

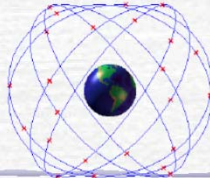
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## The Malaysia Real-Time Kinematic GNSS Network (*MyRTKnet*) in 2010 and Beyond

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## Introduction

- MRT48 and BT68 were the geodetic infrastructures used for geodetic, mapping and cadastral survey for Peninsular Malaysia and East Malaysia respectively
- The introduction of GPS at JUPEM in 1987 led to the establishment of GPS networks in the Peninsular Malaysia, Sabah and Sarawak. The presence of these 'passive' networks serves its purpose relatively well, especially in mapping and engineering applications.
- However, nowadays most precise applications of GPS such as for the establishment of zero-order networks, make use of 'active' GPS stations, for eg. MASS
- With the widespread use of GPS and technological innovations nowadays, real-time GPS applications began to gain even wider group of users



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## Conventional Networks

### 1. *Malayan Revised Triangulation 1948 (MRT48)*

- basic mapping in Peninsular Malaysia since 1948
- evolved from the Old Triangulations and the Primary (Repsold) Triangulation
- consists of 77 geodetic, 240 primary and ~ 900 (2nd/3rd) points
- Modified Everest Ellipsoid, Kertau Datum and Rectified Skew Orthomorphic (RSO) projection

Repsold Triangulation

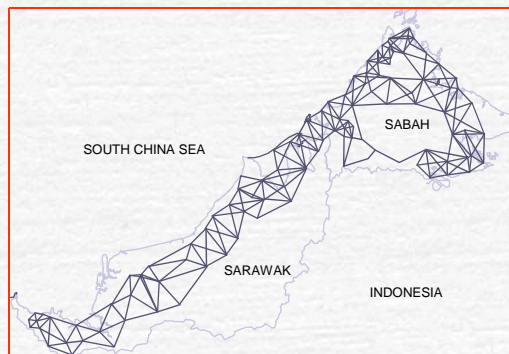


## Conventional Networks

CONTD

### 2. *Borneo Triangulation 1968 (BT68)*

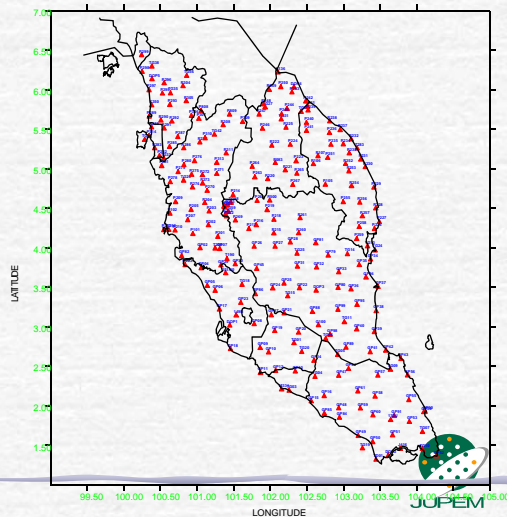
- for mapping in East Malaysia since 1968
- resulting from early readjustment of Borneo in 1948 and 1961
- consists of 145 stations
- Modified Everest Ellipsoid, Timbalai Datum and Rectified Skew Orthomorphic (RSO) projection



## Passive GPS Networks

### 1. Peninsular Malaysia Primary Geodetic Network

- a 1989-93 Swedsurvey/JUPEM project
- 238 points observed in Dec 89 - March 90 & Dec 91 - March 93
- consists of 5 Doppler points, 21 geodetic points, 42 existing points & 189 new points
- fitted to MRT using 6-parameter transformation via 32 common points
- 36 stations re-observed in 1999-2000, 11 of them as check stations for Quality Check (QC) and network verification to bring the datum to GDM2000

