

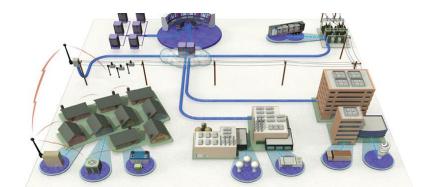
Smart Meter Pilot Project in Tenaga Nasional Berhad, Malaysia: 3 Different Communication Technology Tested

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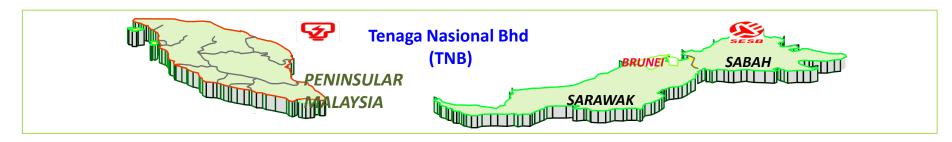




Agenda

- Background of Tenaga Nasional Berhad (TNB), Malaysia
- TNB's Smart Grid Drivers
- Pilot Project Overview and Implementation
- Performance of the technologies tested
- Lessons to Leverage for Full Scale Rollout
- TNB's proposed nationwide rollout roadmap

Tenaga Nasional Berhad (TNB) is the largest utility company undertaking the role of developing, managing and operating the Generation, Transmission and Distribution of Malaysia's Electicity Supply Industry, with presence in Peninsular Malaysia & Sabah.



Peninsular Malaysia

Customers ~8.1 million **Installed Capacity** 21,060 MW 16,901 MW Max Demand

Sarawak

Customers 0.504 million **Installed Capacity** 2,930MW **Max Demand** 1,758 MW

Sabah

0.49 million Customers **Installed Capacity** 1,241 MW Max Demand 917MW

RESOURCES	Employees
	36,146 people
CAPACITY	Customers
	8.6 mill (Peninsula & Saba

Maximum **Demand**

16,901 MW

RM 110.7 billions (as of 2014)



Fuel Mix

Installed

Capacity

10.814 MW

T&D Losses

53.8%	35.3%	10.3%	0.6%	0.04%
GAS	COAL	HYDRO	DISTILLATES	MFO





Revenue

Assets

105,000 GWh (FY 2013/14)



8.3% losses (FY 2013/14)



PERFORMANCE

FINANCIAL

Electrification Peninsula 99.99% Sabah 90.81%

RM10 Billion

(FY 2014/15)

CAPEX



SAIDI (Distribution) 55 mins



SAIDI (Transmission)

0.1 min



TNB's Smart Grid Drivers

Existing business model imposes multitude of challenges towards sustainability



Higher customer demand

Require significant technologies and equipment to meet customer demand



High dependency on fossil fuels (more than 90% from gas and coal)

Reliance on 100% imported coal - issue on energy security



Increasing cost of supply

Rationalizing energy subsidies and recovery of higher cost of supply



Reduction of CO₂ emission & low carbon economy

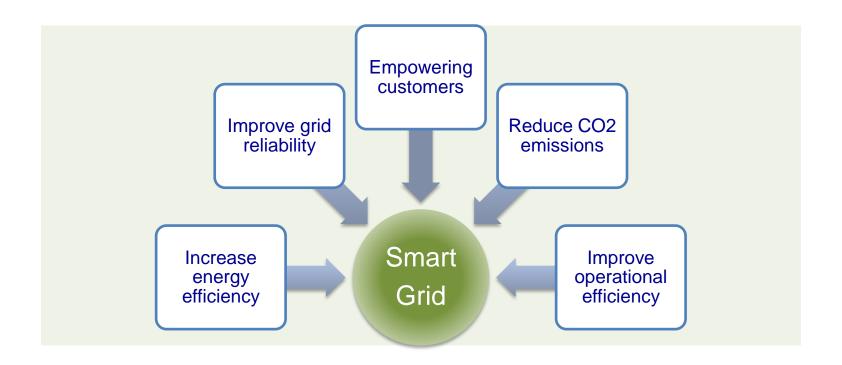
Commitment to reduce up to 40% in emission intensity of GDP in year 2020 compared to 2005 levels



Increasing pressure on energy security

Availability and reliability of energy resources

TNB's Smart Grid Drivers

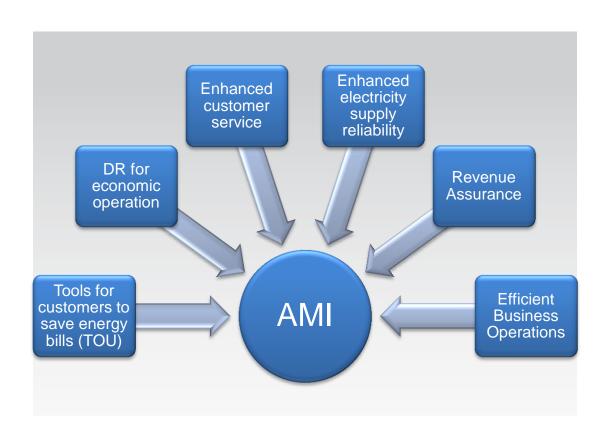


"Upgrading capability of the existing electric power grid by deploying more automation and ICT technologies to enable the grid to operate more efficiently and reliably and offer additional services to consumers to save money and reduce CO₂ emissions"

