega168, Atmega328P
Arduino Uno Wifi rev 2	16	48	6	14	6	ATMEGA4809, NINA-W132 Wi-Fi module from u-blox, ECC608 crypto device
Arduino 101 Genuino 101	32	196	24	14	6	Intel® Curie™ module[6] two tiny cores, an x86 (Quark SE) and an ARC
Arduino Due	84	512	96	54	12	ATSAM3X8E (Cortex-M3)
Arduino Mega	16	256	8	54	16	ATmega2560
Arduino Micro	16	32	2.5	20	12	Atmega32U4
Arduino Pro Mini	8 (3.3V), 16 (5V)	32	2	14	6	Atmega328
Arduino Fio	8	32	2	14	8	ATmega328P
Arduino Nano	16	16, 32	½	14	8	ATmega328 (ATmega168 before v3.0)
Arduino Lilypad	8	16	1	14	6	ATmega168V or ATmega328V

CONCLUSION

As per comparison with our system we've concluded that Arduino nano is most cost feasible and suitable. Because we need to do some basic calculations for our power system (Power factor, units in KWH, active reactive power, billing as per unit rate etc) by using data from hall effect sensor. So for this nano is has suitable specifications to do this.

AVAILABLE OPTIONS FOR COMMUNICATION

ZIGBEE

ZigBee, like Bluetooth, has a large installed base of operation, although perhaps traditionally more in industrial settings. ZigBee PRO and ZigBee Remote Control (RF4CE), among other available ZigBee profiles, are based on the IEEE802.15.4 protocol, which is an industry-standard wireless networking technology operating at 2.4GHz targeting applications that require relatively infrequent data exchanges at low data-rates over a restricted area and within a 100m range such as in a home or building.

ZigBee/RF4CE has some significant advantages in complex systems offering

Low-power operation, high security, robustness and high scalability with high node counts and is well positioned to take advantage of wireless control and sensor networks in M2M and IoT applications.

WIFI MODULE

WiFi connectivity is often an obvious choice for many developers, especially given the pervasiveness of WiFi within the home environment within LANs. It requires little further explanation except to state the obvious that clearly there is a wide existing infrastructure as well as offering fast data transfer and the ability to handle high quantities of data.

Currently, the most common WiFi standard used in homes and many businesses is 802.11n, which offers serious throughput in the range of hundreds of megabit per second, which is fine for file transfers, but may be too power-consuming for many IoT applications. A series of RF development kits designed for building WiFi-based applications are available from RS.

Standard: Based on 802.11n (most common usage in homes today)

Frequencies: 2.4GHz and 5GHz bands

Range: Approximately 50m

Data Rates: 600 Mbps maximum, but 150-200Mbps is more typical, depending on channel frequency used and number of antennas (latest 802.11-ac standard should offer 500Mbps to 1Gbps)

CELLULAR (GSM)

<  Any IoT application that requires operation over longer distances can take advantage of GSM/3G/4G cellular communication capabilities. While cellular is clearly capable of sending high quantities of data, especially for 4G, the expense and also power consumption will be too high for many applications, but it can be ideal for sensor-based low-bandwidth-data projects that will send very low amounts of data over the Internet. A key product in this area is the range of products, including the original tiny CELLv1.0 low-cost development board and a series of shield connecting boards for use with the Raspberry Pi and Arduino platforms.

Standard: GSM/GPRS/EDGE (2G), UMTS/HSPA (3G), LTE (4G)

Frequencies: 900/1800/1900/2100MHz

Range: 35km max for GSM; 200km max for HSPA

Data Rates (typical download): 35-170kps (GPRS), 120-384kbps (EDGE), 384Kbps-2Mbps (UMTS), 600kbps-10Mbps (HSPA), 3-10Mbps (LTE)

SIGFOX

SIGFOX

An alternative wide-range technology is Sigfox, which in terms of range comes between WiFi and cellular. It uses the ISM bands, which are free to use without the need to acquire licenses, to transmit data over a very narrow spectrum to and from connected objects. The idea for Sigfox is that for many M2M applications that run on a small battery and only require low levels of data transfer, then WiFi's range is too short while cellular is too expensive and also consumes too much power. Sigfox uses a technology called Ultra Narrow Band (UNB) and is only designed to handle low data-transfer speeds of 10 to 1,000 bits per second. It consumes only 50 microwatts compared to 5000 microwatts for cellular communication, or can deliver a typical stand-by time 20 years with a 2.5Ah battery while it is only 0.2 years for cellular.