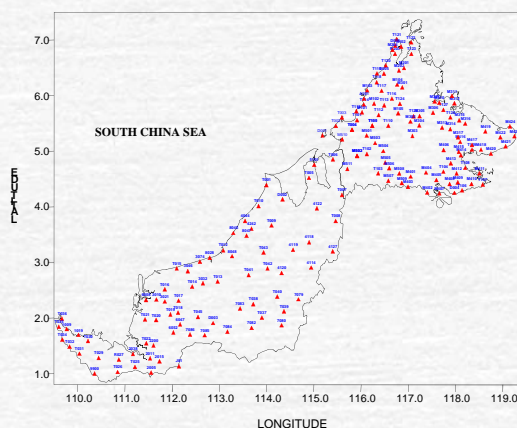


## Passive GPS Networks

CONTD

### 2. East Malaysia Primary Geodetic Network

- a 1995-96 JUPEM project
- 171 points observed in 1995-1996
- consists of 6 Doppler points, 73 geodetic points & 92 new points
- fitted to BT68 using 7-parameter transformation via 49 common points
- 30 stations re-observed in 1999-2000, 10 of them as check stations for Quality Check (QC) and network verification to bring the datum to GDM2000





## Active GPS Network

CONTD



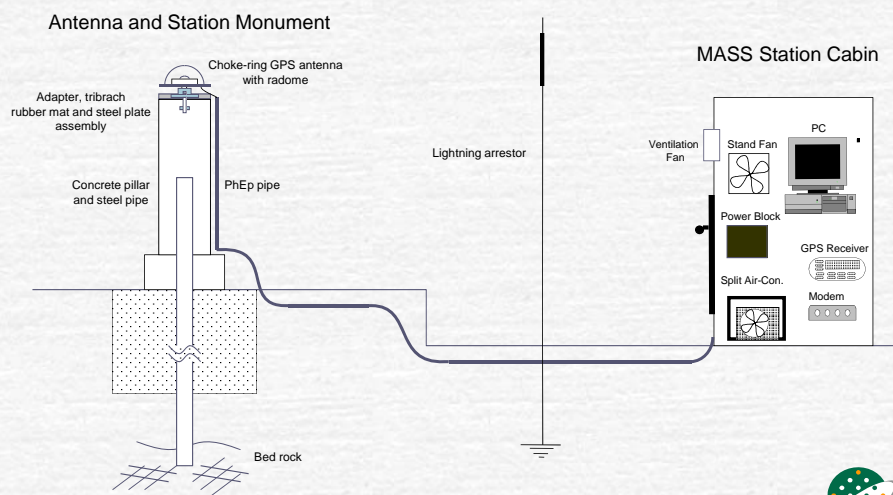
### 1. Malaysia Active GPS System (MASS)

- A nation wide zero-order network of 18 permanent GPS satellite tracking stations
- Began collecting data since 1998
- Products generated include:
  - MASS Station GPS observation data
  - MASS station coordinates and velocities
- For use in various applications such as surveying, navigation, engineering, geodynamic and scientific studies
- The network has been superseded with MyRTKnet beginning from June 2007



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## A Typical MASS Station



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## Active GPS Network

CONTD



### 2. Malaysia Real-Time Kinematic GNSS Network (MyRTKnet)

- A nation of real-time kinematic network of 78 permanent GNSS satellite tracking stations (50 stations in Peninsular Malaysia completed in 2007 and 28 stations in Sabah & Sarawak shall be completed in 2008)
- Began collecting data since 2003
- For use in various applications such as surveying, navigation, engineering, geodynamic and scientific studies



