KURSUS COORDINATED CADASTRAL SYSTEM (CCS)
INSTITUT TANAH & UKUR NEGARA
BEHRANG, PERAK

PILOT PROJECT

COORDINATED CADASTRAL SYSTEM

OLEH:
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Development of Implementation Plan of CCS for Malaysia: Research Objectives

The main objective of this study is:

i. **To develop and realize a geocentric based Cadastral Control Data Base**
ii. **To establish methodology for the Development of National Digital Cadastral Data Base**
iii. **To develop techniques for integrating the digital Cadastral Data with Mapping Data**
iv. **To address the Institutional Issues on the Implementation of CCS.**

DEFICIENCIES IN THE PRESENT CADASTRAL SYSTEM

General – problems associated with cadastral survey system:

- General Deficiencies in the Cadastral Survey System
  - "Whole to the Part" concept not utilized.
  - Survey errors – not properly distributed and adjusted.
  - Use of running traverses.
  - Some earlier surveys – uncoordinated.
  - Use of natural feature boundaries.
- Difficulties in Using Different Projection Systems
  - Problems of data integration.
  - Complications when survey crosses from one State to another.

Cont…

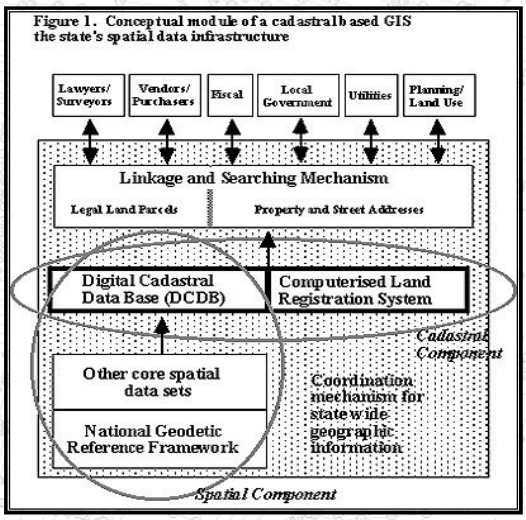
- Incompatibility with Current Technologies
  - Systems provided by new technologies – increasingly coordinate based
  - Cadastral survey system based on parcel dimensions and relative locations. Therefore, not in a position to take advantage of new technologies.
- Inadequacy of the DCDB
  - Cadastral parcels – one of the core data sets for Malaysian LIS/GIS.
  - DCDB – the most sought after information source. Unfortunately, has flaws propagated through deficiencies of the cadastral survey system.
- Obsolete Rules and Regulations
  - Increasing number of provisions superseded by advances and changes in technology.

CONCEPT OF COORDINATED CADASTRE

Adapted from Williamson (1996)

i) **First Version** of a coordinated cadastre is where the complete cadastral framework is based on coordinates determined by ground survey that is referred to a coordinate system. The said survey is used to define, describe, and re-define parcel boundaries, and its outcome shown graphically on a cadastral map, which in its digital form would form the Digital Cadastral Data Base (DCDB). The conduct of ground surveys and related processes usually result in an accurate cadastral map or DCDB and towards that fulfillment, requires sufficient density of control.

ii) **Second Version** is largely similar with the above description, the only difference being that the coordinates as determined are given legal significance. In this case the coordinates take precedence over boundary marks in the redefinition of boundaries.



Conceptual Module of A Cadastral Based Spatial Data Infrastructure

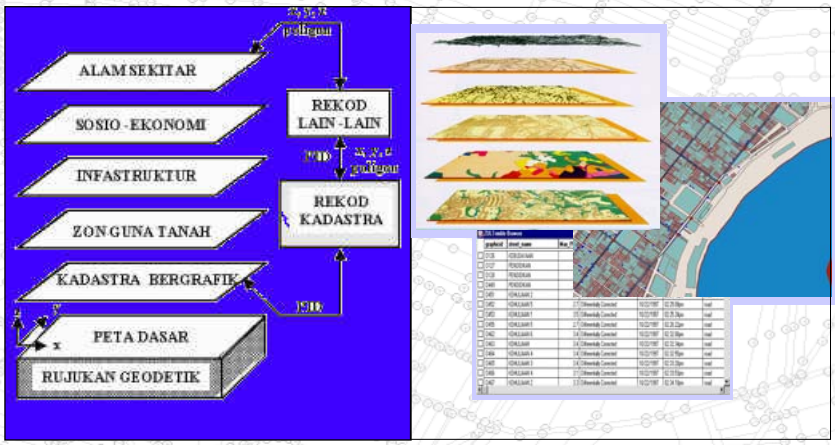
COORDINATED CADASTRAL SYSTEM (CCS) STATEMENT FOR MALAYSIA

- The coordinate-based cadastral system simply means that coordinates are given greater emphasis. Bearings and distances are, therefore, only a means by which the final adjusted coordinates are derived.
- This concept allows: (i) the availability of abundance of survey control stations whose coordinates are given with respect to a geocentric datum; (ii) the adoption of a single coordinate projection system for the whole country; and (iii) the application of a rigorous network adjustment technique on survey accurate data so that a unique pair of coordinates and their respective accuracy information can be defined for every cadastral boundary marks.

THE IMPORTANCE OF THE STUDY

- Coordinated Cadastral System (CCS) – a cadastral reform programme to improve the cadastral survey system. Implementation of CCS – *feasible*, according to results of feasibility study.
- Long term benefits to be accrued from CCS implementation:
  - Utilizing "Whole to the Part" methodology.
  - Facilitate use of rapid data acquisition, storage, processing & management techniques.
  - Improvement of the cadastral survey system.
  - Provides common reference system.
  - Facilitate data integration.
  - CCS – basis for / underpins a good LIS.
  - Others

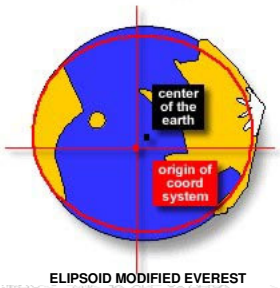
CCS –UNDERPINS A GOOD LAND INFORMATION SYSTEM (LIS)



Coordinate –based LIS facilitate data integration process in GIS Environment

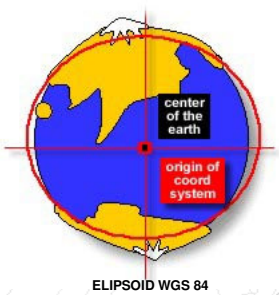
BEFORE INOVATION | AFTER IN0VATION

LOCAL GEODETIC DATUM



ELIPSOID MODIFIED EVEREST
ORIGIN DI KERTAU

GEOCENTRIC DATUM



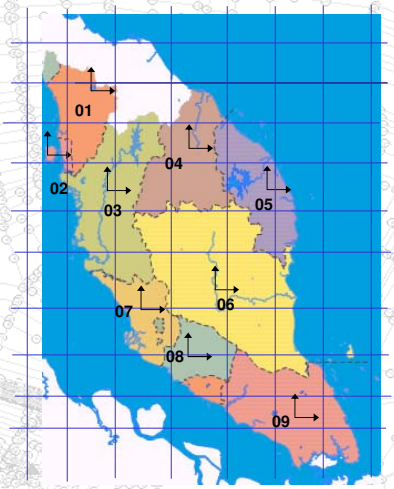
ELIPSOID WGS 84
ORIGIN DI PUSAT BUMI

Integrasi data spatial secara global dapat dilaksanakan

BEFORE INOVATION

UNJURAN CASSINI

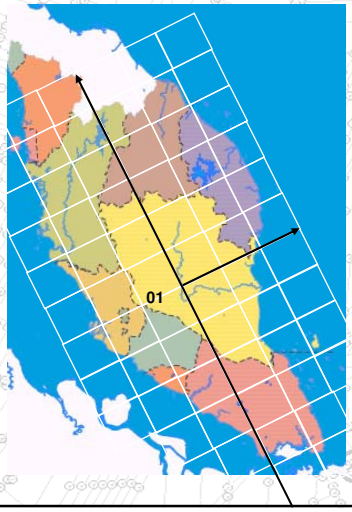
9 titik rujukan yang berbeza bagi setiap negeri



