Powering the next generation of Metering Communications

Kerk See Gim, Power Automation





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Smart Metering

- Introduction on PA
- Smart Metering Communications Overview
- Case Study – NUS- U-Town
- TVWS – The game changer ?
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Power

Automation

SINGAPORE POWER

SIEMENS

POWER AUTOMATION

"To be a leading system integrator and turnkey vendor providing innovative solutions for Power System Control & Substation Automation systems"

Asset &
Expertise

Automation

Power Automation (A Brief Introduction)

- Joint Venture Company between Singapore Power and Siemens since June 1996
- Specializes in SCADA, DA/DMS, EMS, and substation protection & control systems
- As Siemens' center of competence in SEA for Power System Control business
- As Siemens' center of competence in Asia for Substation control business
- To provide better services and supports to customers in Asia Pacific region
- To provide One-Stop Power Quality services to customers in Singapore

Power Automation's personnel have full spectrum of SCADA and power quality experiences

- With electric utility
- With high-tech customers
- Technical development as well as strategy advisory
- Will make available highly trained personnel with experiences on international projects to ensure a successful implementation

Scope of Businesses

Smart Control System

- SCADA/EMS
- SCADA/DMS, DA

Substation Integrated Protection & Control

- Bay Controllers
  - Data Acquisition and Control
  - Interlocking
- Intelligent Electronic Devices (IEDs)
  - Numerical Protection Systems
  - Intelligent Meters
- Remote Terminal Units (RTUs)

Smart Metering

- AMI
- PQA
- PQS

Project References (A Snapshot)

SCADA

- SCADA/DMS hardware and software maintenance services for PowerGrid
- Integrated Substation Control and Protection System for Ayer Rajah II, Labrador II,
- Tampines Wafer 230kV, and Jurong Island 230kV and 66kV Substations, Seraya and Senoko C Switch-houses
- Remote Terminal Units for 66kV, 22kV and 6.6kV substations
- SMRT control systems – East West Line
- Review of electrical network design concept paper for Lands & Estates Organisation, MINDEF
- Upgrading and Replacement of the SCADA/DMS for PowerGrid
- Electrical Integrated Control and Substation Automation System for LNG Plant in Ras Laffan, Qatar
- System Dispatch Center Project (EMS/DMS) for CEM, Macau
- SCADA/EMS for Penampang 120MW IPP Development and Interconnection Project, Sabah
- SCADA/EMS for Sandakan Load Dispatch Centre, Sabah
- SCADA System for Putrajaya, Malaysia
- SCADA system for Taipei, Kaoshiung, MaiLiao
- Substation Control System for various HV/MV Substations in Thailand, Malaysia, Vietnam, Philippines,

Smart Metering Systems

- Power Quality Monitoring System for PowerGrid's T&D Substations
- PQMS Jurong Shipyard
- PQMS ST Microelectronics
- PQMS Mindef for Changi Air Base, Changi East Naval Base, Mandai Camp
- Seagate RMO at Woodlands plant 1, 2 and 3
- Sony Visual Display Corp
- Changi Airport Terminal 1,2 and 3
- Changi Water Reclamation Plant
- AMR study and Design for BSES, Mumbai

A Sample of Our Customers

SP POWERGRID
A member of Singapore Power Group

CHINASTEEL

Taiwan power company

SP SERVICES
A member of Singapore Power Group

澳電 cem

台塑石化股份有限公司
FORMOSA PETROCHEMICAL CORPORATION

TUAS POWER

Senoko
Powering in better ways

POWERSERAYA

EVN

TENAGA NASIONAL BERHAD

ENERGY MARKET AUTHORITY

STMicroelectronics

Knight Frank

SABAH ELECTRICITY SDN. BHD. (462872-W)

TAIPEI RAPID TRANSIT CORPORATION

Seagate

CAAS
Civil Aviation Authority of Singapore

jtc
Corporation

SUPREME COURT
SINGAPORE

SONY

福建省电力有限公司
FUJIAN ELECTRIC POWER COMPANY

国家电网公司
STATE GRID
CORPORATION OF CHINA

RG

PUB

Po
Automation

The Smart Grid.

Everywhere for everyone.

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Smart Metering Communications Overview

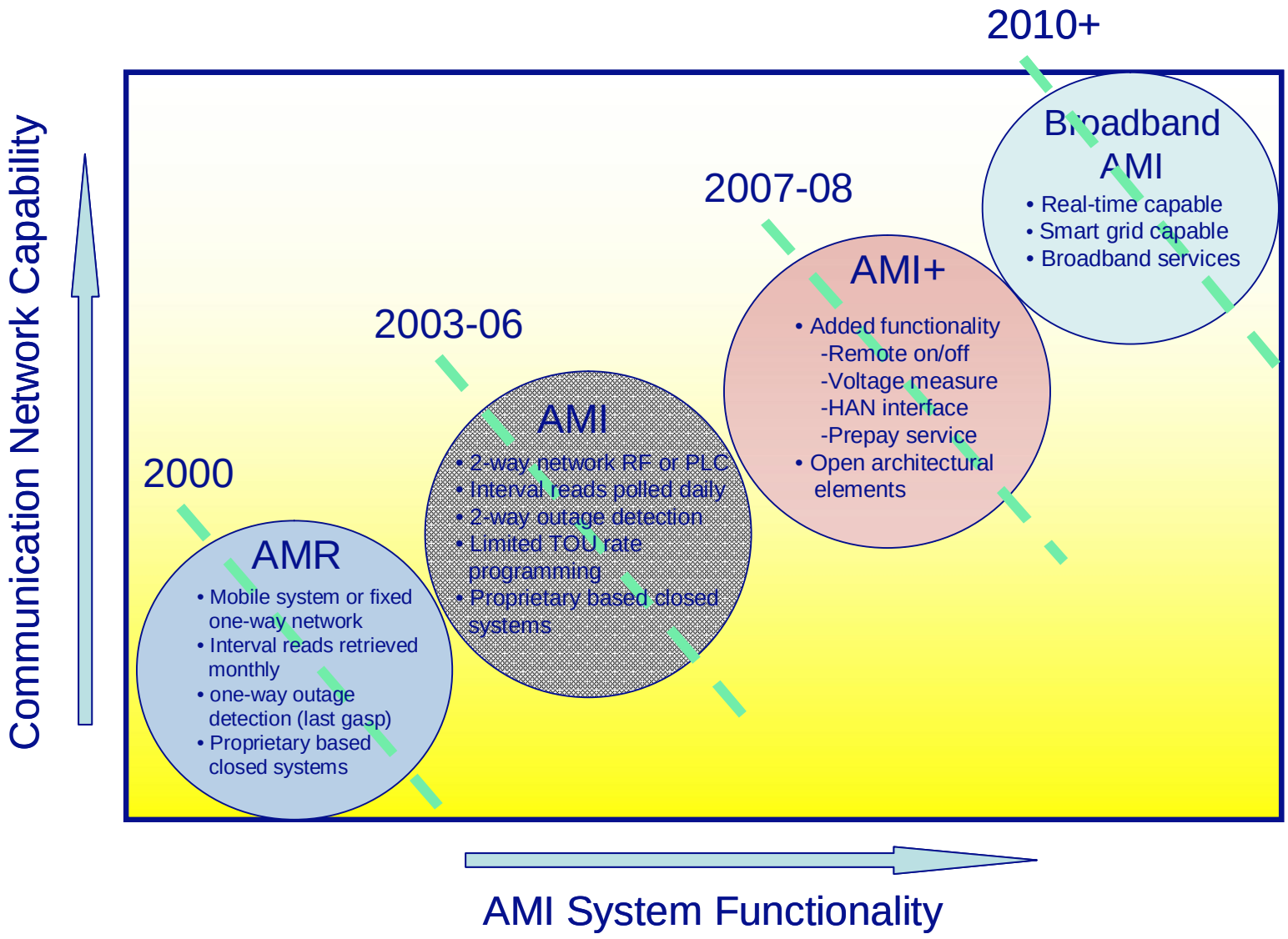
What Utility/Regulators what for Smart metering

- Improve retail efficiency and increase revenue
- Improve real time management and increased service offerings
- energy management, demand management, condition monitoring at the distribution level to achieve predictive maintenance, Outage Management
- better fault response and improving reliability
- Security and Asset Management
- LOW COST, PREFERABLY FREE !!!