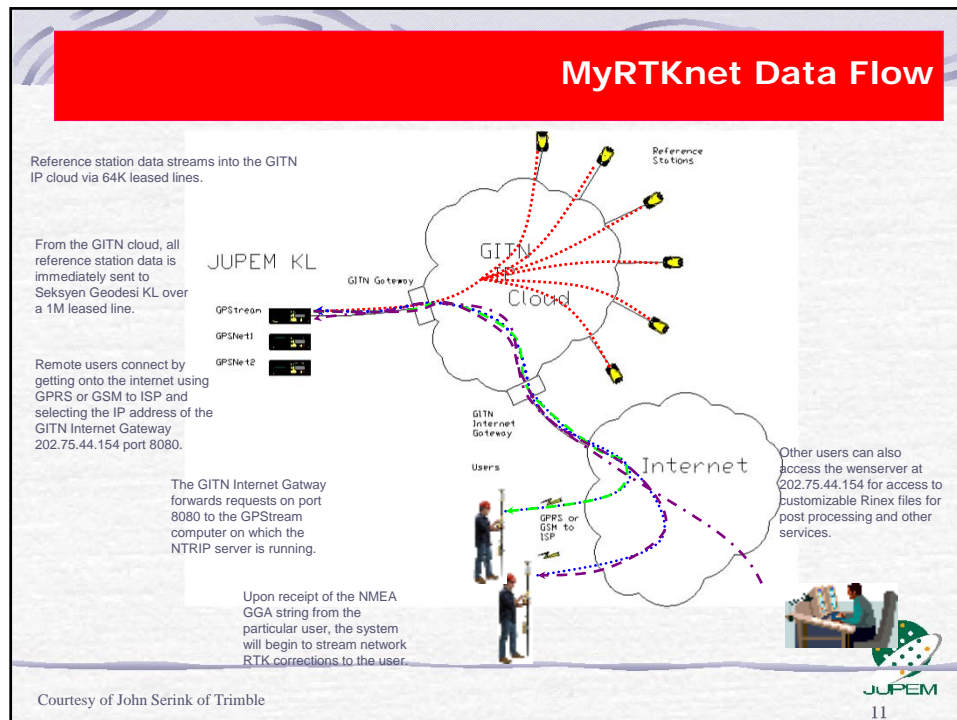
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## MyRTKnet Reference Station Monuments



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## MyRTKnet Data Flow



## MyRTKnet Services

### VRS Correction

- Within the limits of our MyRTKnet Dense Network, MyRTKnet provides VRS GPS corrections with an accuracy of 1 to 3 cm horizontally and 3 to 6 cm vertically.
- Distance dependent errors are considerably minimized with utilization of the MyRTKnet network, thereby achieving increased accuracy and reliability.
- RTK Surveying works at its optimum with a base station network to achieve the pinnacle of RTK Technology production potential.



## MyRTKnet Services

### Single Base Correction

- a) Within the limits of our MyRTKnet Reference Stations, MyRTKnet provides RTK GPS corrections with an accuracy of 1 to 3 cm horizontally and 3 to 6 cm vertically.
- b) Base Station coordinates errors are eliminated with utilization of the MyRTKnet Single Base service, thereby achieving increased accuracy and reliability.
- c) RTK Surveying works at its optimum with a base station which is not limited by range of radio transmission.



## MyRTKnet Services

### Network DGPS Correction

- a) This application is a sub-meter Mapping and Navigation Technology.
- b) The service provided by MyRTKnet Solutions includes data for post-processed positioning and Real Time Correction.
- c) Distance dependant errors are eliminated for users' observations due to MyRTKnet Solutions' array of base station locations.



## MyRTKnet Services

### Static Correction Data

- a) Within the larger limits of the Single Base Station Coverage, MyRTKnet Solutions provides data for post-processing of static survey sessions, enabling positioning in the order of 1 cm or even millimeter recovery limit. The data is provided in the standardized RINEX format and is available via our password protected internet website.
- b) Information with a data rate of 1-60 seconds are available.
- c) Post-processing provides the highest accuracy and is suitable where increased precision is required.



## Accuracy

- ✓ VRS and Single Base RTK
  - $\pm 3$  cm
- ✓ DGPSnet
  - $\pm 20 - 50$  cm
- ✓ Post-process Virtual Rinex Data
  - $< \pm 3$  cm





## MyRTKnet Applications

### Survey / Mapping

- Single receiver positioning, GIS systems Integration, CCS, Map Completion, e-CADASTRE

### Transportation / Recreation / Navigation

- Real Time Positioning
- Recreation eg: Fishing, boating, bike touring, hiking etc.
- Dynamic surveying
- Vehicle tracking/reporting
- Intelligent transport system



### International Collaboration

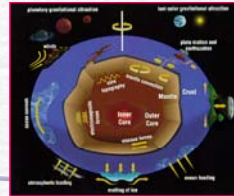
- Support for SEAMERGES and APRGP GPS Campaigns

### Environment

- Tide gauge monitoring
- Auto tide/current measures
- Oil spill containment

### Geodynamics

- Monitoring earth deformations, rotation and variation
- Atmospheric monitoring
- Geodynamic applications