AFTER INOVATION

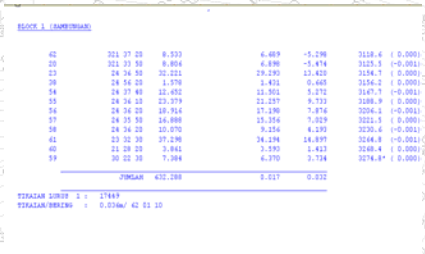
UNJURAN RSO

Origin yang sama bagi keseluruhan



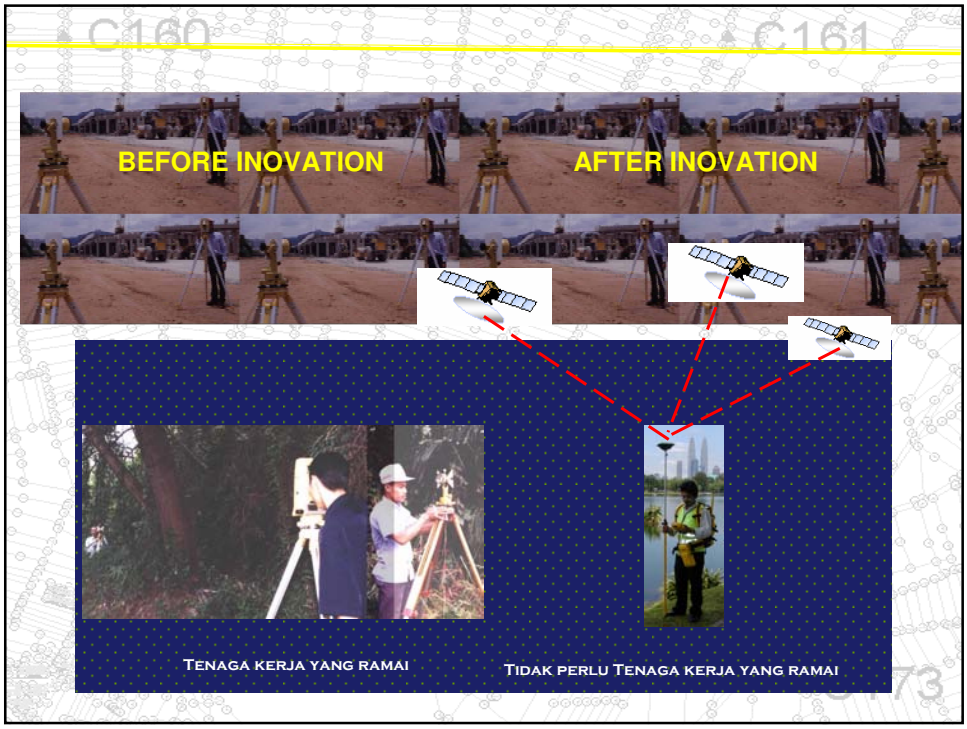
BEFORE INOVATION

AFTER INOVATION



Ketepatan dan kejituan yang kurang, dengan taburan seliseh yang tidak seragam

Ketepatan dan kejituan yang lebih tinggi dengan taburan seliseh yang seragam


C160
C161
BEFORE INOVATION
AFTER INOVATION
TENAGA KERJA YANG RAMAI
TIDAK PERLU TENAGA KERJA YANG RAMAI
C173


C160
C161
BEFORE INOVATION
AFTER INOVATION
Koodinat plotan tidak dilaras secara keseluruhan
Koodinat terlaras dihasilkan
C173

STUDY FRAMEWORK

IMPLEMENTATION OF CCS

TECHNICAL ISSUES

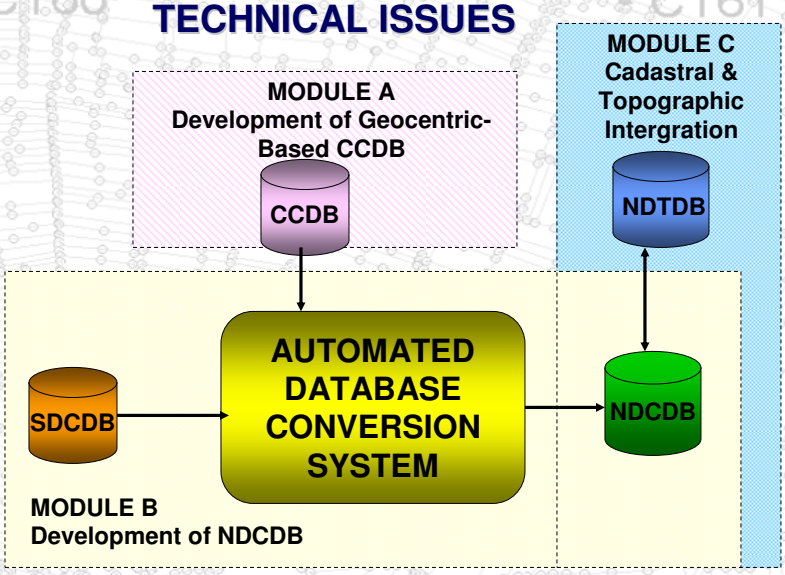
- Development of Geocentric Based Cadastral Control Data Base (CCDB)
- Development of National Digital Cadastral Data Base (NDCDB)
- Integration of National Digital Cadastral Data Base (NDCDB) & National Digital Topography Data Base (NDTDB)

INSTITUTIONAL ISSUES

- Organizational
- Legal
- Economic
- Social

Implementation of CCS

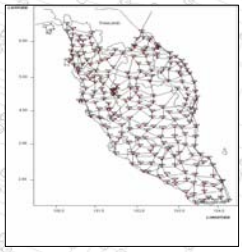
TECHNICAL ISSUES



SDCDB - State Digital Cadastral Data Base
NDCDB - National Digital Cadastral Data Base
CCDB - Cadastral Control Data Base
NDTDB - National Digital Topographic Data Base

MODULE A: Development of A Geocentric-Based Cadastral Control Database

Zero Order Geodetic GPS Network (MASS Stations)



First Order Geodetic GPS Network (30km Network)

Cadastral Control Infrastructure
- 5km, 2.5km,0.5km
- Ties to Cadastral Network

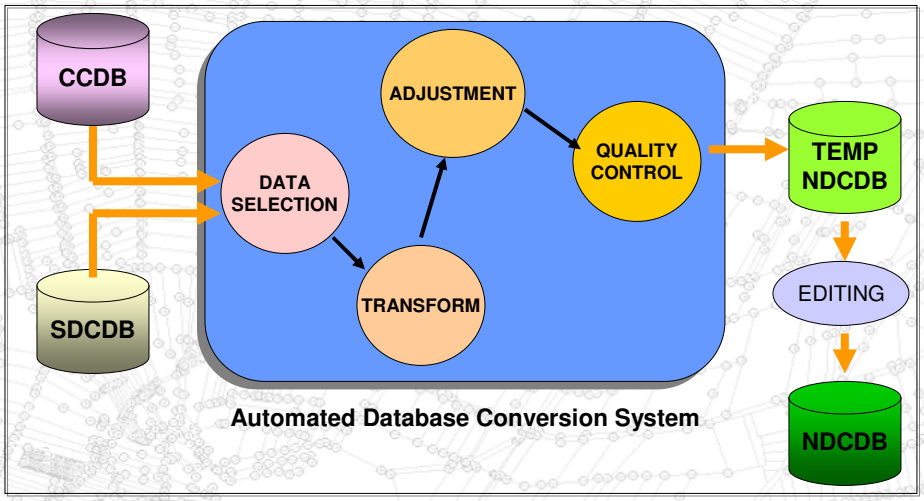
Computation of Geocentric RSO Coordinates