What the current communications technologies can provide

- daily settlement data – 48 intervals
- 2 way communications at limited data speed to support ad-hoc queries
- daily struggle to meet performance criteria – 97% successful read on the first day, 99% on the second day, 100% on the third day , using SNEAKER NET , if need be
- Definitely NOT CHEAP !!!

Evolving needs

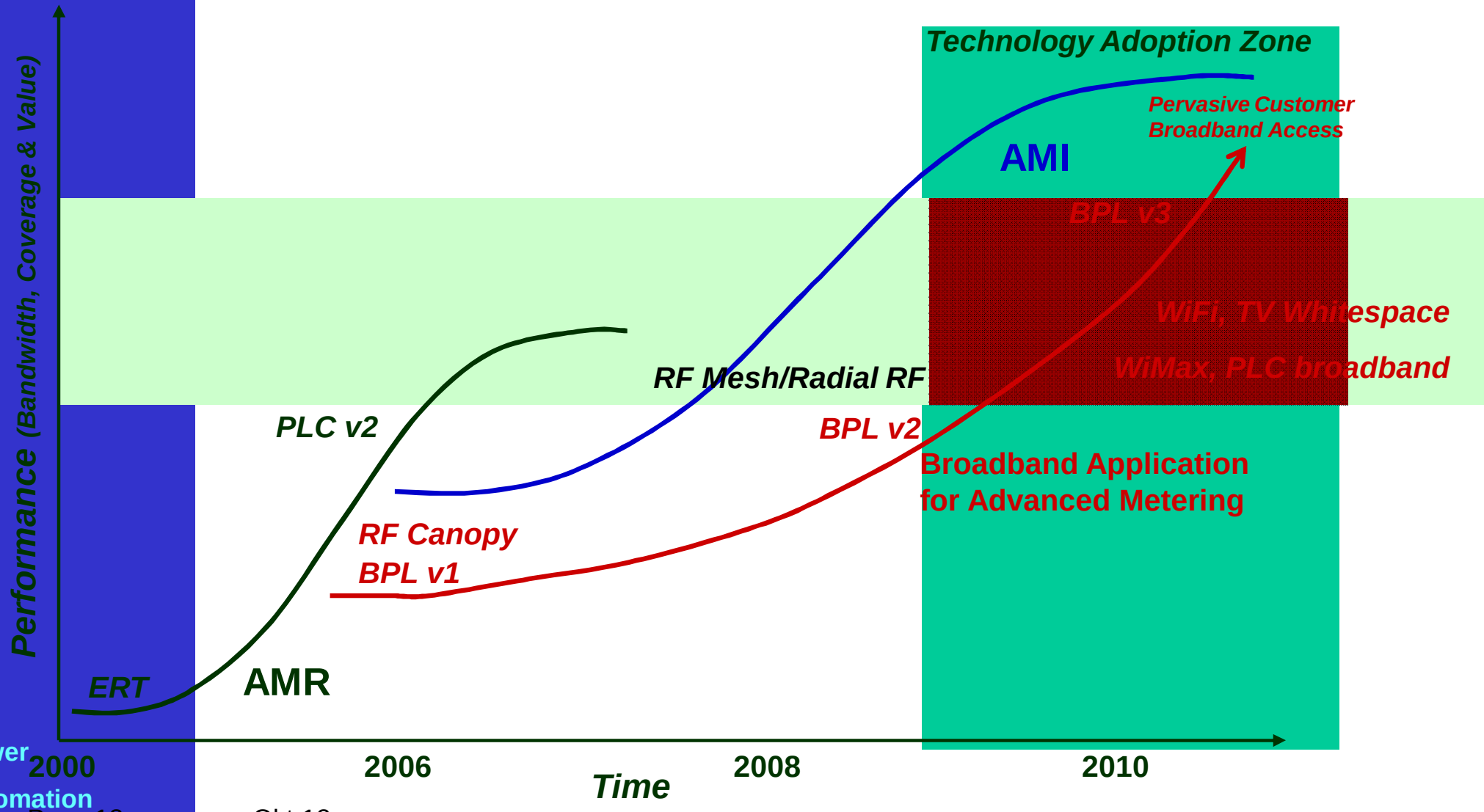


AMI Data and Network Needs

	Electric AMI	Gas/Water Meter	Thermostat Control	Distribution FCI
Daily Uplink Payload Data	5kb -10Kb +Alarms	500bytes + Alarms	1Kb +Alarms	250 bytes +Alarms
Daily Downlink Payload Data	Network acknowledgement, shut off, rate tables	Network acknowledgment, shut off	Rate tables, control messages	Network acknowledgment, reset
Latency Tolerance	Seconds for alarms; Minutes for payload	Seconds for alarms; Minutes for payload	Seconds for control messages	Seconds for alarms; Minutes for payload
Firmware Upgrade	600kb	200kb	200kb	100Kb
Battery Requirements	n/a for meter; months to years for HAN devices	15-20 years	15-20 years	10 years

Our Approach on Communication Technologies – support changing technologies

Develop our system from backend to demand applications based on high speed connectivity



NUS University Town – Electricity Vending System for Aircon units

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NUS University Town

Meter with Smart Card System

Smart Meters with wireless communications
E-Payment Gateways (Nets, AXS, Credit Cards)

Which to Choose ??

