Adaptive Lighting Presentation to IESNA

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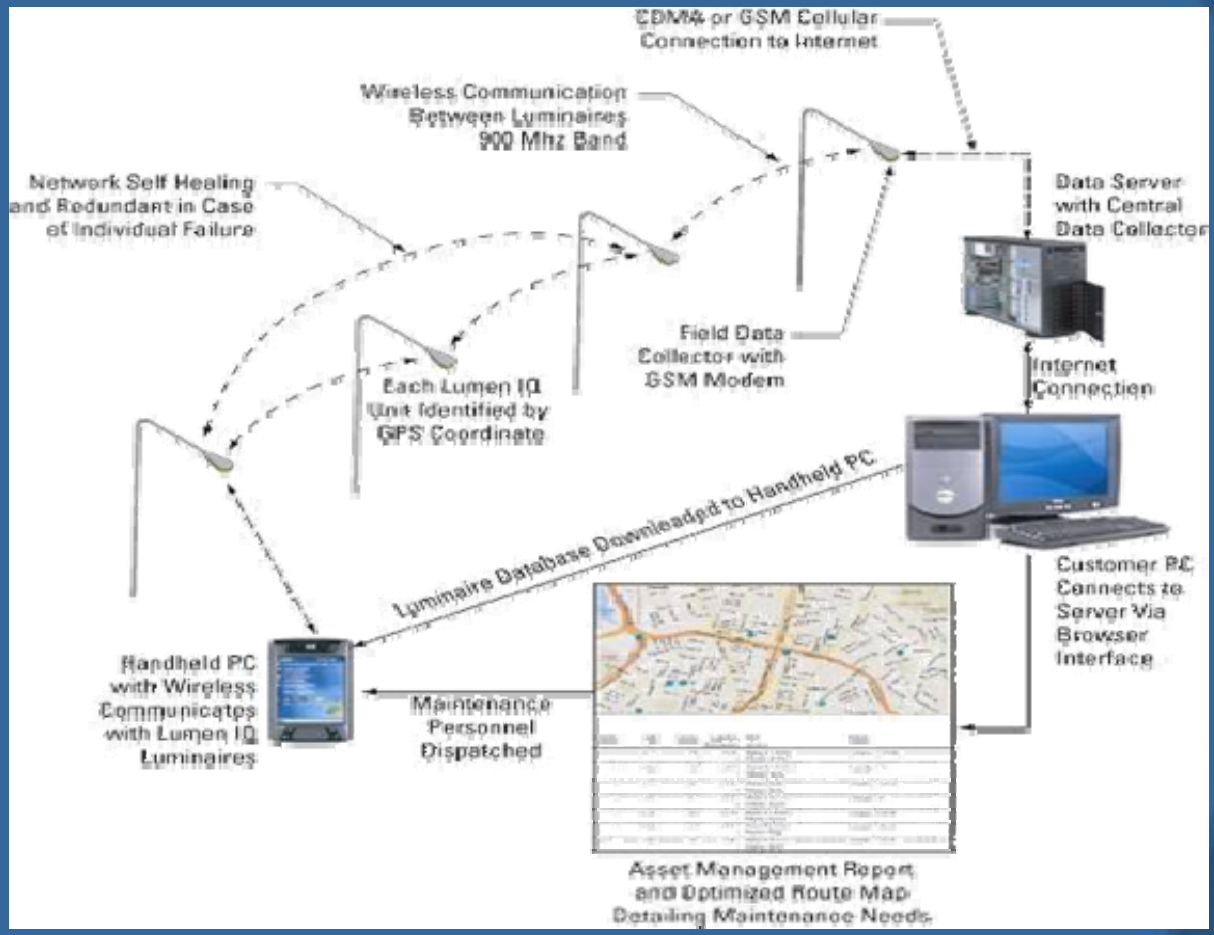
What is Adaptive Lighting (new term):

"Is lighting where the levels can be varied to suit activity levels."