Design & Analysis Of CCDB

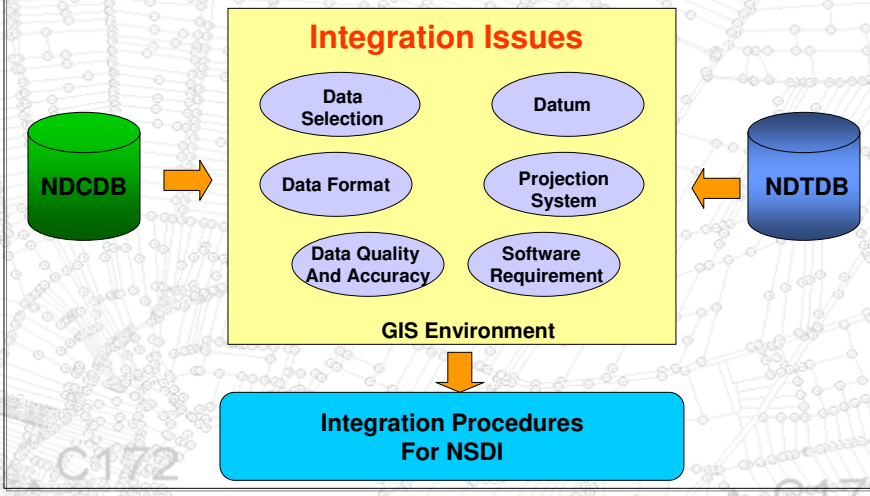
Cadastral Control Database

CCDB

MODULE B: Development of A National Digital Cadastral Database

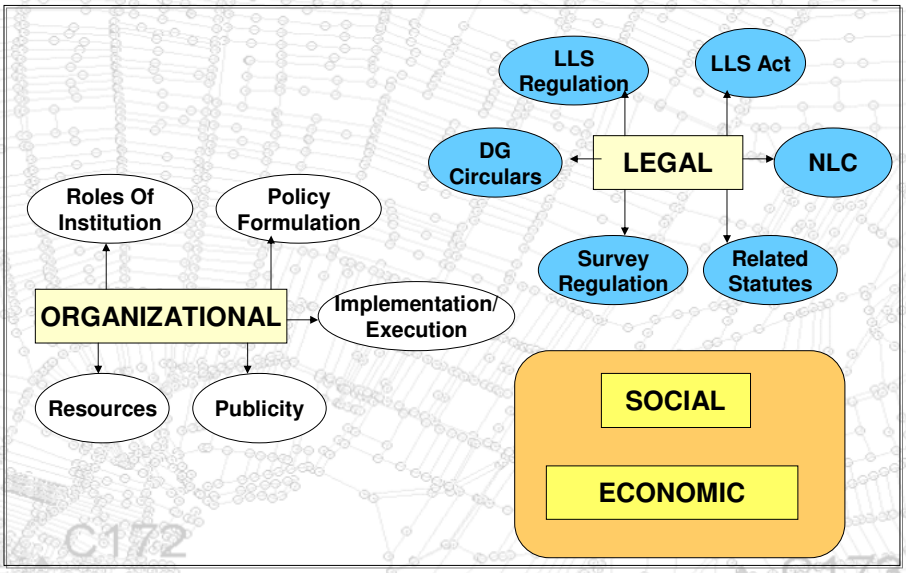


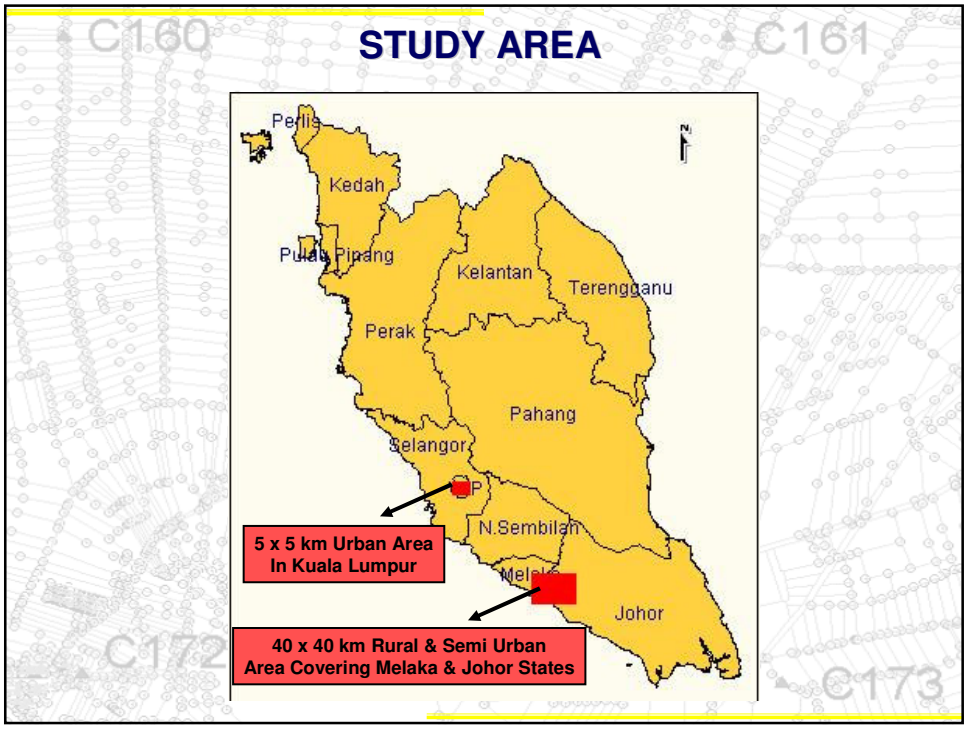
MODULE C : Techniques For Integrating The Digital Coordinated Cadastral Data With Mapping Data

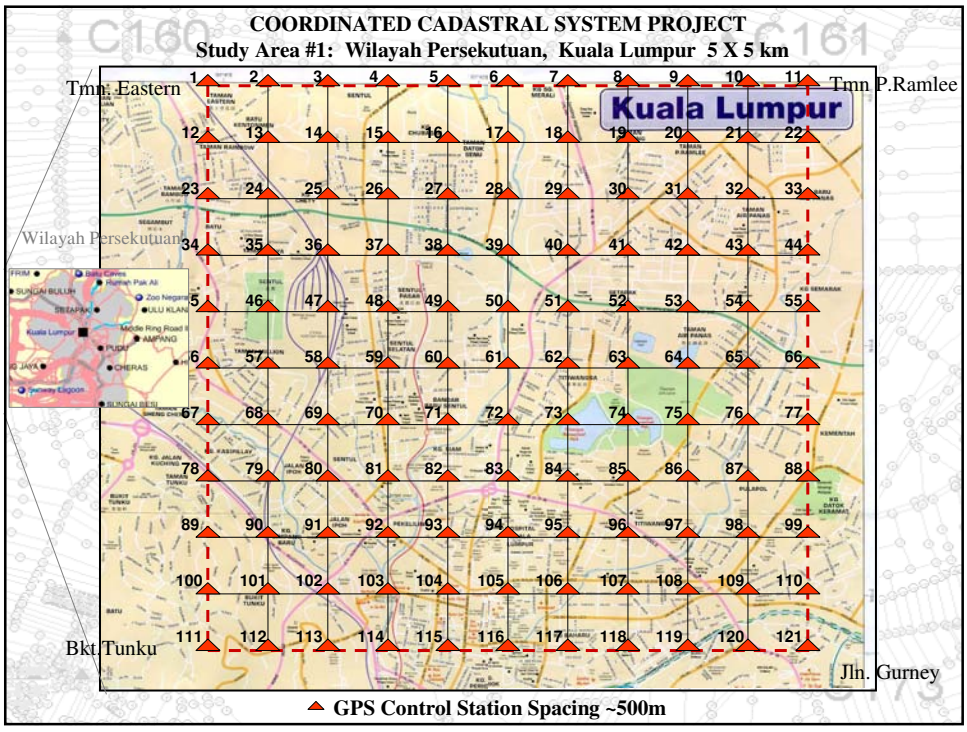


IMPLEMENTATION OF CCS

Institutional Issues (Module D)



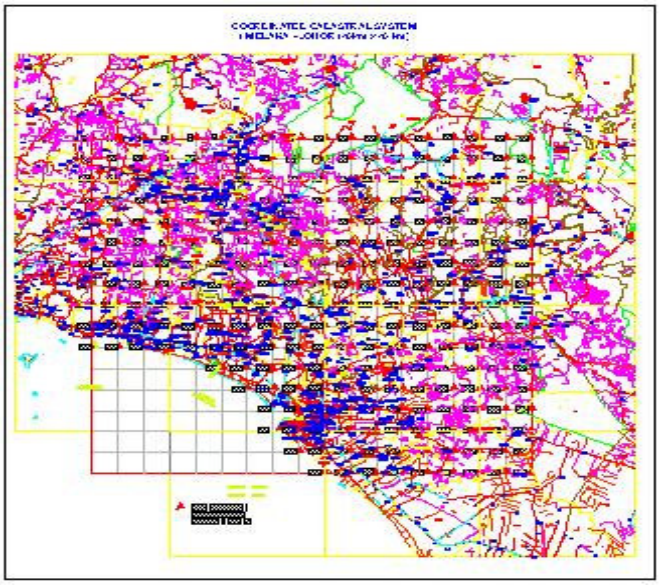

STUDY AREA
Perlis
Kedah
Pulau Pinang
Kelantan
Terengganu
Perak
Pahang
Selangor
KL
N.Sembilan
Melaka
Johor
5 x 5 km Urban Area
In Kuala Lumpur
40 x 40 km Rural & Semi Urban
Area Covering Melaka & Johor States


COORDINATED CADASTRAL SYSTEM PROJECT
Study Area #1: Wilayah Persekutuan, Kuala Lumpur 5 X 5 km
Tmn. Eastern
Tmn P.Ramlee
Kuala Lumpur
Wilayah Persekutuan
Bkt.Tunku
Jln. Gurney
GPS Control Station Spacing ~500m

COORDINATED CADASTRAL SYSTEM PROJECT
Study Area #2: Melaka – Johor 40 X 40 km

U 270,000.000 m
T 480,000.000 m

U 270,000.000 m
T 540,000.000 m



Ulu Kemengkang
Kesang

Bkt Serampang

Kg Pt Payong
Parit Bakar

Parit Jawa &
Seri Menanti

U 200,000.000 m
T 480,000.000 m

U 200,000.000 m
T 540,000.000 m

▲ **GPS Control Station Spacing ~2.5 km**

Cadastral Control Infrastructure Development

PHASE	MELAKA	REMARKS	JOHOR	REMARKS
Reconnaissance*	Mac 2001	131 of 132 stations have been identified	Mac 2001	89 of 132 stations have been identified
Monumentation*	Mac 2001	Standard Traverse, Pipe and Cadastre mark	Mac 2001	Standard Traverse, Pipe and Cadastre mark
GPS Field Observation *	19 Mac – 7 April	Jasin, Melaka Tengah, Alor Gajah	7 Apr – 14 April	Muar
GPS Processing and Results*	Results Delivered: 3/5/2001			

** Note: Geodesy Section, JUPEM Melaka and JUPEM Johor*

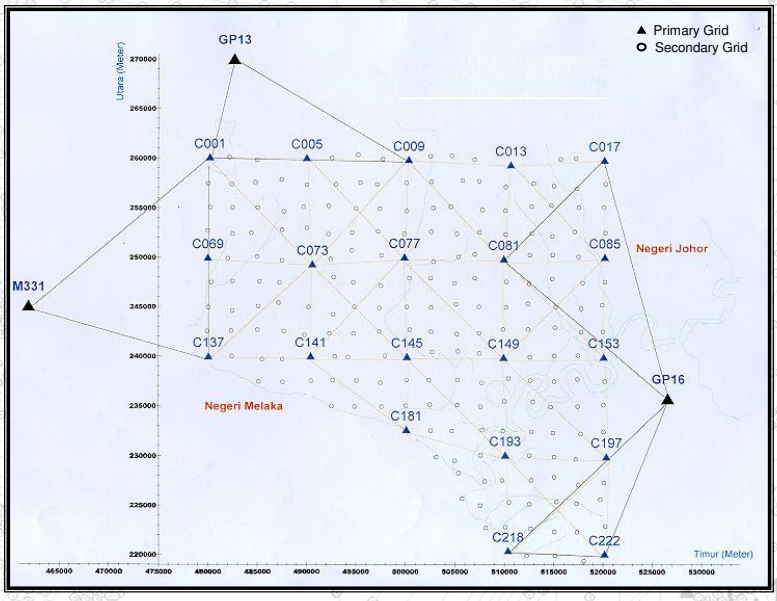
Cont...