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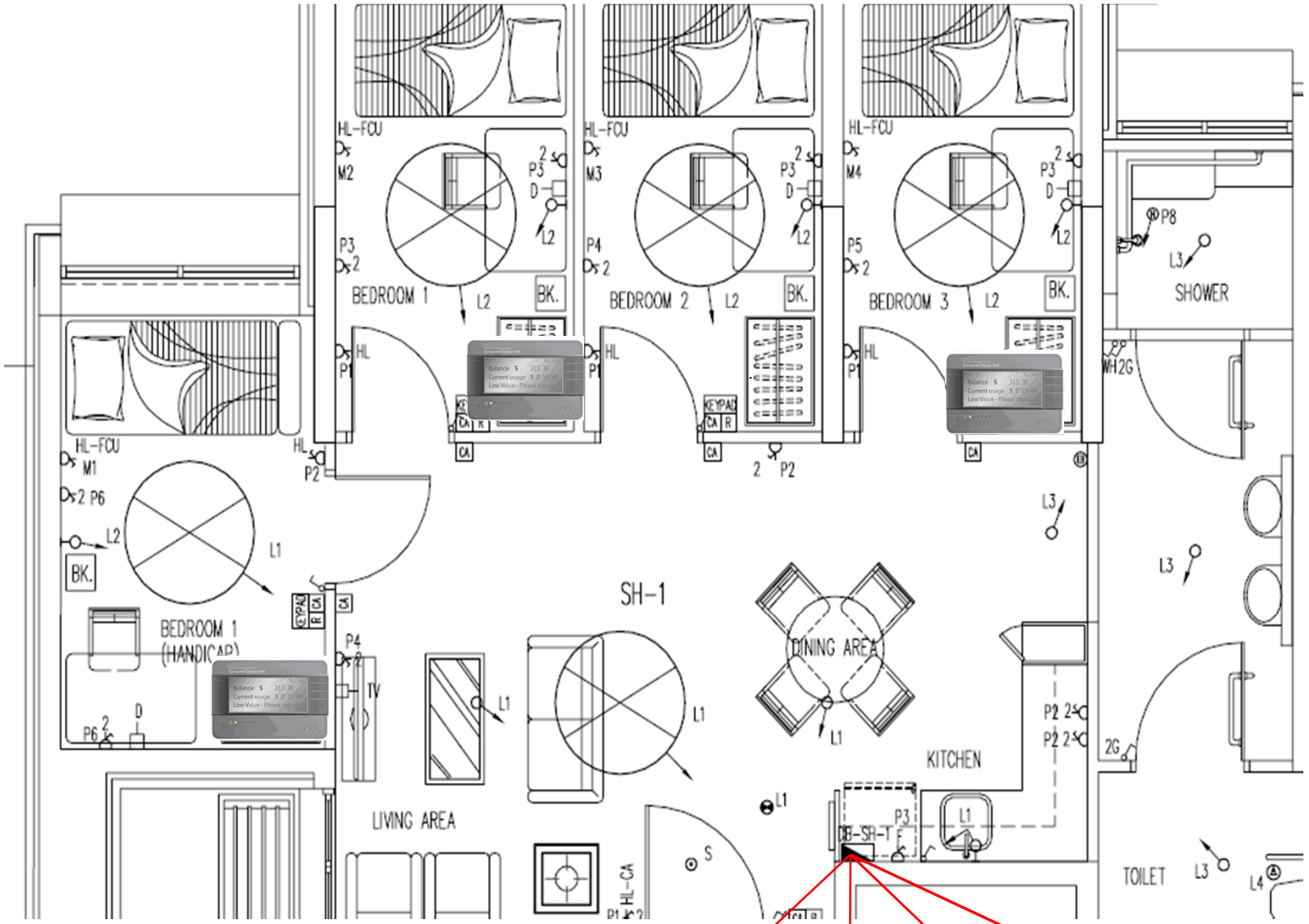
Meter Challenges and EVS benefits

- No awareness of actual usage – manual download via the smart key when they top up could be delayed, ineffective tamper analysis
- Ease of tampering as checks on site are less frequent now
- Difficulty in making adjustments to tariffs and emergency credits
- Difficulties in addressing special case and ad- hoc credits
- Loss of tokens/Keys
- Conversion requires changing back to normal meter
- High meter costs and High Transaction Charges

EVS Solution Offers

- Real time readings and 48 interval of 30 mins uploaded daily
- Smart meter with anti tampering alarms
- sub-station audit module computes daily energy transferred from the substation – anti tampering analysis on a daily basis
- real time adjustments to tariff, credit amount and packages
- require no tokens/keys
- Support both prepaid and postpaid options
- Cost effective meter with 15 year product design life
- supports giro, bulk transactions and lowers transaction costs
- OVERALL LOWER OWNERSHIP COSTS

Meter Installation with RF Meter and CDU



All meters are installed at the DB near the entrance, the CDU is available to remind the users to top-up.

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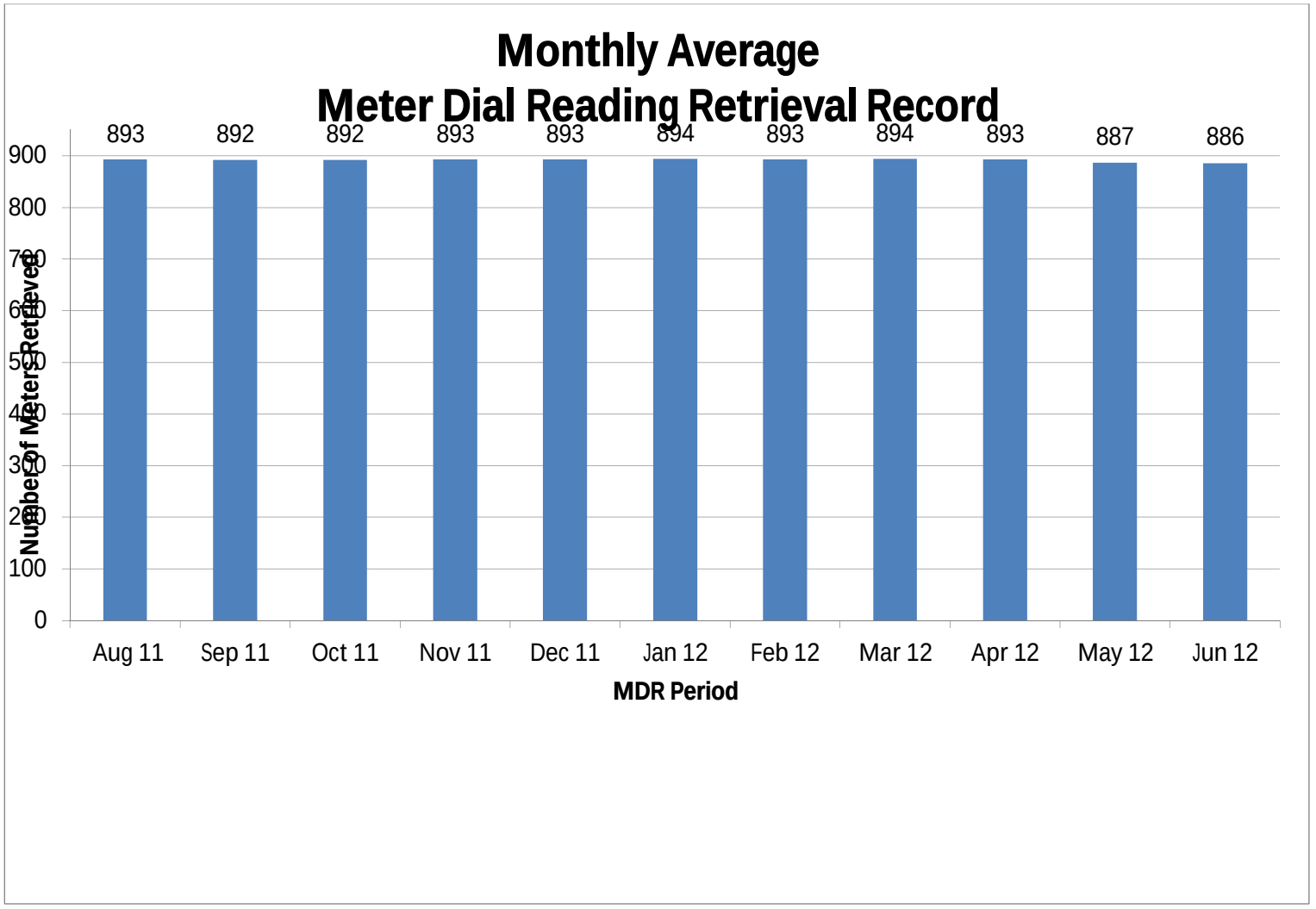
Performance Results – Daily Read

Date	Aug 11	Sep 11	Oct 11	Nov 11	Dec 11	Jan 12	Feb 12	Mar 12	Apr 12	May 12	Jun 12
Meter Read	893	892	892	893	893	894	893	894	893	887	886
Total	895	895	895	895	895	895	895	895	895	895	895
	99.78%	99.66%	99.66%	99.78%	99.78%	99.89%	99.78%	99.89%	99.78%	99.11%	98.99%