Advantages of Adaptive Street Lighting System:

- Reduced Energy Consumption
- Obtrusive Light Reduction
- Power Consumption Monitoring
- Streamlined Asset Management

System Overview



Product Overview

A) Microprocessor B) WiFi Interface C) Lamp Lumen Sensor D) Day/Night Sensor

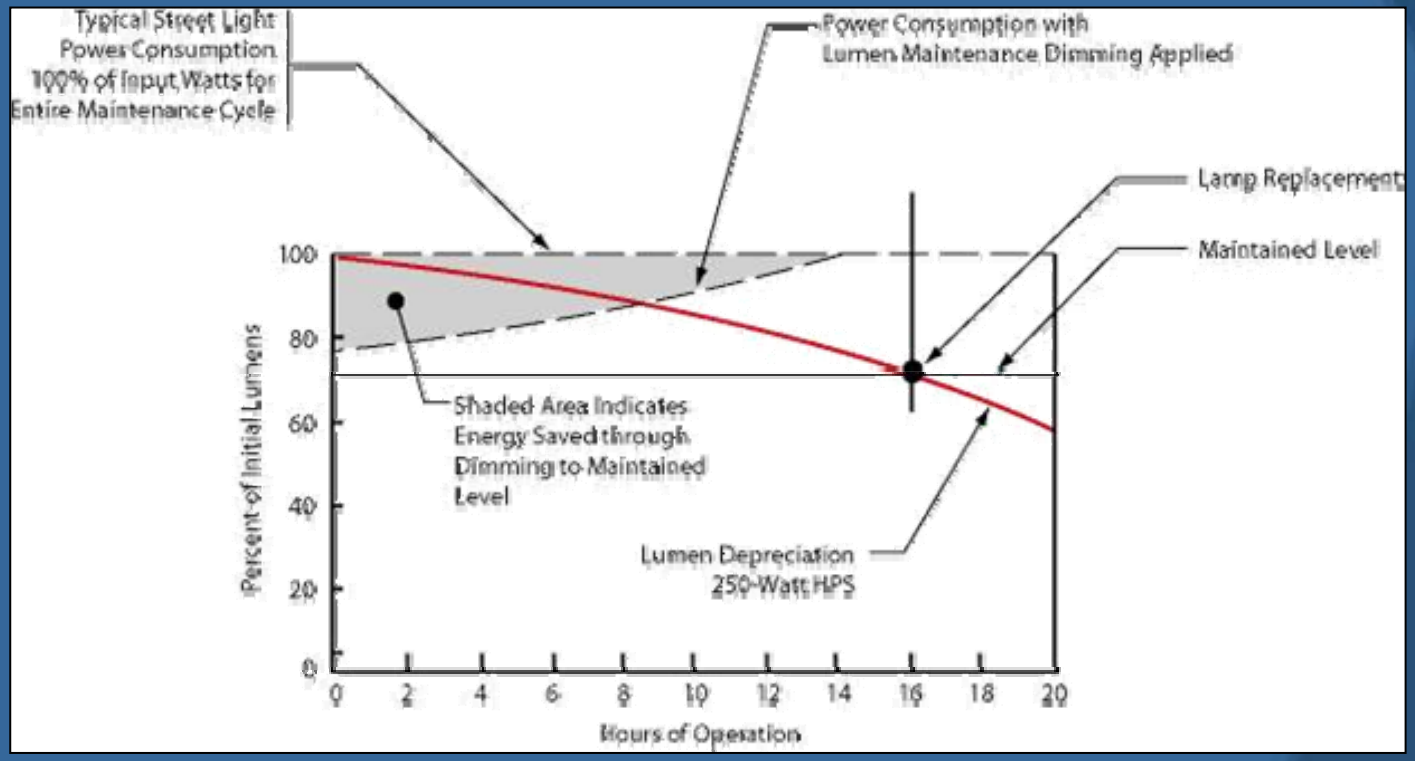
Projects

- Complete 2002 – Retrofit of 30 luminaires with adaptive system at Camosun College, Victoria
- Complete 2005 – Retrofit of 171 luminaires with adaptive system on Prince George arterial roadway
- Study 2005 – Retrofit of up to 1000 luminaires with adaptive system on Highway 1 from Port Mann Bridge to Lonsdale Interchange
- Study 2005 – Retrofit approx 10,000 luminaires with adaptive system for a local City