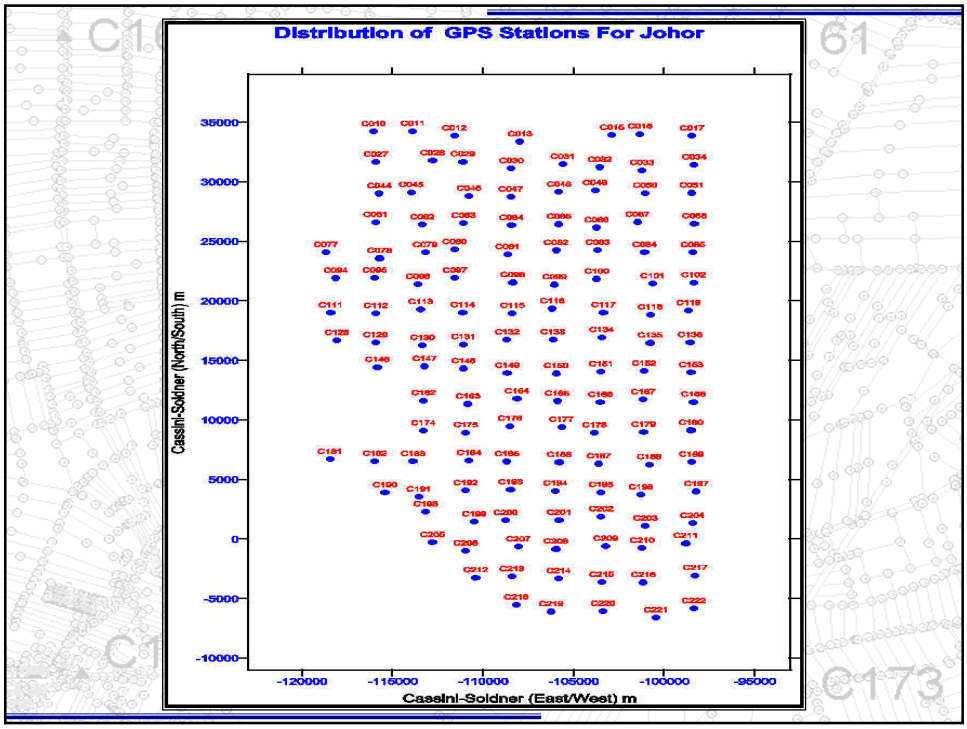
GPS Field Observation For Study Area # 2 (Melaka – Johor)

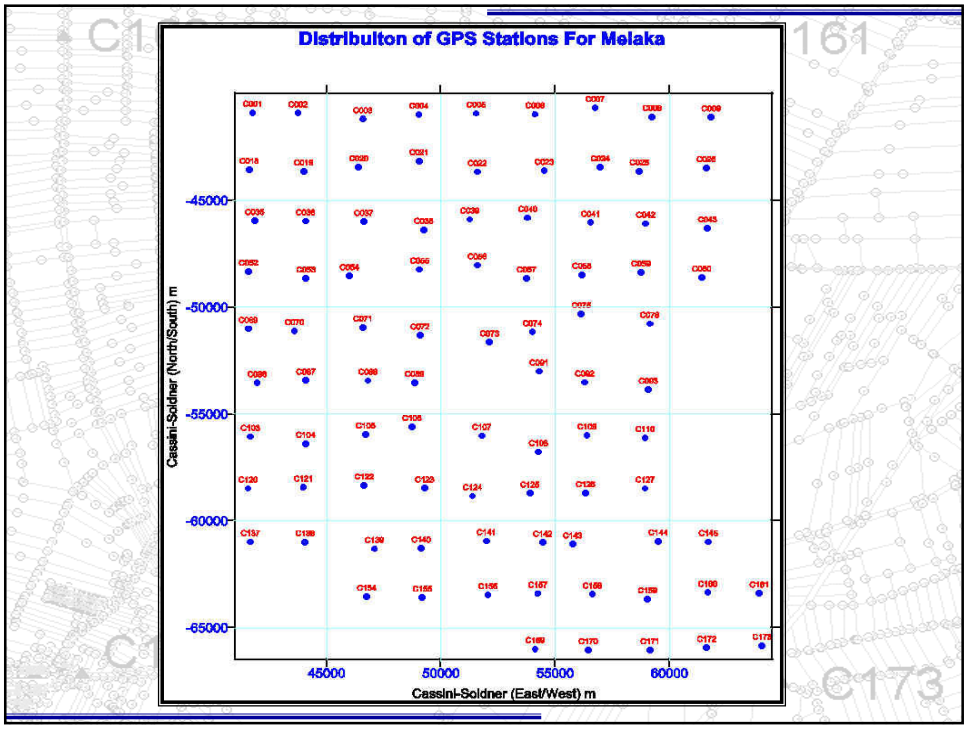
- GPS Network Grid consists of
  - Primary Grid (10 kmx 10 km)
  - Secondary Grid (2.5 km x 2.5 km

	Primary Grid	Secondary Grid
Observation Technique	Static Reference Stations: M331 (Tg.Keling, Melaka), GP13 (Tebong, Melaka), GP16 (Pagoh, Johor)	Rapid Static : Reference Stations Primary Grid Points
Observation Time	90 minutes	15-30 minutes
Total of Stations	23	197
GPS Processing Software	Trimble Geomatic Office V1.1	Trimble Geomatic Office V1.1
Adjustment Software	Geolab 2.4c	Trimble Geomatic Office V1.1

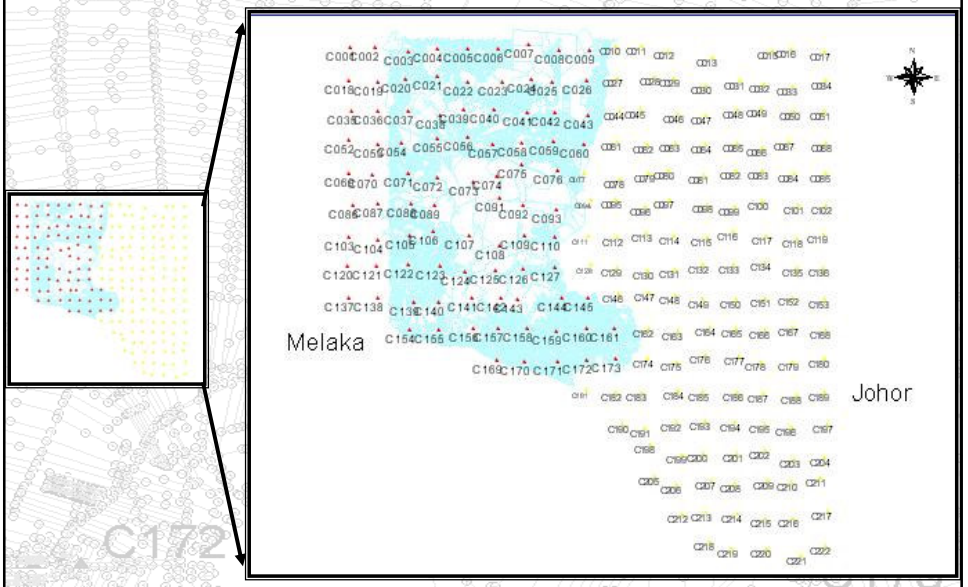
GPS Network Grid For Study Area # 2: Melaka




Distribution of GPS Stations For Johor
Cassini-Soldner (North/South) m
Cassini-Soldner (East/West) m
35000
30000
25000
20000
15000
10000
5000
0
-5000
-10000
-120000
-115000
-110000
-105000
-100000
-95000


Distribulton of GPS Stations For Melaka
Cassini-Soldner (North/South) m
Cassini-Soldner (East/West) m
-45000
-50000
-55000
-60000
-65000
45000
50000
55000
60000

Cadastral Control Infrastructure For Study Area # 2



Statistics of GPS Derived Coordinates From Two Base Stations

Table 1. Summary of Coordinates Differences : Melaka

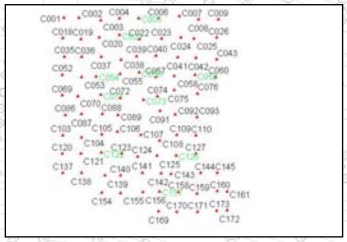
	North/South (cm)	East/West (cm)
Maximum	2.7	3.7
Minimum	0.1	0.1

Table 2. Summary of Coordinates Differences : Johor

	North/South (cm)	East/West (cm)
Maximum	3.7	3.7
Minimum	0.2	0.1

Note: i) Tables 1 and 2 conclude that coordinates differences are below 4 cm tolerance (as discussed)

Cadastral Control Database (CCDB)

