Internet of Things:

from intelligent to smart building

HKIE Veneree Club Talk

DR ABRAHAM LAM

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FUSQUARE

MEGA AUTOMATION

About the speaker

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Affiliations

- PhD (Hong Kong Polytechnic University)
- Founder of MEGA Automation (HK) & FUSQUARE (China)
- ASHRAE 2016-2018 Electronic Communication Chair
- Hon Secretary of iEthics

Latest Publications

- (TII '16) Asynchronous and Selective Transmission for DeWiring of Building Management Systems
- (APCBE '15) Occupant-participatory Approach to Enhance Thermal Comfort
- (e-energy '14) An Occupant-participatory Approach for Thermal Comfort Enhancement and Energy Conservation in Buildings
- (BuildSys '13) Carrying My Environment with Me: A Participatory-sensing Approach to Enhance Thermal Comfort

80% Time in buildings

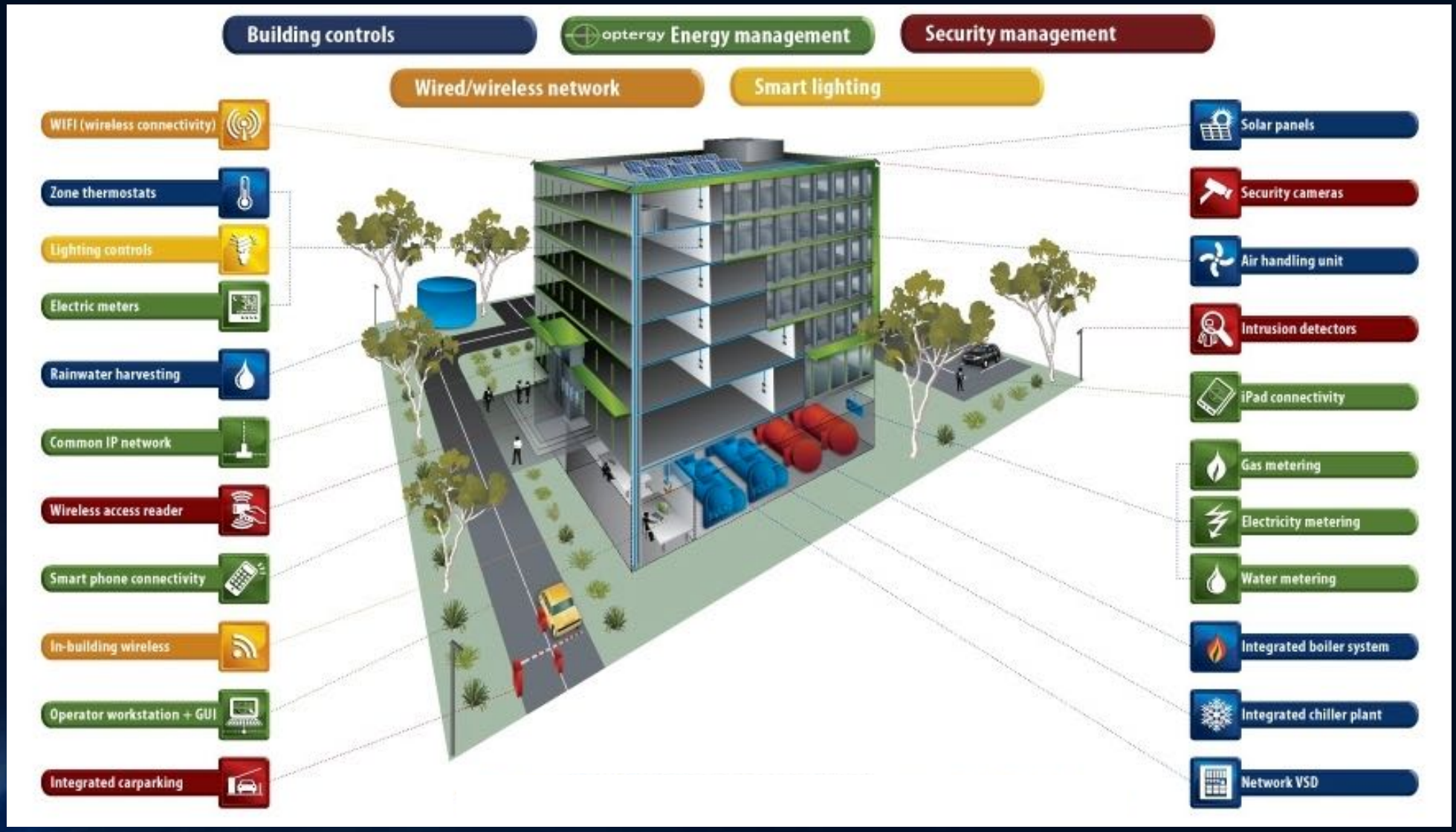
65% Electricity used in buildings

54% Consumed by HVAC system

In Hong Kong,
it's all buildings!