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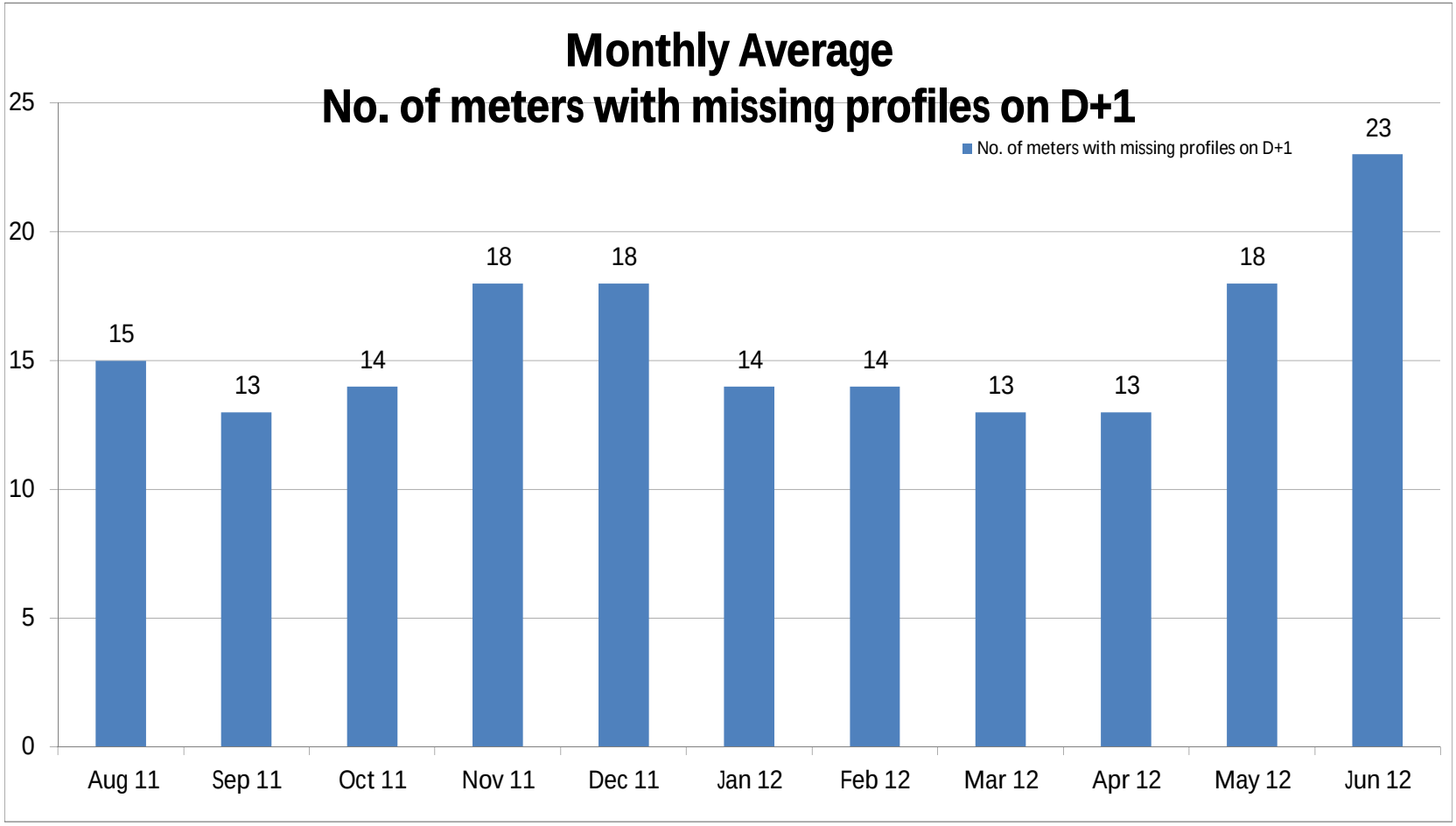
Performance charts- Load profile – 48 intervals

Date	Aug 11	Sep 11	Oct 11	Nov 11	Dec 11	Jan 12	Feb 12	Mar 12	Apr 12	May 12	Jun 12
No. of meters with missing profiles on D+1	15	13	14	18	18	14	14	13	13	18	23
Total number of meters	895	895	895	895	895	895	895	895	895	895	895
	1.68%	1.45%	1.56%	2.01%	2.01%	1.56%	1.56%	1.45%	1.45%	2.01%	2.57%



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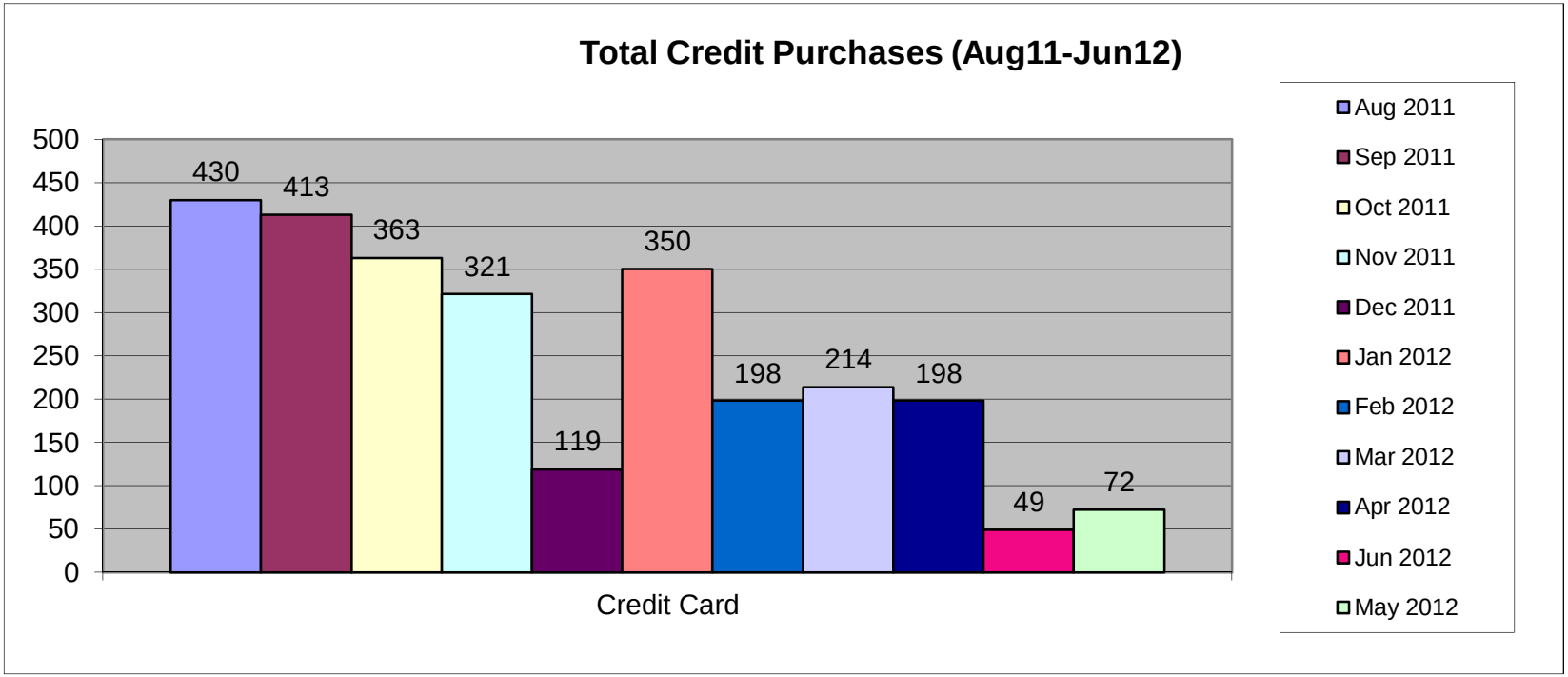
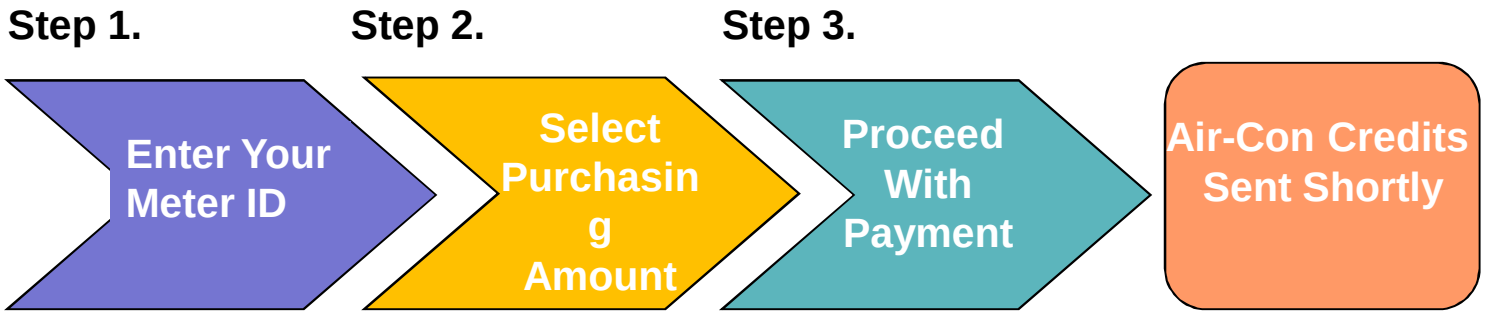
Purchase records