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## MyRTKnet Users

### THE LIST OF REGISTERED USER IN JUPEM

NO	AGENCY	EQUIPMENT BRAND	NUMBER OF USER NAME
1	JUPEM (GEODESI)	TRIMBLE	25
2	JUPEM (KADASTER)	TRIMBLE	144
3	SEKSYEN FOTOUDARA (JUPEM)	TRIMBLE	4
4	JUPEM SARAWAK	TRIMBLE	2
5	SEKSYEN PEMETAAN UTILITI	TOPCON & TRIMBLE	6
6	SEKSYEN TOPOGRAFI SABAH	TRIMBLE	5
7	SEKSYEN TOPOGRAFI SEMENANJUNG	TRIMBLE	2
<b>TOTAL</b>			<b>188</b>



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## MyRTKnet Users *cont*

### THE LIST OF REGISTERED USER IN GOVERNMENT AGENCY

No	AGENCY	EQUIPMENT BRAND	NUMBER OF USER NAME
1	Pusat Remote Sensing Negara	Trimble	1
2	Institut Teknologi Maju	Trimble	1
3	Universiti Teknologi Mara (UiTM)	Topcon	1
4	Institut Penyelidikan Perhutanan Malaysia	Trimble	1
5	Jabatan Mineral & Geosains (Free)	Topcon	1
6	Universiti Sains Malaysia	Topcon	1
7	Jabatan Perhutanan Negeri Selangor	Topcon	1
8	MaCGDI (Free)	Topcon	4
9	INSTUN (Free)	Trimble	6
<b>TOTAL</b>			<b>17</b>



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## MyRTKnet Users *cont*

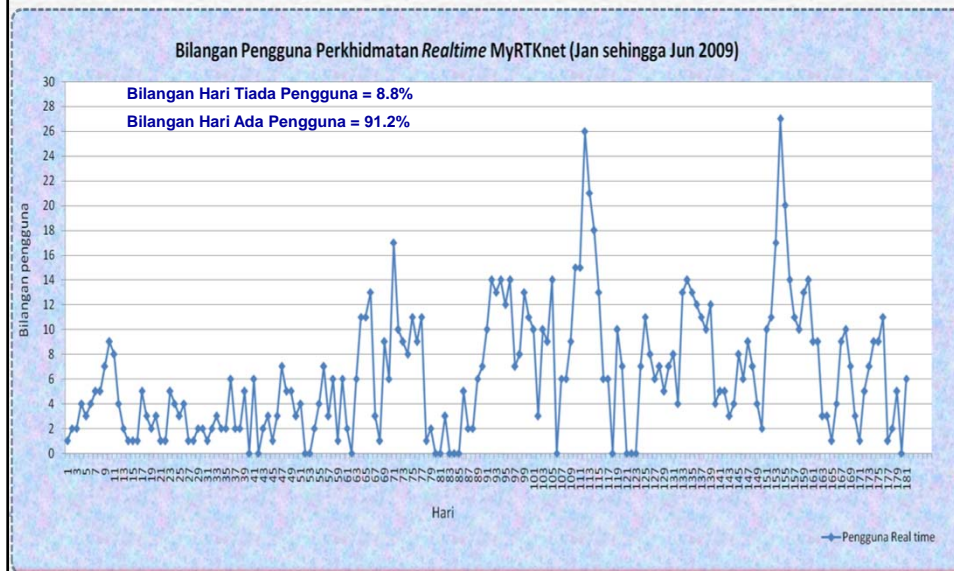
### THE LIST OF REGISTERED USER IN PRIVATE AGENCY

NO	COMPANY	EQUIPMENT	NUMBER OF USER NAME
1	S.O Survey Consultants	Unistrong E650	1
2	PJS Utilities- Z&I JV	Topcon	1
3	Top System Sdn Bhd	Leica	1
4	Jalal Johari Consultants	Leica	1
5	Geometra Surveys sdn Bhd	Unistrong E650	1
6	Pristine Dragon Sdn Bhd	Unistrong E650	1
7	Jurukur Setia Sdn Bhd	Topcon	1
8	Jurukur Radian	Unistrong E650	1
9	Jurukur Amirudin	Unistrong E650	1
10	Hydronav Navigation (M) sdn Bhd	Trimble	3
11	JURUKUR SEJATI	Unistrong E650	1
12	Jurukur Hashim Serantau	Unistrong E650	1
13	SAJ Holdings Sdn Bhd	Leica	1
14	Jurukur Putra	Unistrong E650	1
15	Ranhill Water Services Sdn Bhd	Trimble	2
16	Jurukur Perunding Services Sdn Bhd	Unistrong E650	1
17	Roslan Ukur Runding	Unistrong E650	1
18	Jurukur Khoo	Topcon	1
19	SYARIKAT AYOB BIN SAUD	Unistrong E650	1
20	Jurukur Mutiara	Topcon	1
21	Yeoh Hin Kok	Leica	1
<b>TOTAL</b>			<b>24</b>