- TNB Smart Grid Steering Committee (Sept 2010)

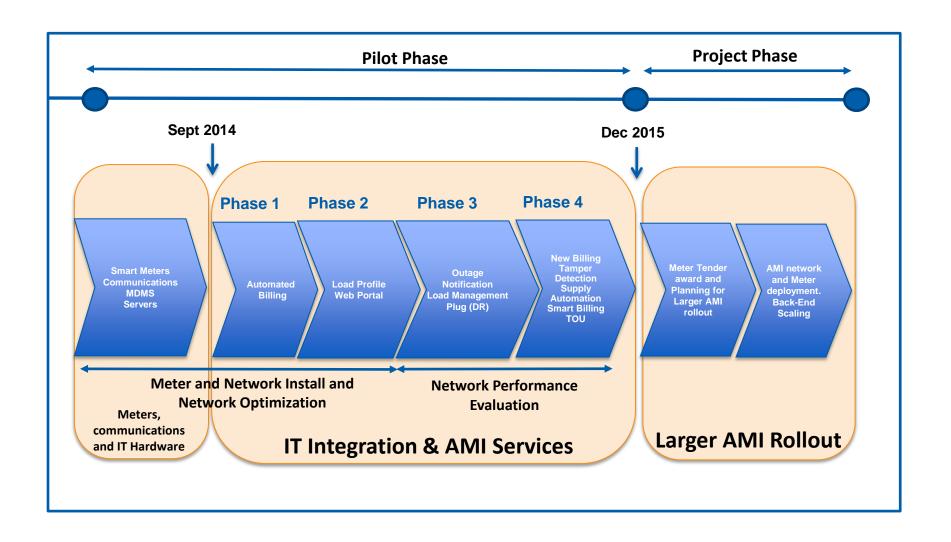
TNB Smart Meter Pilot Project

- The pilot project is funded by the Malaysian Government (MESITA Fund)
- Implementation of 1000 smart meters in the states of Melaka and Putrajaya
- The project is part of TNB's smart grid Initiative