Energy Saving Applications

Application		Advantages
1	Reduce Lumen Output of Lamps to IESNA Maintained Levels	• Energy Savings • Obtrusive Light Reduction
2	Reduce levels on over lighted roads to levels required by IESNA	• Potential Energy Savings • Obtrusive Light Reduction
3	Match Lumen Output to Variable IESNA Pedestrian Conflict Levels	• Significant Energy Savings • Obtrusive Light Reduction

Application – Dim to Maintained Level for Full Lamp Life



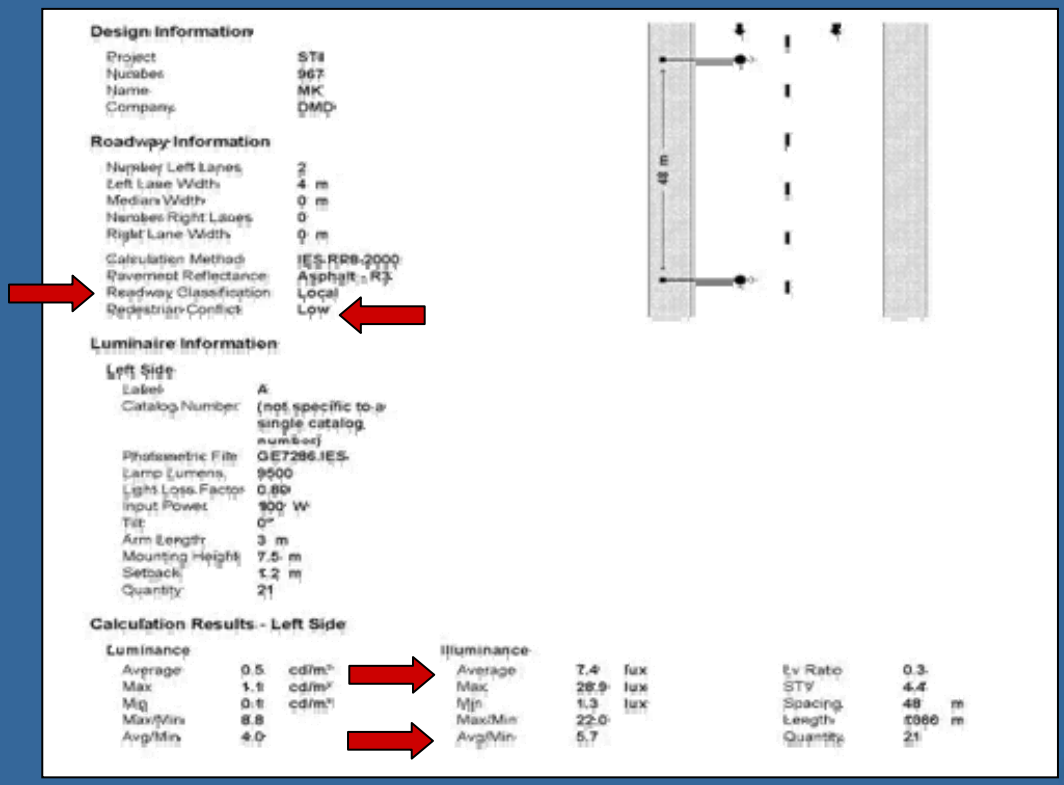
Obtrusive Light Reduced to Maintained Levels for Life of Lamp