Date	Credit Card	Nets	Cashcard			Total	Total
Aug 2011	0	400	30			430	15.77%
Sep 2011	136	259	18			413	15.14%
Oct 2011	172	179	12			363	13.31%
Nov 2011	148	162	11			321	11.77%
Dec 2011	53	66	0			119	4.36%
Jan 2012	126	213	11			350	12.83%
Feb 2012	95	100	3			198	7.26%
Mar 2012	82	129	3			214	7.85%
Apr 2012	100	95	3			198	7.26%
May 2012	46	25	1			72	2.64%
Jun 2012	29	18	2			49	1.80%
Total	**987**	**1646**	**94**			**2727**	

Buying of Air-Con Credit
Simply purchase your credit by Internet or Kiosk !

Internet	Kiosk
• Visit https://nus-utown.evs.com.sg	• Kiosk located at the lobby



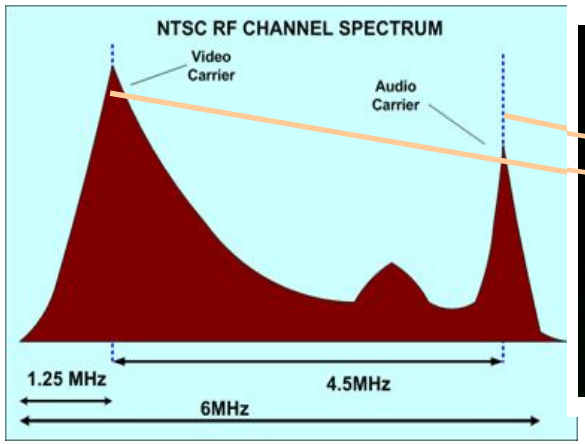
For more information:

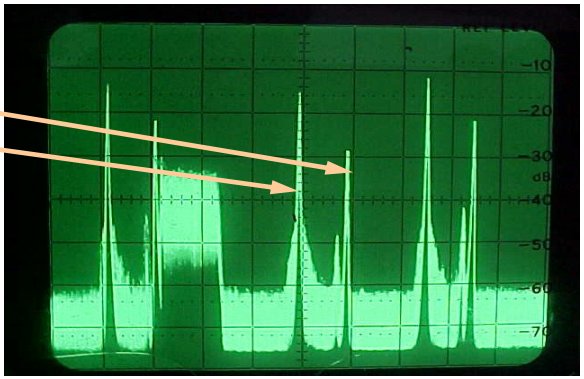
- Visit https://nus-utown.evs.com.sg
- Technical Hotline 82999655

TVWS Technology

What is TV White space ?

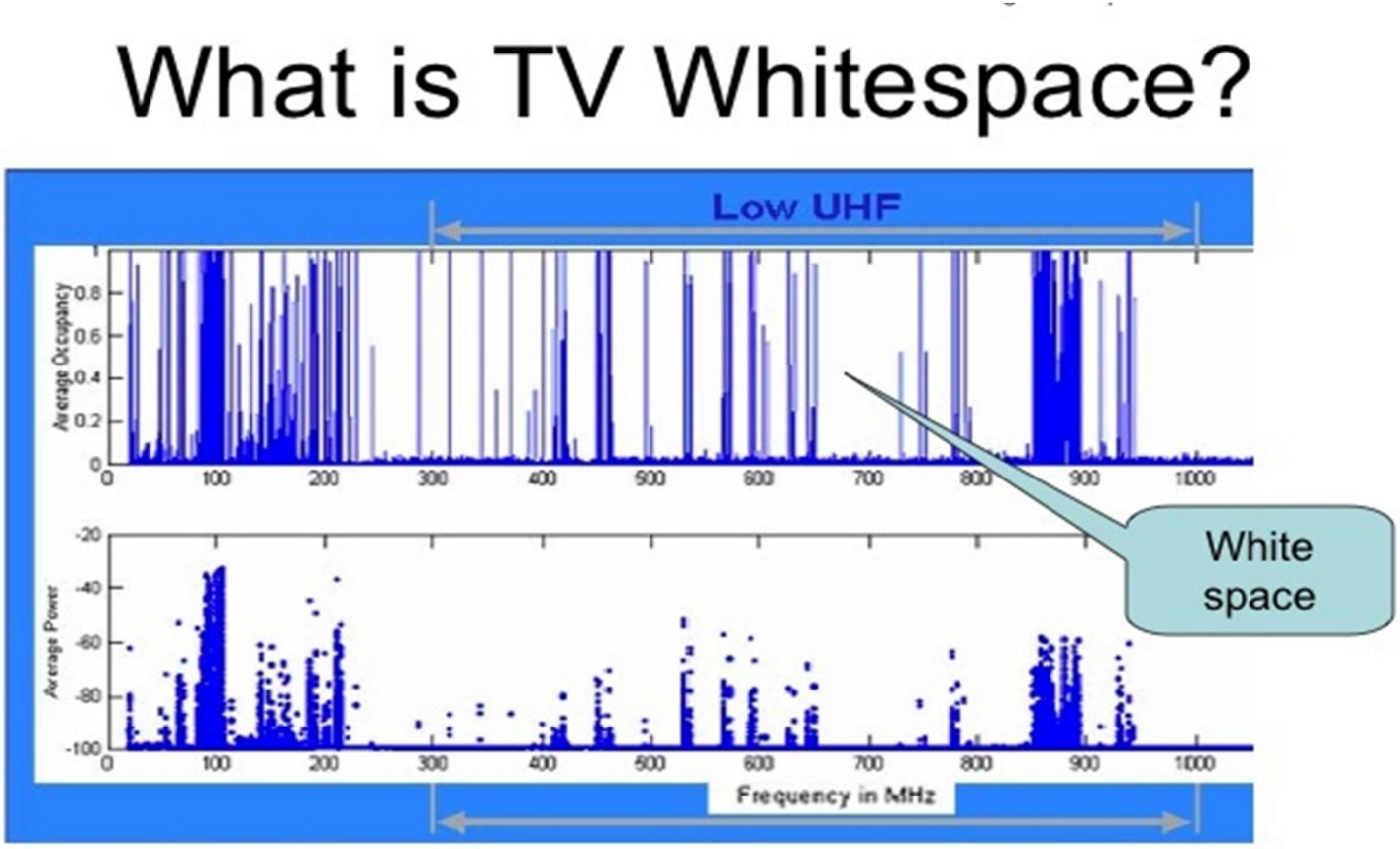
- As a start, TV frequency channels refers to the spectrum for television broadcast and radio spectrum from 4 contiguous blocks of a total of 418 Mhz bandwith
- The term “TV white space” relates to the same parts of, which in a given location or any given time remains unused for broadcast television. This happens when TV channels are now broadcasted via cable or fiber networks leaving them un-used or simply under-utilised. The reduced required for separation distances are offering new opportunities for TVWS
- Singapore is the only country other USA which allow “free to use” TV Whitespace. This open up huge opportunities for players to utilise them for smartgrid, remote monitoring and control and surveillance purposes. The rest that are testing for approval are UK, Canada and France