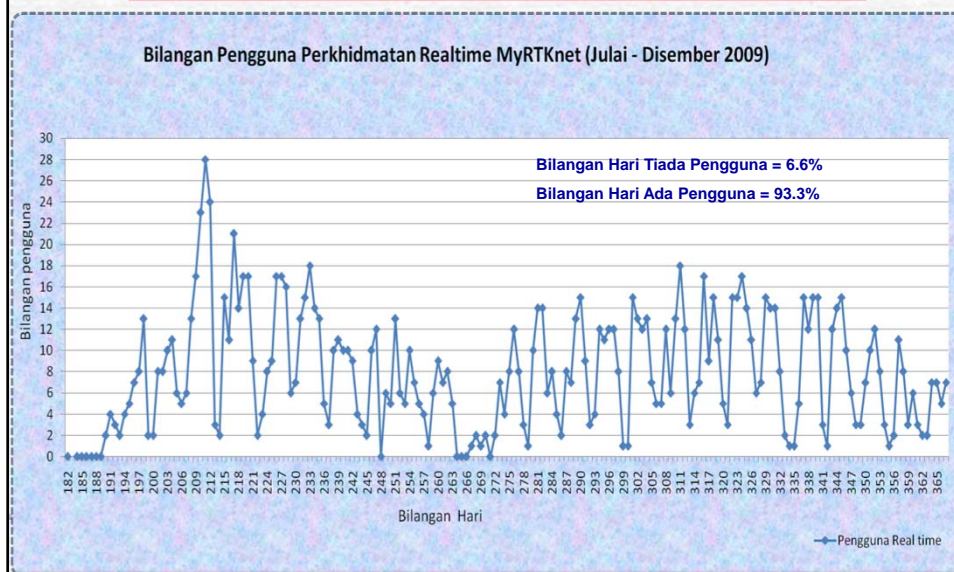


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## MyRTKnet Real-Time user from Jan – Jun 2009