Power Off Everything！

Behind the scene…



Source: http://optergy.com.my/solutions/integrated-solutions/

Building Automation system

- Monitoring & controlling of building systems
  - HVAC
  - Fires
  - Lighting
  - Lifts & escalators
  - Measuring meters
  - Sensors & actuators

Too many systems…

What's worse…

- Different systems cannot talk with others
- Maintenance Difficulties
- Unable to conduct system optimization
- Low flexibility for retrofit
- Vendors lock-in

Source: http://www.bacnet.org/Tutorial/HMN-Overview/sld002.htm

Moreover...

- Improper management to building facilities leads to
  - Sick building syndrome (病態建築綜合症)
  - Inefficient energy use
  - Rise of energy bill
  - Higher CO_2 emission

部份退伍軍人症桿菌超標水塔

地　點	含菌量（每毫升菌落）	超　標
荃灣德士古道聯合貨運中心	約 18,000	17.0 倍
大埔工業村大順街 11 至 13 號	約 8,000	7.0 倍
黃大仙環鳳街鳳祥樓	約 4,400	3.4 倍
沙田新翠邨商場	約 3,600	2.6 倍
何文田愛民商場	約 2,800	1.8 倍
黃大仙新光中心	約 3,200	1.2 倍

*上限為每毫升 1,000 菌落　資料來源：機電署

Emergence of intelligent buildings

Timeline

1980s

Paper Document

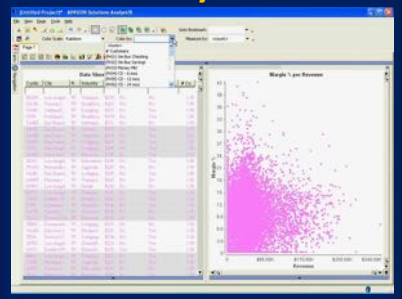
1990s

BMS System

2000s

Document Management

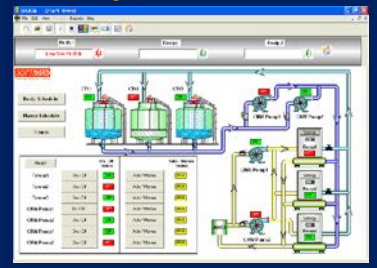
Analytics



Energy Management

NOW

System Optimization

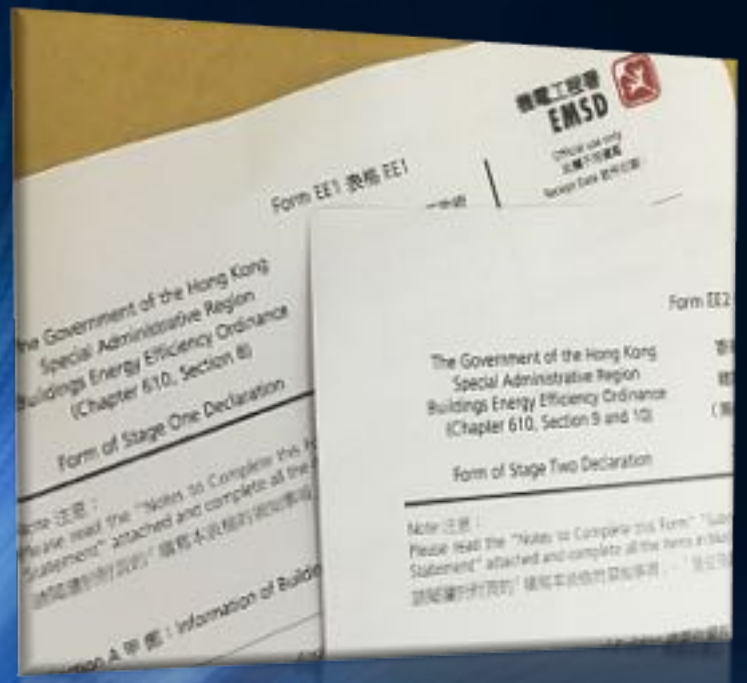


Planning

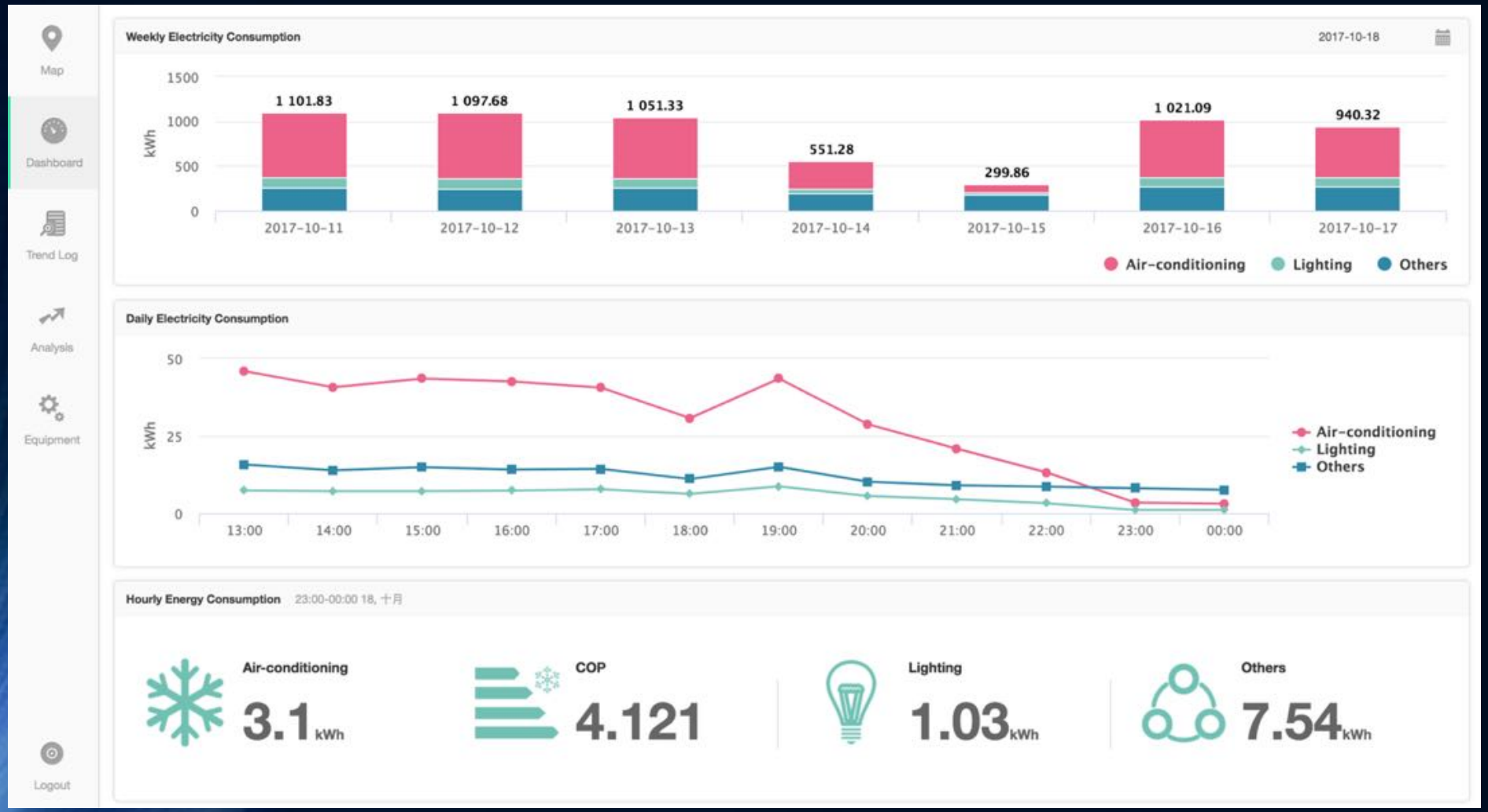
BIM modeling

Energy Audit Code

- Building Energy Efficiency Ordinance (Cap.610)
- Covers A/C, electrical, lighting & escalator
- ALL HK commercial buildings!