TVWS – Under-utilised Analog TV channels

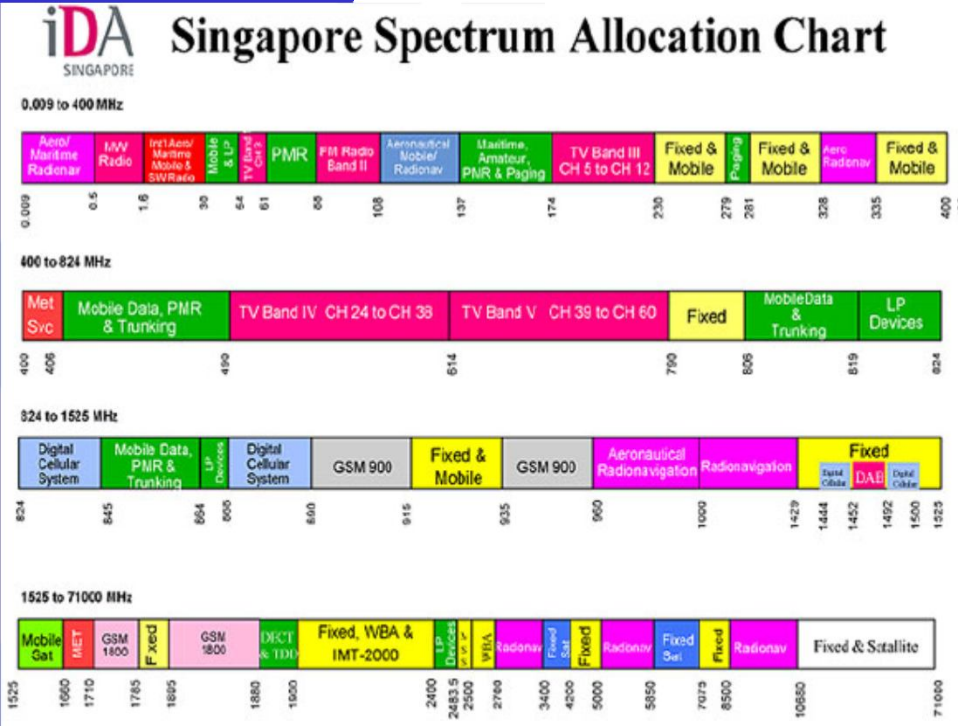
What is TV Whitespace

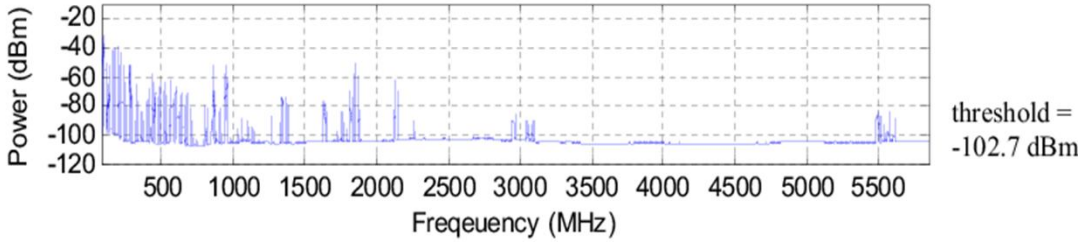


CASE STUDY – Singapore

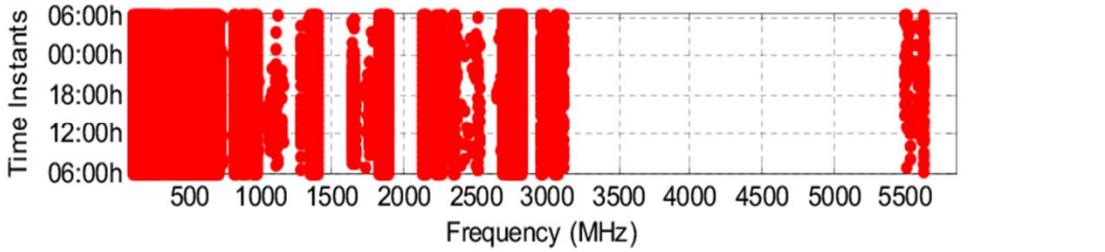
Spectrum allocation ~100%

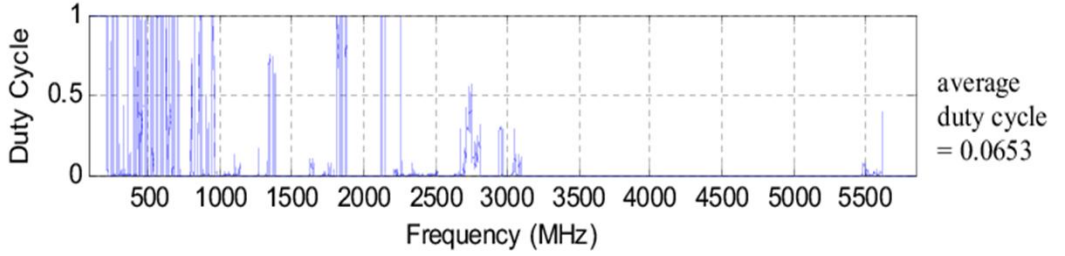
Spectrum utilization ~6.5% meaning that most of the time, its free





threshold = -102.7 dBm





average duty cycle = 0.0653

Unused spectrum exists from …
time to time, & location to location

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But this is not all! – a large chunk is block off for our neighbours – lets start with them

Regional Coordination

Indonesia TVR1

Malaysia TV2

Ch5	Ch6	Ch7	Ch8	Ch9	Ch10	Ch11	Ch12

TV Channels Used in SG

DAB Channels Used in SG

Wireless MIC Channels Used in SG

To avoid interference in TV spectrum with Malaysia and Indonesia, Singapore virtually loses 2/3 of the spectrum

Solutions? – IDA approves TVWS use for 630 Mhz to 742 Mhz – around 10 channels

Spectrum is wasted!