Application - Match Lumen Output to Variable IESNA Pedestrian Conflict Levels

Road and Pedestrian Conflict Area		Pavement Classification (Minimum Maintained Average Value)			Uniformity Ratio	Veiling Luminance Ratio
Road	Pedestrian Conflict Area	R1 lux/fc	R2 & R3 lux/fc	R4 lux/fc	E_{avg}/E_{min}	L_{vmax}/L_{avg}
Freeway Class A		6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Freeway Class B		4.0/0.4	6.0/0.6	5.0/0.5	3.0	0.3
Expressway	High	10.0/1.0	14.0/1.4	13.0/1.3	3.0	0.3
	Medium	8.0/0.8	12.0/1.2	10.0/1.0	3.0	0.3
	Low	6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Major	High	12.0/1.2	17.0/1.7	15.0/1.5	3.0	0.3
	Medium	9.0/0.9	13.0/1.3	11.0/1.1	3.0	0.3
	Low	6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Collector	High	8.0/0.8	12.0/1.2	10.0/1.0	4.0	0.4
	Medium	6.0/0.6	9.0/0.9	8.0/0.8	4.0	0.4
	Low	4.0/0.4	6.0/0.6	5.0/0.5	4.0	0.4
Local	High	6.0/0.6	9.0/0.9	8.0/0.8	6.0	0.4
	Medium	5.0/0.5	7.0/0.7	6.0/0.6	6.0	0.4
	Low	3.0/0.3	4.0/0.4	4.0/0.4	6.0	0.4

Potential for Dimming of 1/3 to 1/2 Based on IESNA Pedestrian Conflict Levels

Application – Reduce Lighting in Over-Lighted Areas



Design Information

Project	STI
Number	967
Name	MK
Company	DMD

Roadway Information

Number Left Lanes	2
Left Lane Width	4 m
Median Width	0 m
Number Right Lanes	0
Right Lane Width	0 m
Calculation Method	IES RP8-2000
Pavement Reflectance	Asphalt R3
Roadway Classification	Local
Pedestrian Conflict	Low

Luminaire Information

Left Side

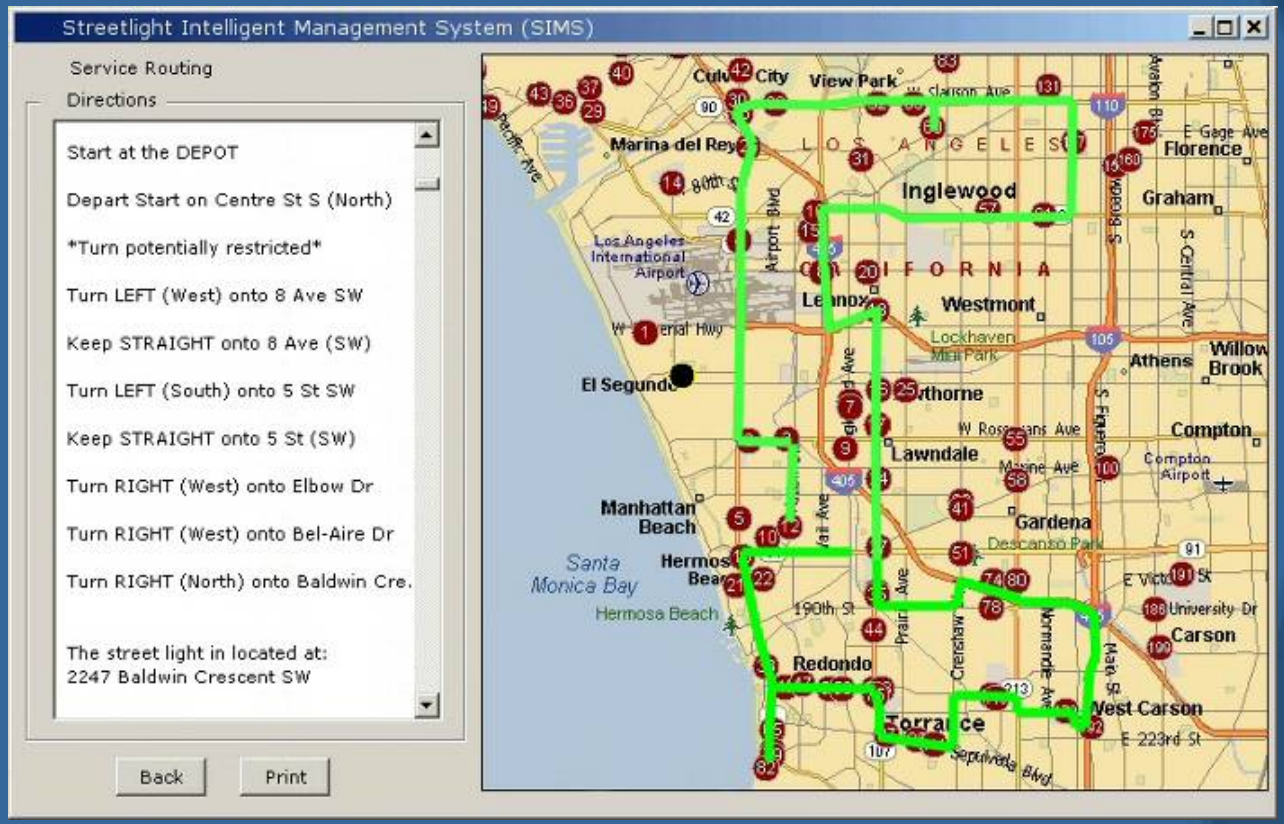
Label	A
Catalog Number	(not specific to a single catalog number)
Photometric File	GE7286.IES
Lamp Lumens	9500
Light Loss Factor	0.80
Input Power	900 W
Tilt	0°
Arm Length	3 m
Mounting Height	7.5 m
Setback	1.2 m
Quantity	21