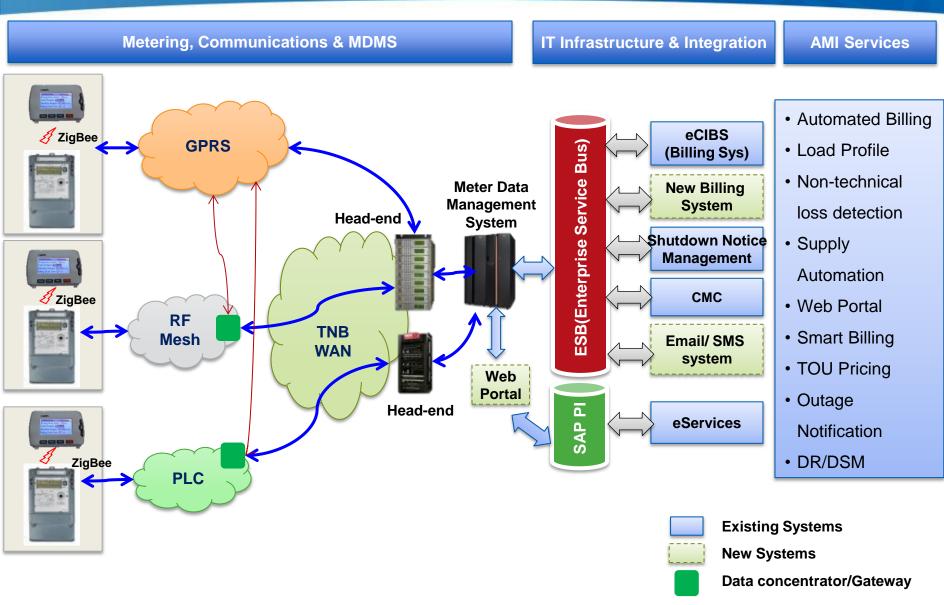




Implementation Stages and Progress



AMI Pilot Project System Design and Services



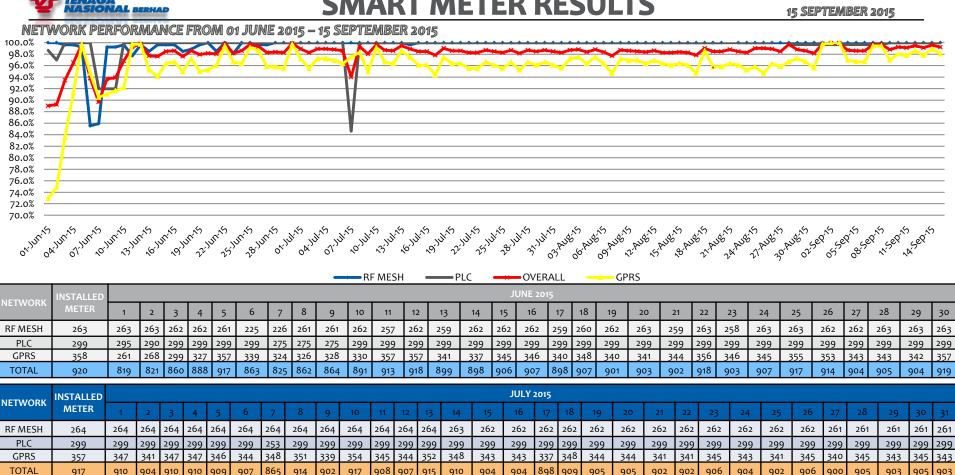
PLC

GPRS

TOTAL

298 298

SMART METER RESULTS



299 299 299

354 358 355

255 255

298 298

350 346

TOTAL	920	819	821	860	888	3 917	863	825	862	864	891	913	91	8 8	99 8	98 90	90	7 8	98 9	07 90	01 90	9 9	02	918	903 9	07	917	914	9
	INSTALLED		JULY 2015																										
NETWORK	METER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
RF MESH	264	264	264	264	264	264	264	264	264	264	264	264	264	264	263	262	262	262	262	262	262	262	262	262	262	262	262	261	Г
PLC	299	299	299	299	299	299	299	253	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	Γ
GPRS	357	347	341	347	347	346	344	348	351	339	354	345	344	352	348	343	343	337	348	344	344	341	341	345	343	341	345	340	Г
TOTAL	917	910	904	910	910	909	907	865	914	902	917	908	907	915	910	904	904	898	909	905	905	902	902	906	904	902	906	900	Г
INSTALLED	INSTALLED		AUGUST 2015																										
METER	METER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	ı
RF MESH	261	261	261	261	261	261	261	261	261	260	260	259	259	259	259	259	258	258	258	256	256	257	256	256	256	256	256	256	Γ
PLC	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	299	2259 9	Γ
GPRS	362	346	350	351	347	351	347	341	350	349	348	347	349	346	346	347	346	342	353	348	348	350	348	346	353	353	352	348	Γ
TOTAL	916	906	910	911	907	911	907	901	910	908	907	905	907	904	904	905	903	899	910	903	903	906	903	901	908	908	907	903	
																			_										
NETWORK	INSTALLE	SEPTEMBER 2015																											
NETWORK	METER		1	2	3	4	5	5	6	7	8	9	10	1	1 12	13	14	15											
RF MESH	254	2	55	255	255	255	5 25	55	255	255	255	255	25	5 25	55 255	254	254	254											

RF Network								
Issue	Solution							
Meter data arrived late at Trilliant Head End from RF Collector in Melaka due to weak RF links	 Installation of repeaters to improve weak RF links back to the RF collector Creation of additional tasks on HES to transfer these late meter reads to the MDMS. Enable MDMS to process Head End data until 6.00pm for the late meter reads. 							
Cellular RF Collector unreachable due to third party network issue (poor GPRS coverage)	Replace GPRS/2G sim card with 3G sim card to achieve better network availability							

PLC Network								
Issue	Solution							
PLC DCU unreachable due to third party network issue (poor GPRS coverage)	Replace GPRS/2G sim card with 3G sim card (with external router) to achieve better network availability							
LAN interface on PLC DCU Putrajaya was down	Remote restart LAN port interface							

GPRS Network								
Issue	Solution							
59 smart meters using GPRS as backhaul communication not reporting consistently to the HES (49/59 not reporting at all)	Third party network operator increased its backhaul capacity to address network congestion issue in Melaka and Putrajaya							
6 trouble meters not reporting daily until October 2015 due to backlog LP data stored in the meter – data too big to be pushed to HES via GPRS network	Solution proposed – next software upgrade on the current HES will allow staggered retrieval of meter data that will solve this problem							

Lessons to Leverage

AMI Implementation is Far Reaching

- Many business processes are transformed
- Various systems (new and legacy) involved
- Important to setup a separate team/department dedicated to the project

Important to clearly identify business requirements

- Ensure technology chosen supports business requirements (ie real time events, etc)
- Important to find the right balance between performance requirements and commercial impact