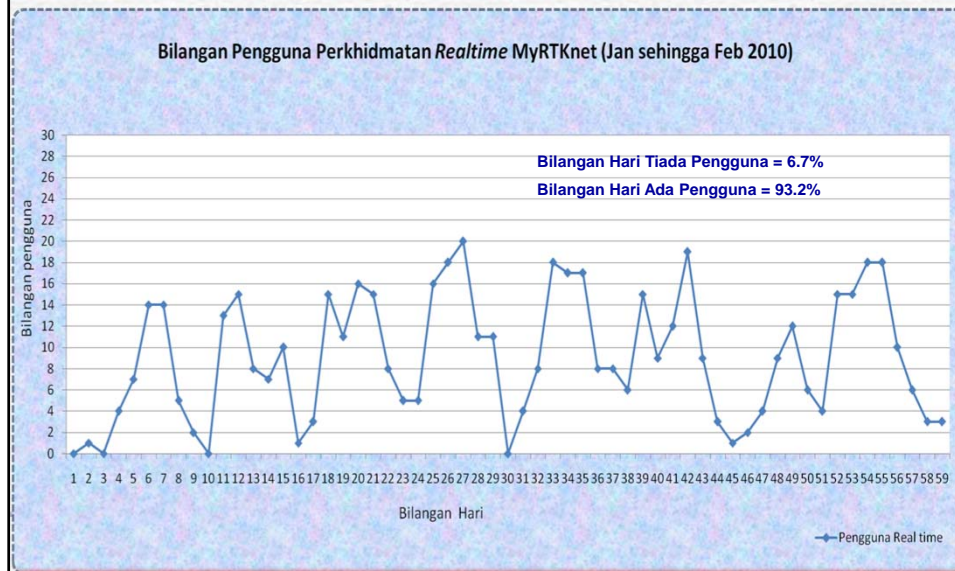


## MyRTKnet Real-Time user from Jul – Dec 2009

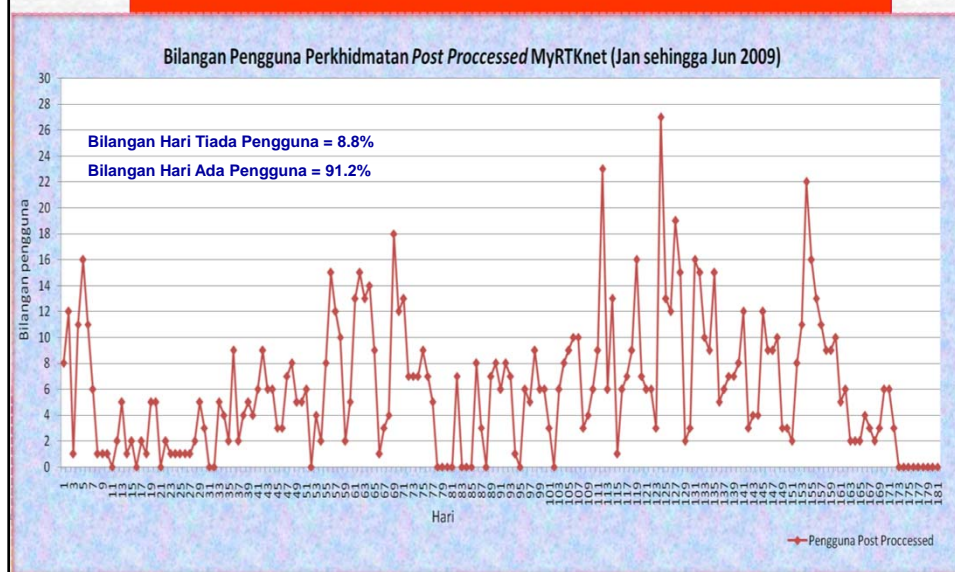




## MyRTKnet Real-Time user from Jan – Feb 2010

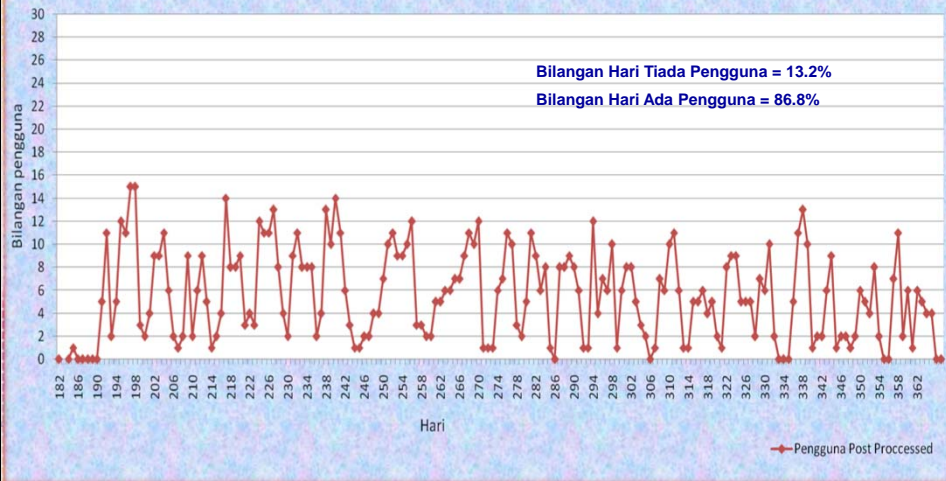


## MyRTKnet Post-Processing user from Jan – Jun 2009



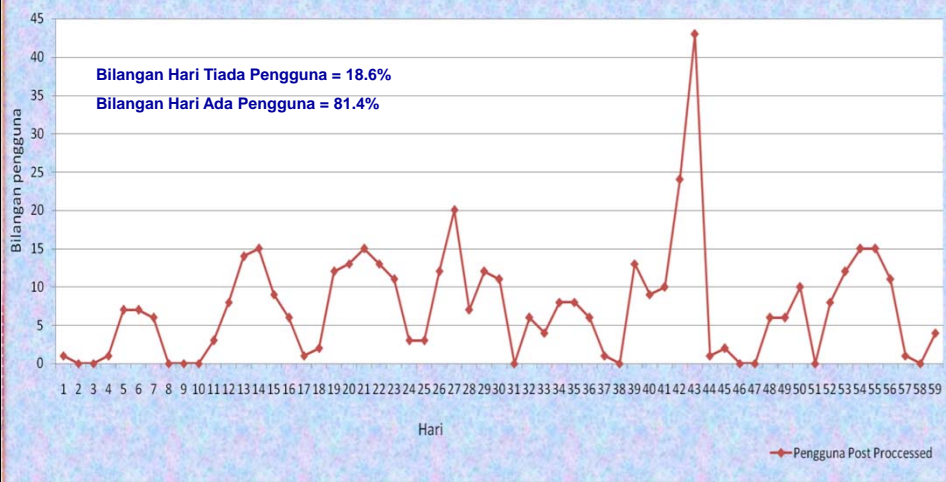
## MyRTKnet Post-Processing user from Jul – Dec 2009

Bilangan Pengguna Perkhidmatan Post Processed MyRTKnet (Julai - Disember 2009)



## MyRTKnet Post-Processing user from Jan – Feb 2010

Bilangan Pengguna Perkhidmatan Post Processed MyRTKnet (Jan sehingga Feb 2010)



## MyRTKnet CHARGES

- a) Registration Fee:
- Government Department – RM 500
  - Private sector – RM 1,000
- b) Annual Subscription of RM 3,000 for the services:
- VRS Correction
  - Single Base Correction
  - Network DGPS Correction
- c) Post-Process Data:
- Virtual RINEX Data - RM 15 per minute