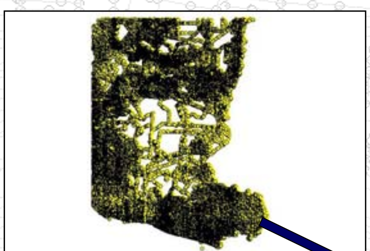


Attributes of Gps.shp

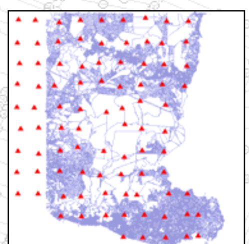
Shape	Pointkey	Gps_stn	R_east	R_north	Rso_x	Rso_y	Wgs84_lat	Wgs84_lon
Point	782020037	CCS154	46749.326	-63575.039	485141.675	237408.741	2.1457302372	102.3621242312
Point	462020620	CCS139	47065.365	-61426.072	485461.497	239557.095	2.1651633328	102.3649706606
Point	7017980	CCS071	46584.652	-50935.386	484999.366	250048.237	2.2600355191	102.3606750721
Point	10PA9232	CCS088	46810.088	-53426.524	485220.365	247556.806	2.2375067100	102.3626956112
Point	106013766	CCS054	45993.213	-48528.110	484412.230	252456.457	2.2818068702	102.3553637384
Point	34PA9268	CCS020	46321.184	-43433.928	484749.356	257549.793	2.3278745590	102.3583250102
Point	45PA24796	CCS037	46501.690	-45966.720	484925.302	255016.812	2.3049691639	102.3599415675
Point	16PA8052	CCS003	46579.768	-41184.775	485011.999	259790.353	2.3482138263	102.3606555261
Point	83172958	CCS140	49133.233	-61279.612	487529.666	239699.933	2.1664827064	102.3835607633
Point	551721516	CCS155	49147.567	-63587.017	487539.956	237392.582	2.1456160132	102.3836836421
Point	5157623	CCS156	51983.498	-63459.761	490376.169	237514.900	2.1467594447	102.4091781655
Point	2191023649	CCS141	51995.255	-60910.021	490392.370	240056.512	2.1697452152	102.4092908209
Point	11PA10920	CCS169	54113.519	-65992.770	492501.822	234970.295	2.1230467309	102.4283192607
Point	10104385	CCS157	54238.849	-63394.050	492631.672	237576.692	2.1473474579	102.4294533289
Point	931020653	CCS142	54453.747	-61008.260	492850.734	239961.993	2.1689223411	102.4313920423
Point	71020653	CCS143	55760.097	-61084.077	494156.964	239883.907	2.1682329774	102.4431357151
Point	35PA23284	CCS170	56564.970	-65990.021	487087.893	245485.661	2.1238646389	102.4503568350
Point	116023939	CCS106	48681.268	-55494.449	487202.499	247481.448	2.2188011155	102.3795125857
Point	30023946	CCS089	48792.335	-53498.376	487556.835	249659.121	2.2368519857	102.3805162657
Point	28019454	CCS072	49142.798	-51319.977	490560.970	249233.907	2.2565511189	102.3836727039
Point	155PA2875	CCS073	52147.681	-51739.891	492651.363	247958.866	2.2527456224	102.4106864721
Point	117PA23249	CCS091	54240.330	-53011.314	492361.060	249769.996	2.2412419030	102.4294964111
Point	128PA23249	CCS074	53946.823	-51200.588	492361.060	249769.996	2.2576177224	102.4268629032
Point	2PA20649	CCS108	54263.375	-56762.278	492667.800	244208.082	2.2073207013	102.4296927934

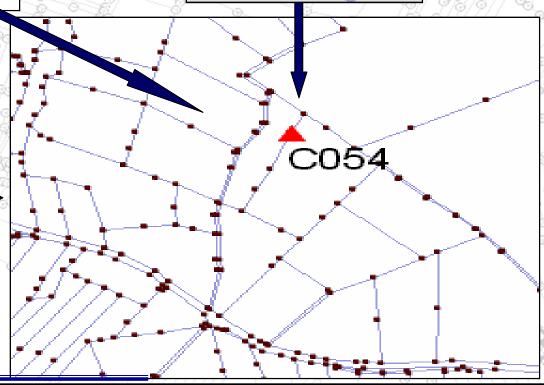
Overlay and Identify Stages

DCDB

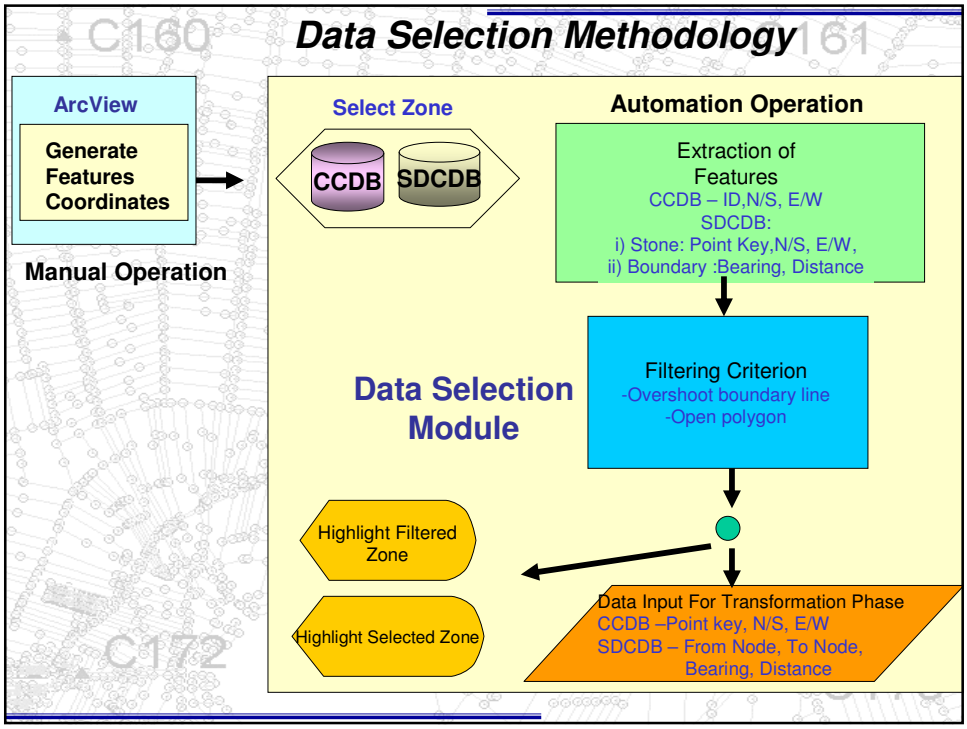


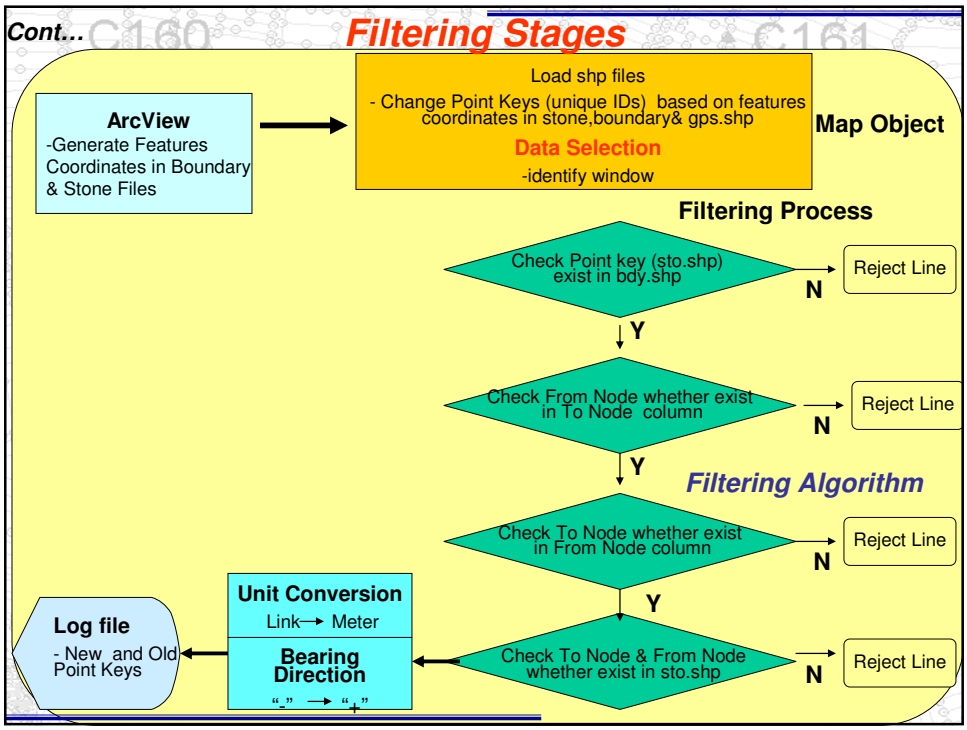
CCDB



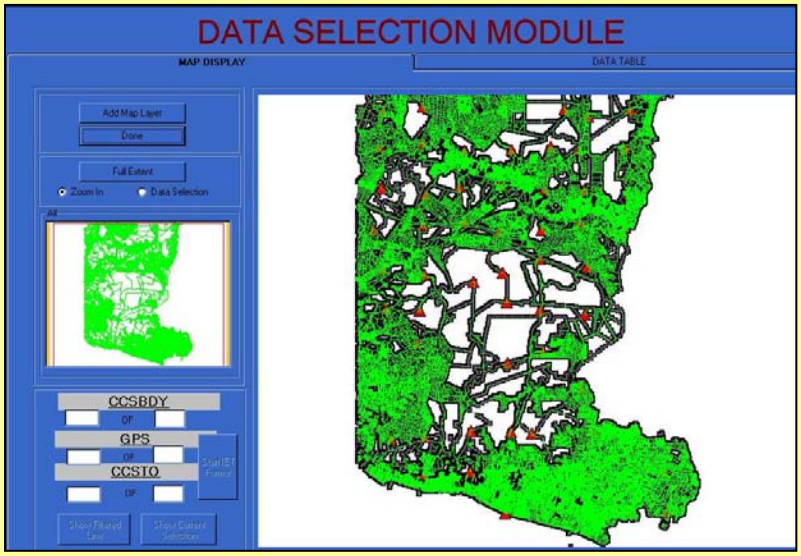


Identify GPS Control Stations in Cadastral Database (DCDB)