Communications Network

Deployment

- Allocate time for appropriate network planning and optimization
- Outage detection and other real time event requirements have an impact on technology and network coverage required
- If using public cellular, work with Telco providers to ensure adequate connectivity and performance

Customer/
Stakeholder acceptance

- Ensure the customer is at the center
- Start engagement activities early
- Get buy-in from Government, Regulators and other stakeholders

Smart Billing Project Full Deployment Overview

Software MDMS & ePORTAL Installation

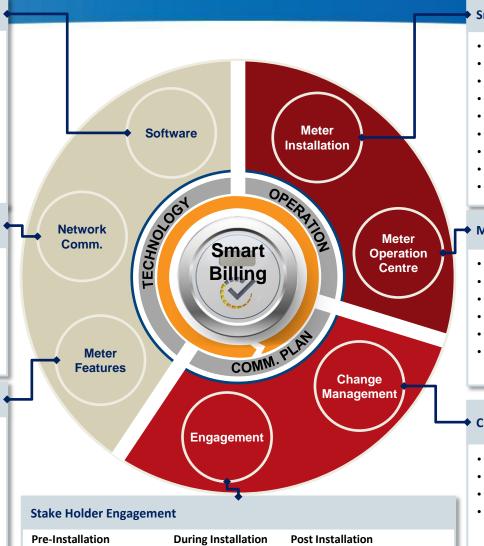
- MDMS Selection & Development (Preproject)
- MDMS Project implementation
- MDM Go Live
- Appointment of system integrator
- Data & server management structure and training

Network Communication, Firewall & Head End System

- RF MESH Network, Firewall & Head End System (including DR)
- Network infrastructure installation
- · TNB Telecomm. Network Upgrading
- Network to support TNB Meter Operations Centre (MOC)
- ICT Control Centers

AMI Features Deliverables

- Auto Billing
- · Validation, Estimation &
- Load Profile
- Supply Automation & Outage Mgmt.
- Non Technical Loses
- Smart Payment
- Time of Use (TOU) Program
- Demand Respond
- Smart /Mobile apps
- Meter Spec.
- Meter Delivery
- · Policy, Regulatory, Guidelines & Standards (Pre-project)



- · Smart Meter Briefing & **Awareness Program**
- Pre-Installation Letter
- Pamphlet
- · Promotion Program

- Door hanger
- Social Media
- Continuous Customer **Engagement Program**
- · Customer Benefit Program
- Customer Reference Center

Smart Meter Rollout

- Roll Out Software
- · Mobility for workforce mgmt.
- Project team
- Tools & Equipment (PPE)
- SJHT revision
- Contractor selection
- Contractor training
- Scrapping procedure
- SOP to contractors

Meter Operation Centre

- · Final design approval
- Tender process
- MOC Renovation work
- Network installation
- Dashboard and system installation
- Training

Change Management

- Meter reader transformation
- Weekly bulletin
- **Business Process Development Exercise**
- **Ownership Communication and** Involvement to Sustain Continuous **Develop and Sustain Capabilities**
- Training and Performance Support
- **Organization and Roles Alignment**
- Half yearly Audit Programs Development

Stakeholder Engagement Plan

"Driving the Green Agenda"

- **Smart Meter colloquium**
- Develop and setup conducive legal framework to support smart meter installations.
- Identify and benchmark utility best practices for task teams.

"Introducing value-added services to consumers"

- **Pre-installation Public mind conditioning programs** (Town hall / media outreach programs / etc)
- **During installation monitor SOP through** installation day survey.
- Post installation introduce value-added services

"Introducing Smart & Efficient Living"

- Strategic Partnership to develop and execute smart lifestyle.
- Appoint as Independent **Customer Advocates to manage** customer issues

- Identify champions for rollout programs
- benchmarking with best utilities.

"Supporting national agenda"

Smart meter familiarization

- Media visit & benchmark to best smart meter deployment
- Cultivate long term relationships / engagement plan with the right people in media

Trilliant

"Strategic Business Partners

- **Strategic Partnership**
- **Cultivate long term & ongoing** relationships
- SOP and SLA

Strong, Caring & Profitable organization"

- Keep them informed.
- Influencers
- **Smart meter familiarization** benchmarking with best utilities.

"Innovative & Dynamics"

"Expanding our services to customers"

Customers

Key

Stakeholders

Staff / Meter **Contractors**

Share

Holders

Vendors

BOD /

Management

MADOLT GROUP

Internal

Regulators

NGO /

Associations

Politicians

TXIOXX.

Media

- Keep all staff informed free flow of information
- Ambassador programs career path
- Vibrant workforce champions to the customers

"Expanding our business solutions"

- **Avoid surprises transparent** reporting
- Maintain goodwill /credibility

 TNB Board of Directors has endorsed the proposed nationwide implementation of Advanced Metering Infrastructure (AMI) of eight (8) million smart meters over five (5) years beginning 2015