Calculation Results - Left Side

Luminance			Illuminance				
Average	0.5	cd/m²	Average	7.4	lux	Uv Ratio	0.3
Max	1.1	cd/m²	Max	28.9	lux	STV	4.4
Min	0.1	cd/m²	Min	1.3	lux	Spacing	48 m
Max/Min	8.8		Max/Min	22.0		Length	1008 m
Avg/Min	4.0		Avg/Min	5.7		Quantity	21

Installation Uses Owner Specified Equipment and is Over-Lighted to Meet Uniformity

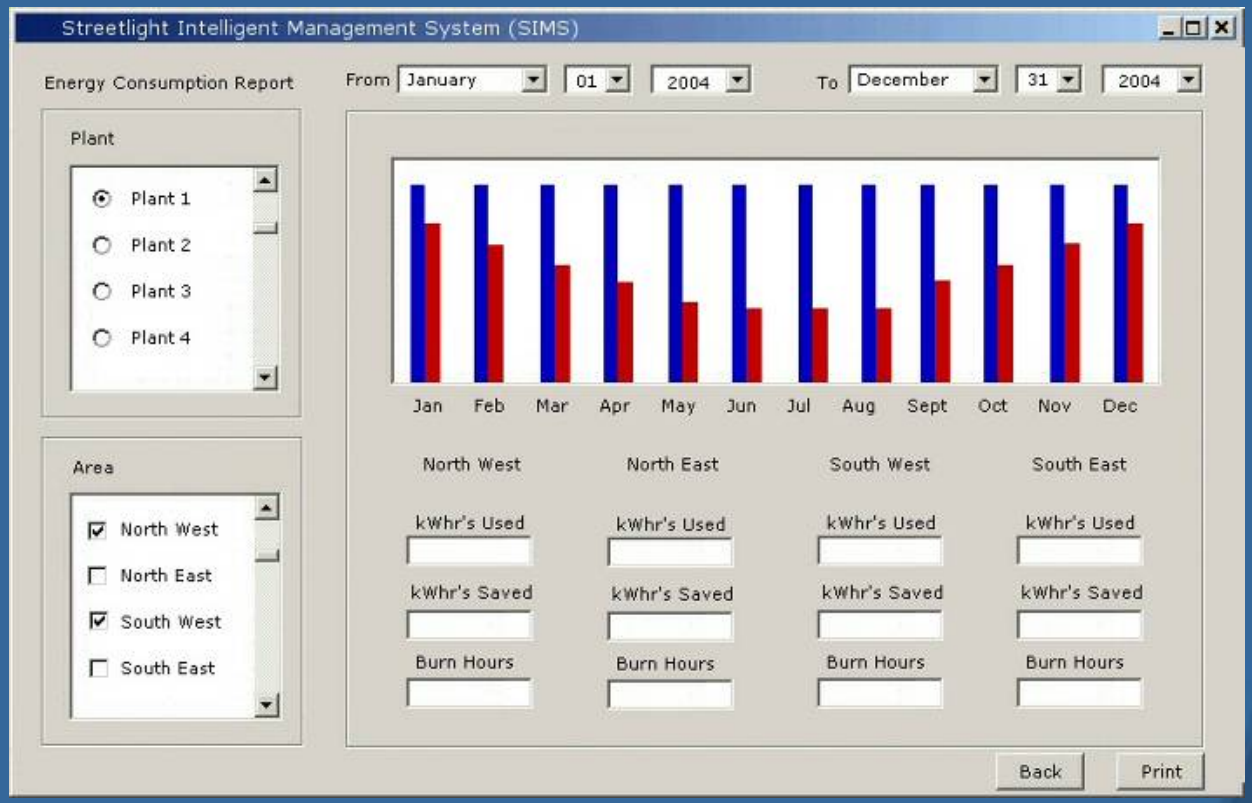
Asset Management



Asset Management Analysis

- Anti-Cycling technology reduces damage to luminaire
- Lamp outages/performance reported to owner via Internet
- Microsoft MapPoint interface optimizes maintenance route development

Energy Consumption Tracking



Tariff Amount Actual Usage

Energy Consumption Tracking Analysis

- Utility can track usage for un-metered installations
- Owner pays for actual power costs

Results of Lab Testing

- **Photometric testing by Dr Lewin of Lighting Sciences:**
  - Lamp sensor accurately measures lumen output at every level of dimming (linear correlation)
  - Granular dimming in 1.1 percent increments
  - Dimming operations do not affect lumen distribution
  - Linear correlation between lumen output and power input through all dimmed levels
  - No negative effects due to power factor (no change needed for existing electrical systems)
- **Thermo testing undertaken**
- **Vibration testing undertaken**

Field Testing

Voltage and current measurement undertaken on random units and full dimming and with no dimming

Illuminance readings undertaken directly under luminaires at full dimming and with no dimming

Cost Benefit

Payback Varies: The main payback is energy savings. Factors include:

- Levels of lighting and area classifications (residential, commercial) and types. Not all Cities are the same.
- Funding has been available from NRCan and BC Hydro (Power Smart)
- Streamlined maintenance benefits can save costs
- In order to verify cost benefit an engineering study needs to be undertaken to verify existing lighting levels and levels and hours of dimming

Beyond Power Savings

- Adaptive lighting could be tied into Road Weather Information Stations (RWIS) and lighting levels could be adjusted to suit weather conditions
- Maintenance contracts could be streamlined by use of performance based maintenance method where performance can be defined and measured
- Lighting levels could be adjusted after installation to accommodate new development or changes in traffic
- Product performance can be tracked

Conclusions

Performance verified through laboratory and field testing. Significant benefits and potential for owners and society:

- Operating costs will be saved by reducing power consumption
- Obtrusive light will be reduced when needed most
- System streamlines asset management which should reduce costs
- Energy consumption can be tracked for un-metered installations

The Big Picture

Why vary lighting levels in off peak periods?

It has been estimate 64 million street lights exist in North America. Estimated power consumed in a year would be approximately 51billion kWh. Just imagine 20% reduction in off peak hours.

That’s 5.1 billion kWh hours per year