Data Selection Methodology
ArcView
Generate Features Coordinates
Manual Operation
Select Zone
CCDB
SDCDB
Automation Operation
Extraction of Features
CCDB – ID,N/S, E/W
SDCDB:
i) Stone: Point Key,N/S, E/W,
ii) Boundary :Bearing, Distance
Data Selection Module
Filtering Criterion
-Overshoot boundary line
-Open polygon
Highlight Filtered Zone
Highlight Selected Zone
Data Input For Transformation Phase
CCDB –Point key, N/S, E/W
SDCDB – From Node, To Node, Bearing, Distance

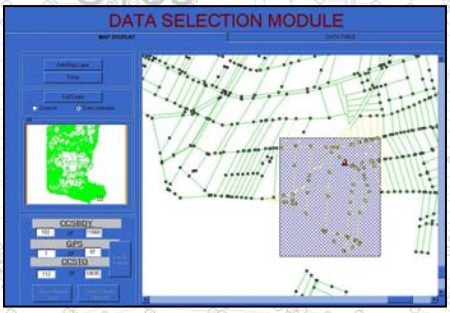

Cont...
Filtering Stages
ArcView
-Generate Features Coordinates in Boundary & Stone Files
Load shp files
- Change Point Keys (unique IDs) based on features coordinates in stone,boundary& gps.shp
Data Selection
-identify window
Map Object
Filtering Process
Check Point key (sto.shp) exist in bdy.shp
N
Reject Line
Y
Check From Node whether exist in To Node column
N
Reject Line
Y
Filtering Algorithm
Check To Node whether exist in From Node column
N
Reject Line
Y
Check To Node & From Node whether exist in sto.shp
N
Reject Line
Unit Conversion
Link→ Meter
Bearing Direction
"-" → "+"
Log file
- New and Old Point Keys