  - RINEX Data - RM 10 per hour



## Maintenance Cost

- ✓ 2008 = RM 379,000.00
- ✓ 2009 = RM 320,711.00

## MyRTKnet Collection of Revenue in 2009

RM 133, 720.00





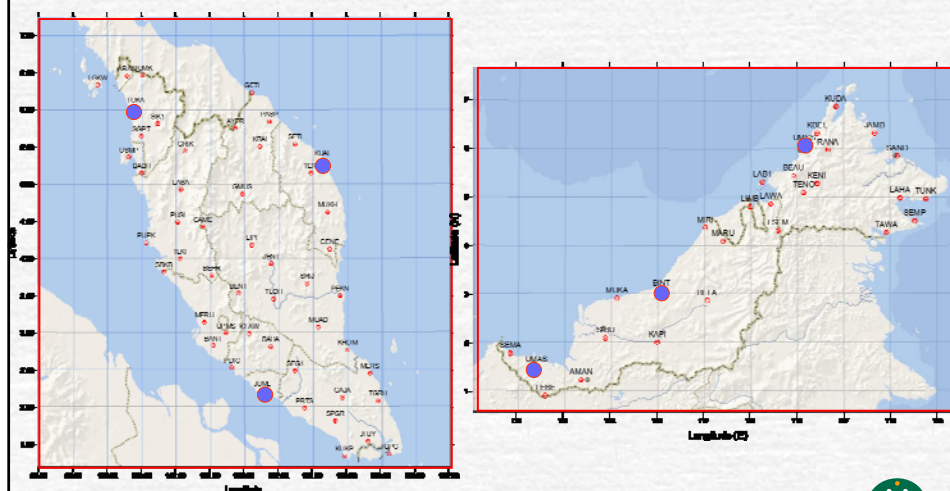
## CONCLUSION

- ✓ The introduction of MyRTKnet to surveying and mapping communities has opened up new applications and vast possibilities to the world of navigation and positioning in Malaysia.
- ✓ Currently MyRTKnet with 78 stations and spacings of between 30 to 120 km is providing real-time corrections with a latency of less than one second using Virtual Reference Station (VRS) technique.
- ✓ Under the 10<sup>th</sup> Malaysia Plan (2011-2015), an additional of another 70 stations is proposed with emphasis on the public delivery system



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## CONTRIBUTION TO IGS



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