Cognitive radio (CR) is a potential solution

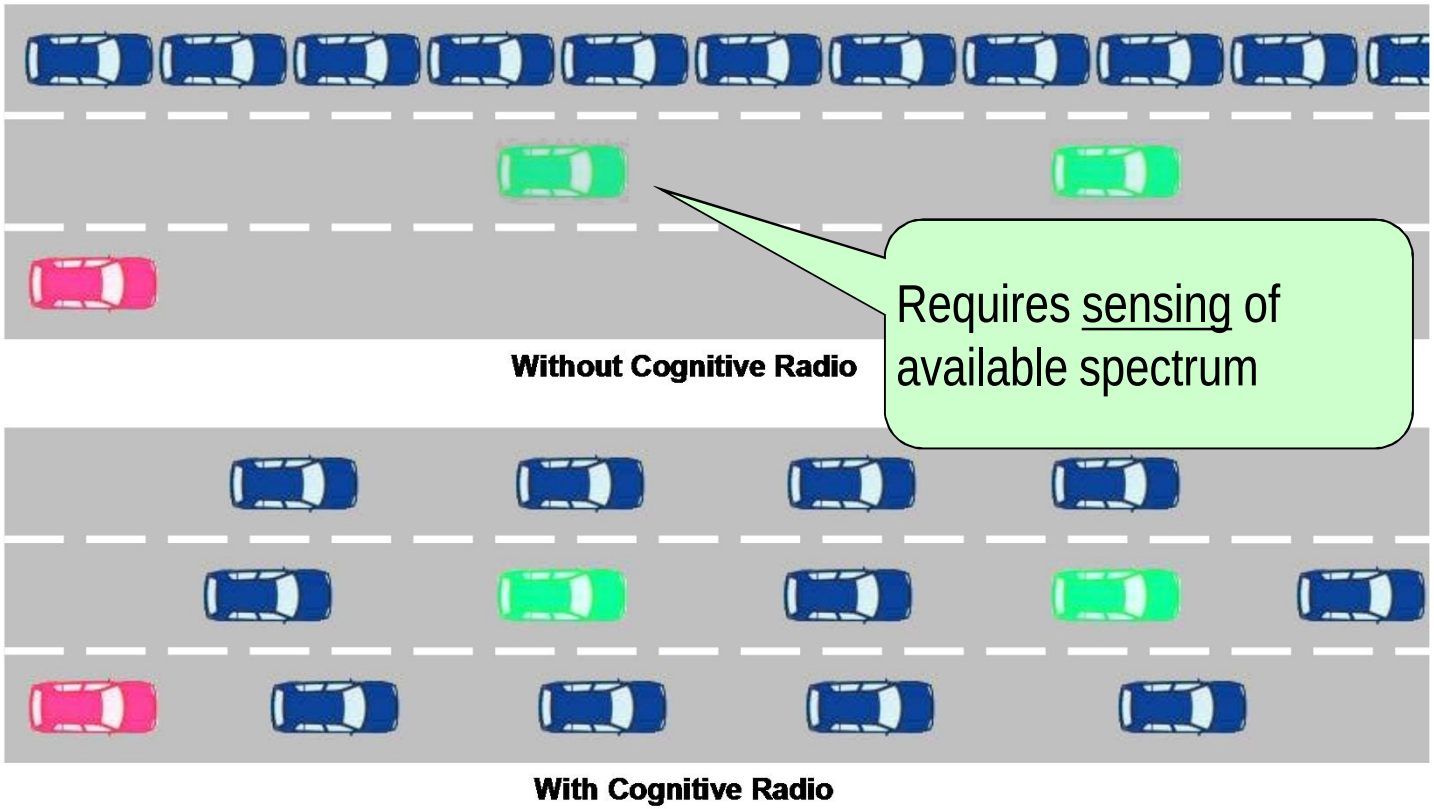
Channel Bandwidth - 5Mhz

Channel Spacing – 8 Mhz

Cognitive Radio	Car Driving
Frequency spectrum	Road
Frequency band	Lane
CR device	Car

Opportunistically use spectrum when it is idle

When applied on TV bands, it is called TV White Space (TVWS)



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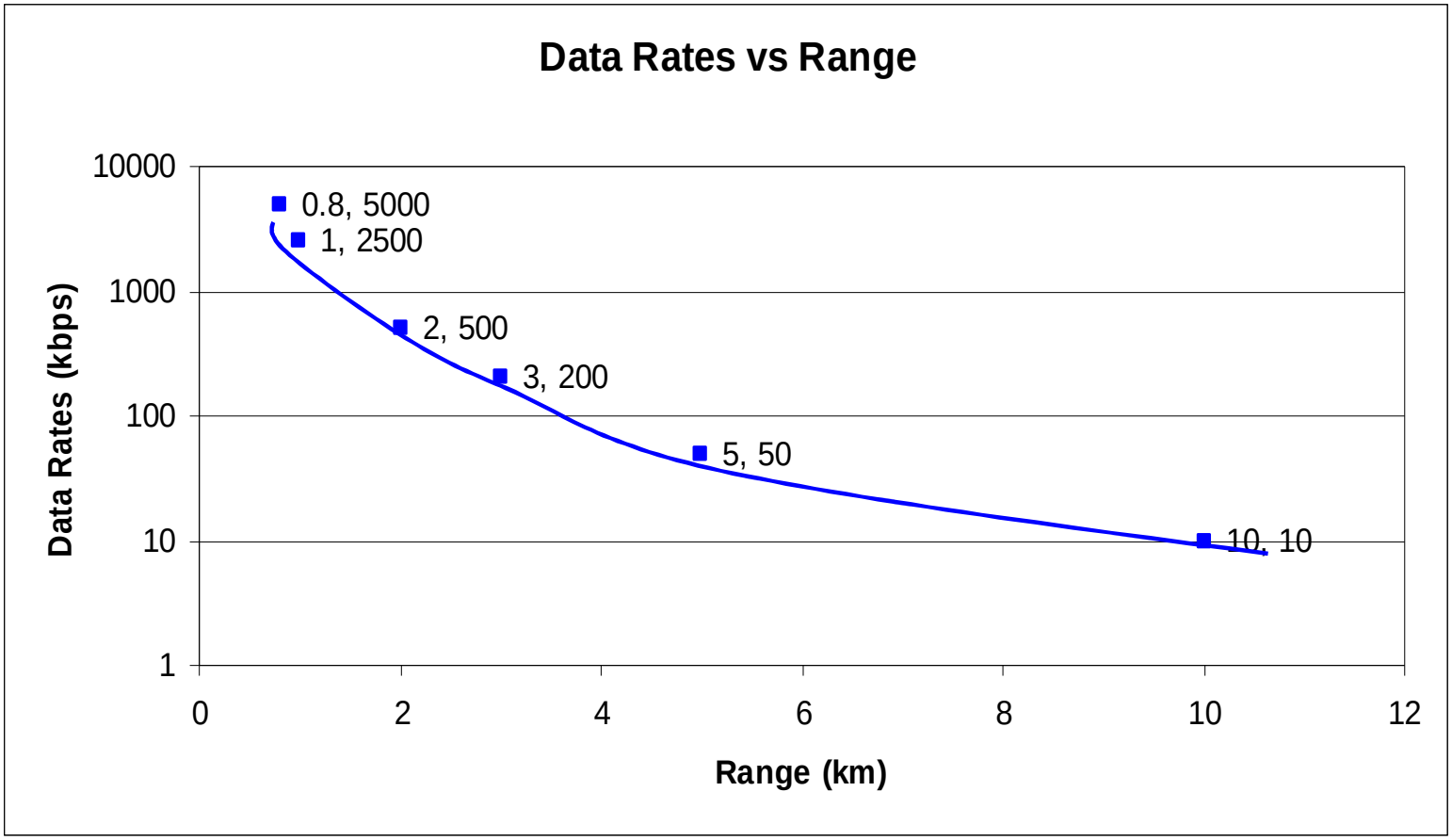
Data Rates & Range Tradeoff



- Based on path loss exponent of 2.5
- Transmission power of 100 mW
- Carrier frequency of 700 MHz, can be varied and “jumped” to any unused channels and for the trial we are planning on 1.5 Mbps for 1 km radius
- Possible to cover the whole of Singapore with 250 concentrators

Comparisons between 3G/GPRS to TV White Space

Factors	3G HSPA	TVWS
Price ($/month)	53.90	0
Max. speed[1] (Mbps)	4.8 (DL), 1.3 (UL)[2]	13.5
Max speed at cell edge (Mbps)	0.6	1.5
Max number of simultaneous connections (assume 100 kbps for Smartgrid applications like load shedding)	6	18
Number of simultaneous 5 MHz frequency channels (max)	1	10[3]
Max number of meters/devices per Access point at one location	600	6000

Notes:

[1]Based on Singtel: http://home.singtel.com/bbmobile/

[2]Uplink (UL) speed is estimated based on downlink speed. Average trueput from 3G 7.2 Mbps are really not achievable and really less than 300 kbps at most situations . GPRS is only 80 kbps at best.