Data Selection Module

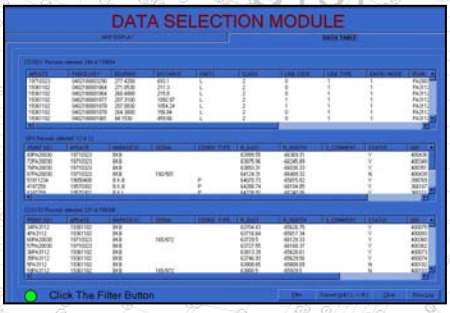


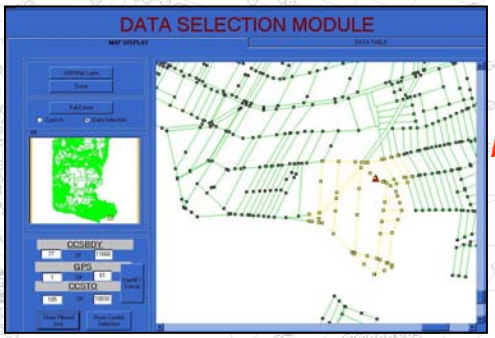
Cont…

Selection Process…



Filtering Process…

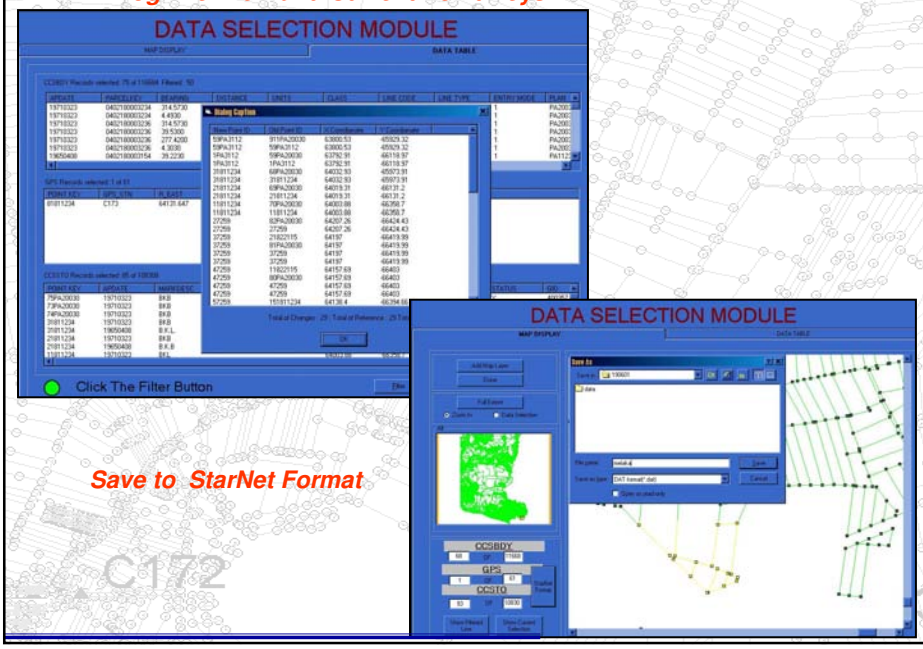




Filtered Zone…

Cont…

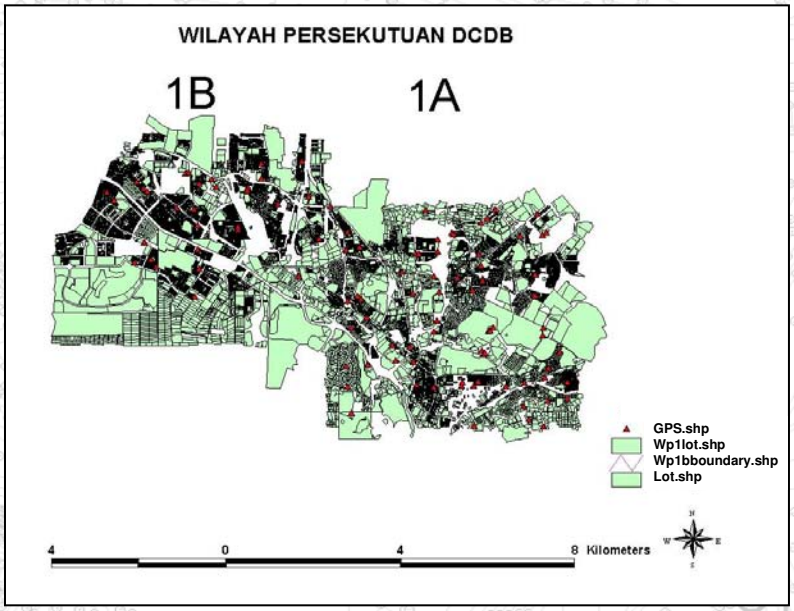
Log File: New and Current Point Keys

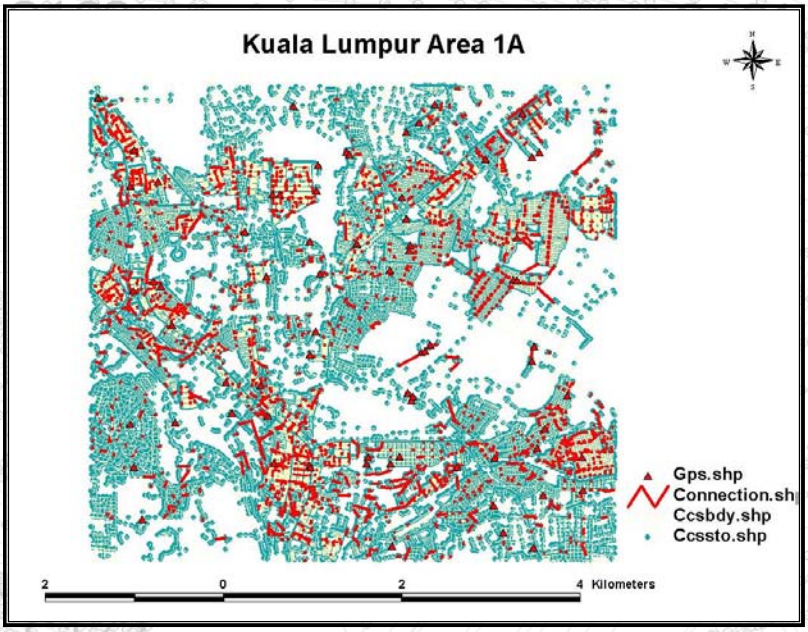


Save to StarNet Format

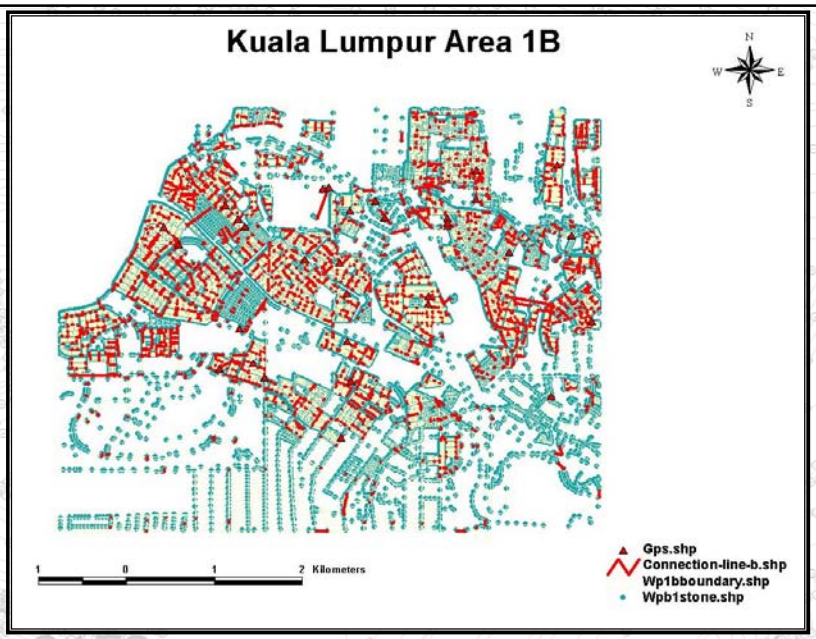
PREPARATION OF DATA INPUT & CONNECTION LINES

DIGITAL CADASTRAL DATABASE FOR STUDY AREA # 1: WILAYAH PERSEKUTUAN KUALA LUMPUR



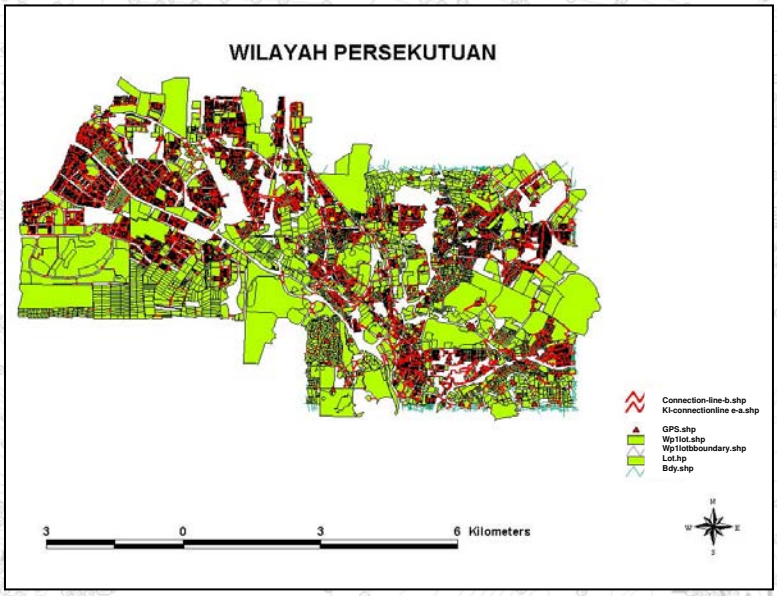


Total of Connection Lines: 2890

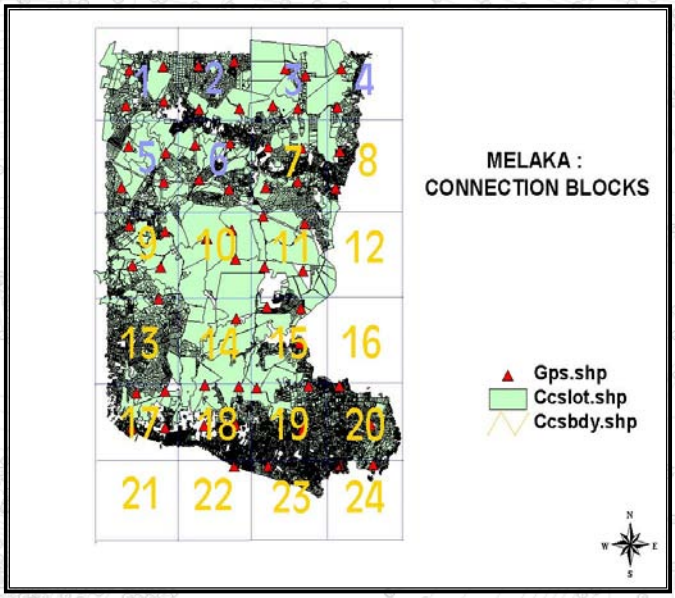


Total of Connection Lines: 3015

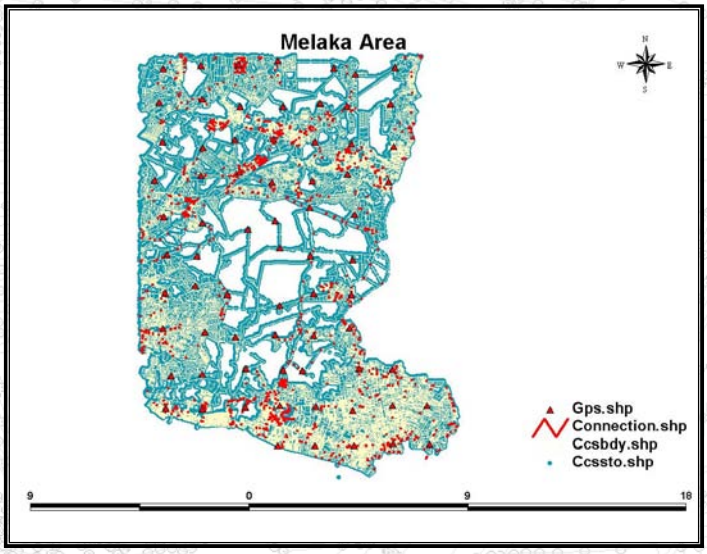
CADASTRAL INFRASTRUCTURE FOR STUDY AREA # 1: WILAYAH PERSEKUTUAN KUALA LUMPUR



PREPARATION OF DATA INPUT: MELAKA

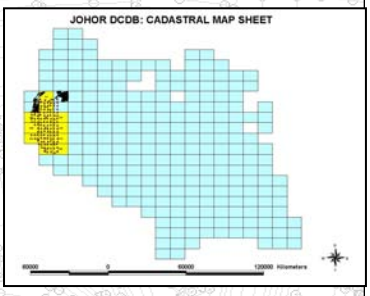


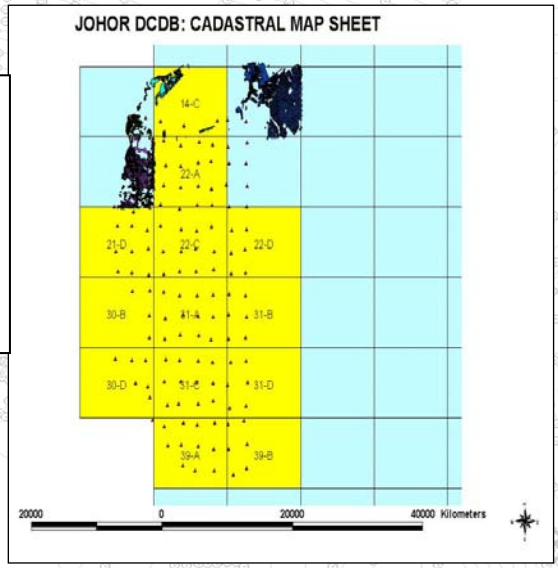
Total of Blocks: 24, block size ~ 2.5 km x 2.5 km