Already deployed in tens of thousands of connected objects, the network is currently being rolled out in major cities across Europe, including ten cities in the UK for example. The network offers a robust, power-efficient and scalable network that can communicate with millions of battery-operated devices across areas of several square kilometres, making it suitable for various M2M applications that are expected to include smart meters, patient monitors, security devices, street lighting and environmental sensors. The Sigfox system uses silicon such as the EZRadioPro wireless transceivers from Silicon Labs, which deliver industry-leading wireless performance, extended range and ultra-low power consumption for wireless networking applications operating in the sub-1GHz band.

- Standard: Sigfox
- Frequency: 900MHz
- Range: 30-50km (rural environments), 3-10km (urban environments)
- Data Rates: 10-1000bps

NEUL

Similar in concept to Sigfox and operating in the sub-1GHz band, Neul leverages very small slices of the TV White Space spectrum to deliver high scalability, high coverage, low power and low-cost wireless networks. Systems are based on the Iceni chip, which communicates using the white space radio to access the high-quality UHF spectrum, now available due to the analogue to digital TV transition. The communications technology is called Weightless, which is a new wide-area wireless networking technology designed for the IoT that largely competes against existing GPRS, 3G, CDMA and LTE WAN solutions. Data rates can be anything from a few bits per second up to 100kbps over the same single link; and devices can consume as little as 20 to 30mA from 2xAA batteries, meaning 10 to 15 years in the field.

- Standard: Neul
- Frequency: 900MHz (ISM), 458MHz (UK), 470-790MHz (White Space)
- Range: 10km

- Data Rates: Few bps up to 100kbps

LORAWAN

Again, similar in some respects to Sigfox and Neul, LoRaWAN targets wide-area network (WAN) applications and is designed to provide low-power WANs with features specifically needed to support low-cost mobile secure bi-directional communication in IoT, M2M and smart city and industrial applications. Optimized for low-power consumption and supporting large networks with millions and millions of devices, data rates range from 0.3 kbps to 50 kbps.

- Standard: LoRaWAN
- Frequency: Various
- Range: 2-5km (urban environment), 15km (suburban environment)
- Data Rates: 0.3-50 kbps.

CONCLUSION

From the options above the most appropriate and preferable method in Pakistan should be cellular network because of its range, power usage and reliability. Cellular network towers are spread everywhere, so to commercialize the project, we want reliability for convenience of consumers. It's not a cost-effective method as yearly the cellular companies will demand large amount of charges, but on positive side it's also less complex and most reliable than others.

RISK ASSESSMENT OF VIABLE OPTIONS

We saw that why aforementioned options of using process and communication are preferable, but still there are risk factors involved in these options.

Designing the circuit for the first time could make more problems than expected that causes reliability issues, like burning and providing wrong data. Even after testing there could be some faults that could occur after long time. So, a good management is required to eliminate these issues from the scratch.

(About Processor)

As, discussed before that communication option has an only disadvantage that it's costly, but after utility will charge bills from consumers, the statistics bills could minimize this cost as whole.

COST ANALYISIS

The components we're using our project are listed below,

Sr no	Component name	Model	Quantity	Price
1	Transformer (Step down)	12v output	1	250
2	PCB board	Transparent 2 layer	1	400
3	LM 317		1	20
4	Microcontroller	Arduino nano + Cable	1	370
5	LCD	20x40 Graphic LCD	1	1000
6	LCD driver		1	250
7	MAX-232		1	20
8	DB-9 connecters	Male jack	1	6
9	WCDMA HSPA module	SIM5320A	1	2850
10	Hall effect sensor	ACS712	1	130
11	Miscellaneous items	Resistances, capacitors, inductors etc		250
12	EPROM Gadget	CAT-24Ccc	1	450
	Total		*Rs = 6000*	