[3]Based on IDA's current TVWS guideline

[4]The actual numbers should be higher as it is unlikely that all devices will be at cell edge

Our Universal Communication Module

Internal Database

RS232/RS485

Data Management & Control Module

Downstream Zigbee and BPL comms module

Upstream comms module

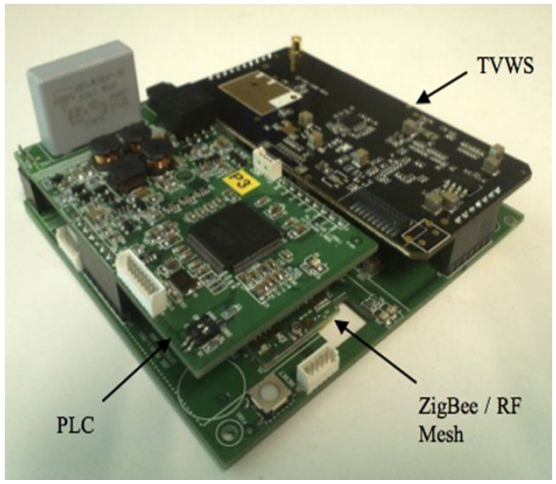
TV White Space

Home Automation

Power Automation

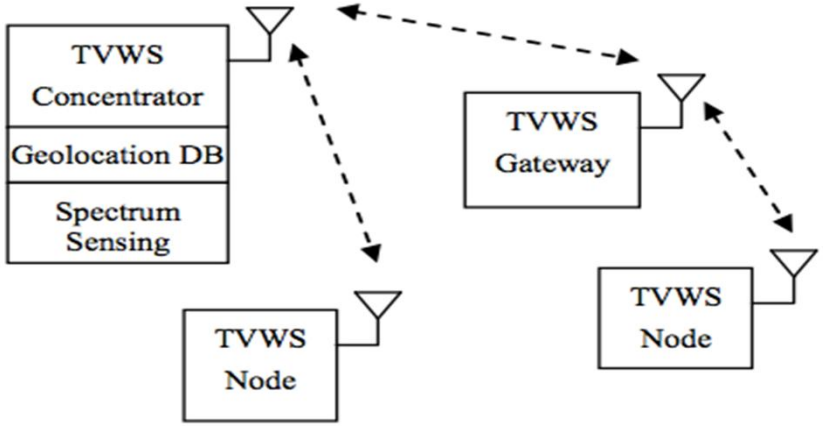
Modules of our TVWS system

TVWS End Nodes



Concentrator/Gateway

meters



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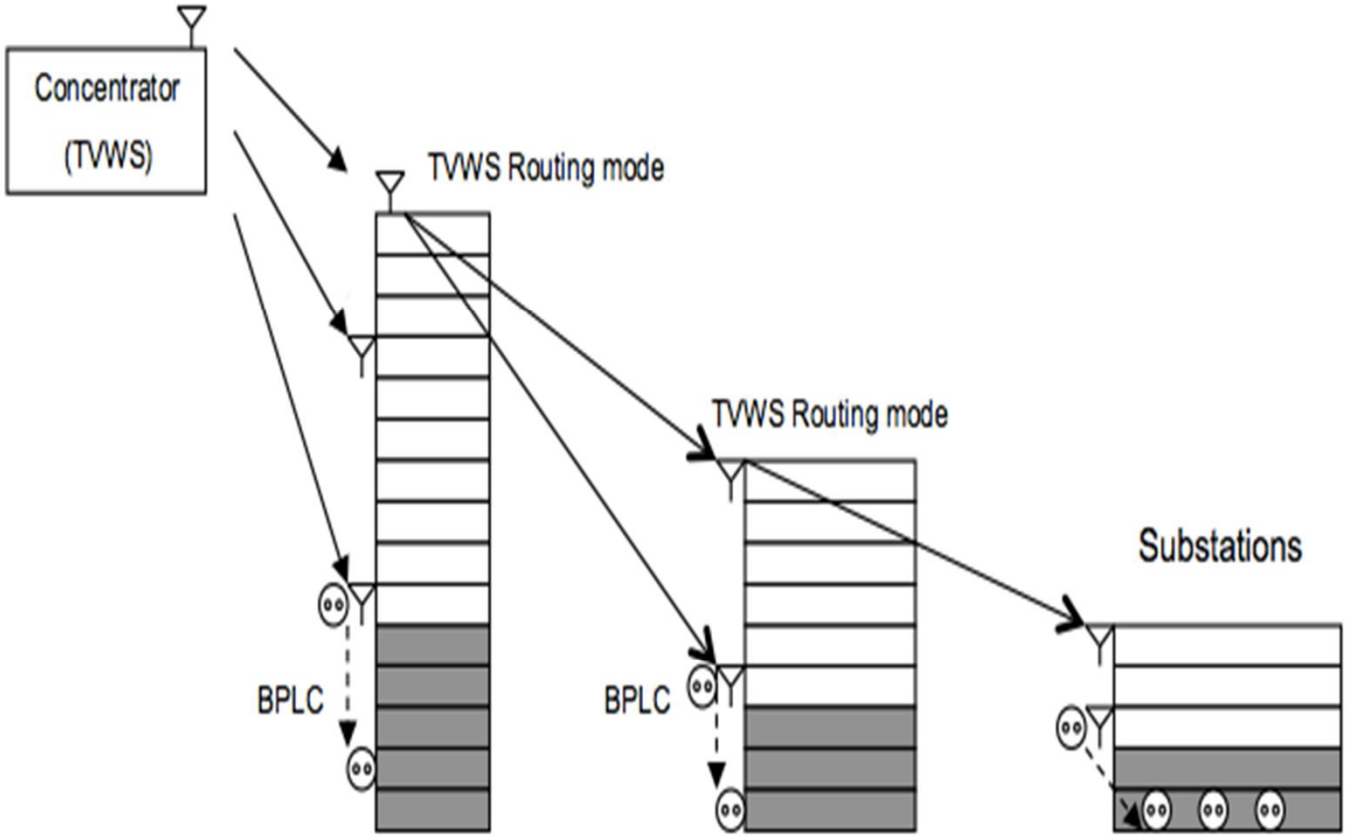
Highly extensible Deployment Design – Multiple Tier networks



Potential deployment scenario for Substation Broadband Communication

TV White Space (TVWS) Trial @ NUS

- No. of concentrators: 2
- No. of meters: up to 800 – Stage 2
- Frequency: UHF bands
- Range: 700-1000m
- Power:
  - 100 mW (last mile)
    - Speed to double if we set at 500 mW as approved
  - Up to 1 Watt (infra)
- Data rates: ~5 Mbps (aggregated raw rate)

Powering the Applications

- Camera Security
- Customer Aware Applications
- Demand Management via Smartplugs
- Smart Home/Smartphone Payment Gateway

End of Presentation

Any questions?

Thank you