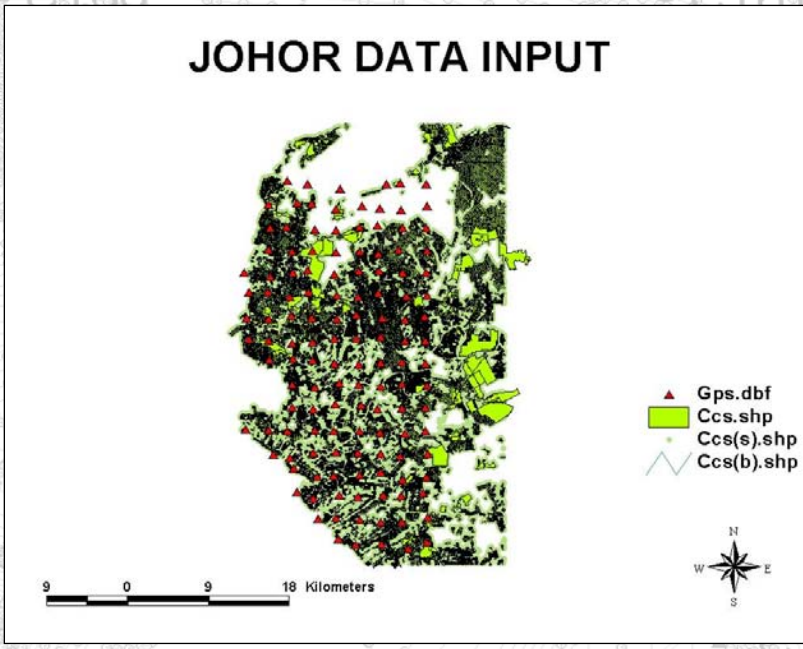


Total of Connection Lines: 4951

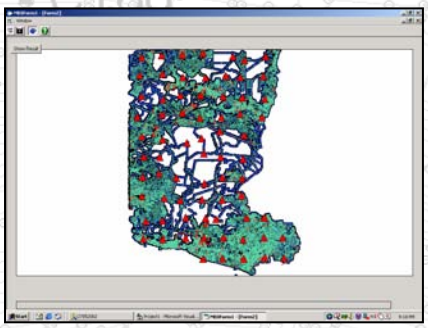
PREPARATION OF DATA INPUT: JOHOR

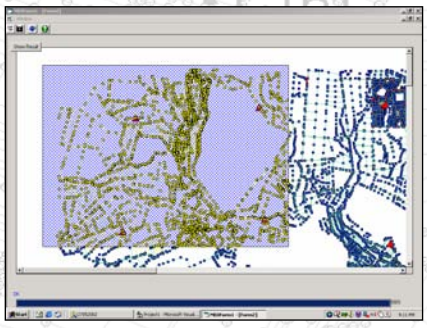


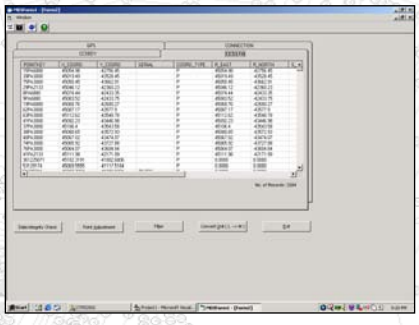


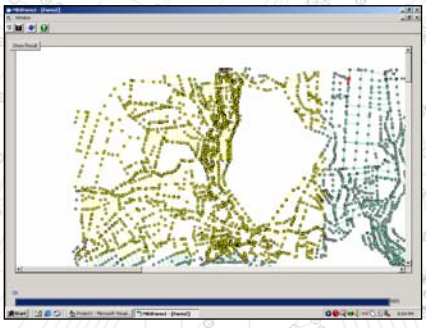


ADJUSTMENT OF MELAKA TEST AREA: BLOCK 1









Statistical Summary for Adjustment: Block 1

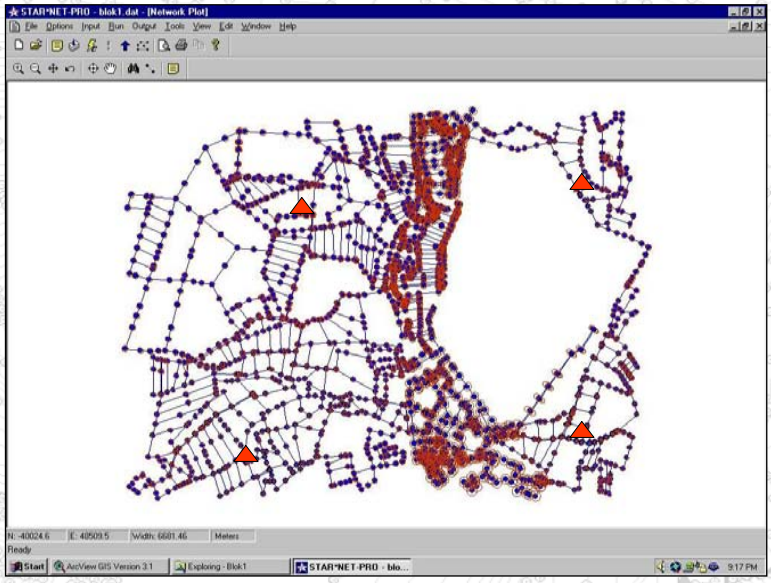
WGS-MRT-RSO-CASSINI

	ADJUSTMENT 2001 (Fixed GPS Control Point at 2.5 km Interval) GPS Control Station: 16PA8052, 13PA20295, 34PA9268 and 15PA2128			
	Residual		Stn.Coord Std.Deviations	
	Bearing	Distance (m)	N (m)	E (m)
MAX	2'13"	0.080	0.142	0.141
MIN	-1'58"	-0.088	0	0
MEAN	-1"	0	0.071	0.068
RMS	20"	0.008	0.075	0.072

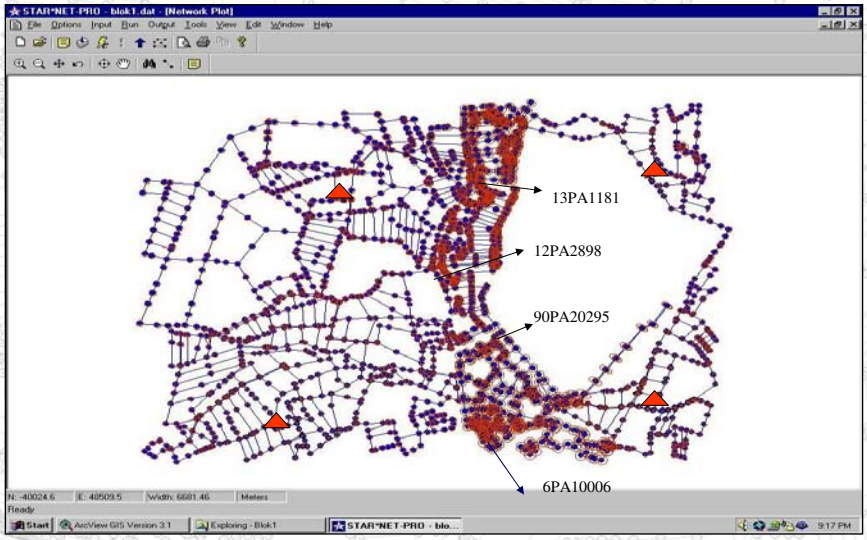
Statistical Summary for adjustment Block 1

Number of Stations :2062
Number of Observations :5036
Number of Unknowns :4116
Number of Redundant Obs. :920
Error Factor :1.800 (Standard error factor = 1.00)

Error Ellipse for Adjustment: Block 1



Error Ellipse for Adjustment: Block 1



Arrow indicate maximum station coordinate standard deviations

: range 0.10 – 0.14 m

Statistical Summary for Adjustment: Block 1

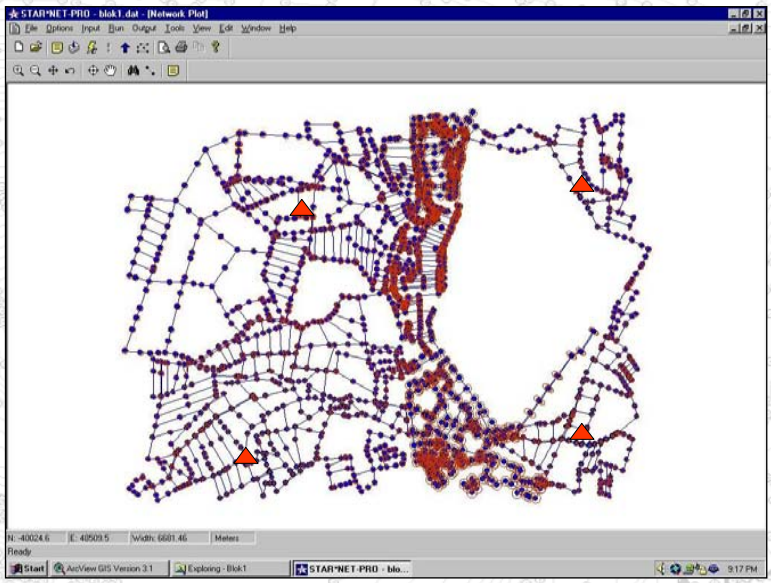
WGS-CASSINI (GEOCENTRIC)

	ADJUSTMENT 2001 (Fixed GPS Control Point at 2.5 km Interval) GPS Control Station: 16PA8052, 13PA20295, 34PA9268 and 15PA2128			
	Residual		Stn.Coord Std.Deviations	
	Bearing	Distance (m)	N (m)	E (m)
MAX	2'01"	0.051	0.134	0.133
MIN	-1'48"	-0.060	0	0
MEAN	-1"	0	0.067	0.065
RMS	19"	0.008	0.071	0.068

Statistical Summary for adjustment Block 1

Number of Stations	:2062
Number of Observations	:5036
Number of Unknowns	:4116
Number of Redundant Obs.	:920
Error Factor	:1.693 (Standard error factor = 1.00)

Error Ellipse for Adjustment: Block 1



SUMMARY & ACTION TO BE TAKEN

1) Connection lines are needed in order to run the adjustment.
2) Data integrity is the most important factor in the implementation of CCS.
3) 2.5 km control station spacing is sufficient for rural area.
4) Data integrity is needed before adjustment can be run. Data screening and cleaning is essential since attribute and spatial errors exist
5) Focus on the adjustment and analysis of results: Blunder errors, connection lines, residuals and standard deviations
6) Expected comprehensive adjustments results for study Melaka and Wilayah Persekutuan areas – end of July.
7) Johor Test Area – end of August.
8) Report writing and submission – end of October.