Energy Management

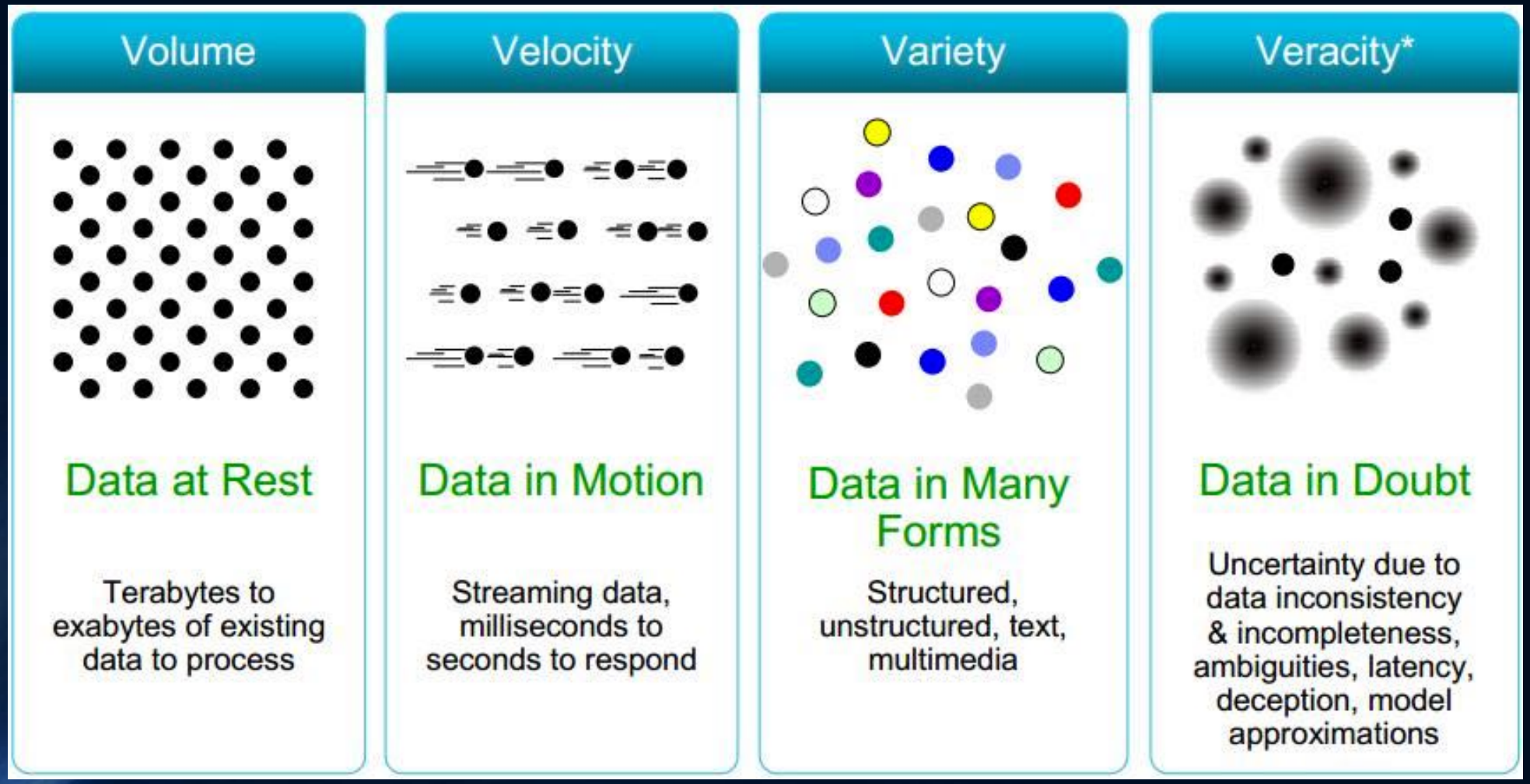


Institutional-driven

- Green building design and assessment
  - Hong Kong
    - BEAM Plus
    - Building Energy Codes
  - China
    - Evaluation standard for green building (绿色建筑评价标准) GB/T 50738-2006
    - China Green Building Label (中国绿色建筑标识)
  - International
    - ISO 50001
    - LEED

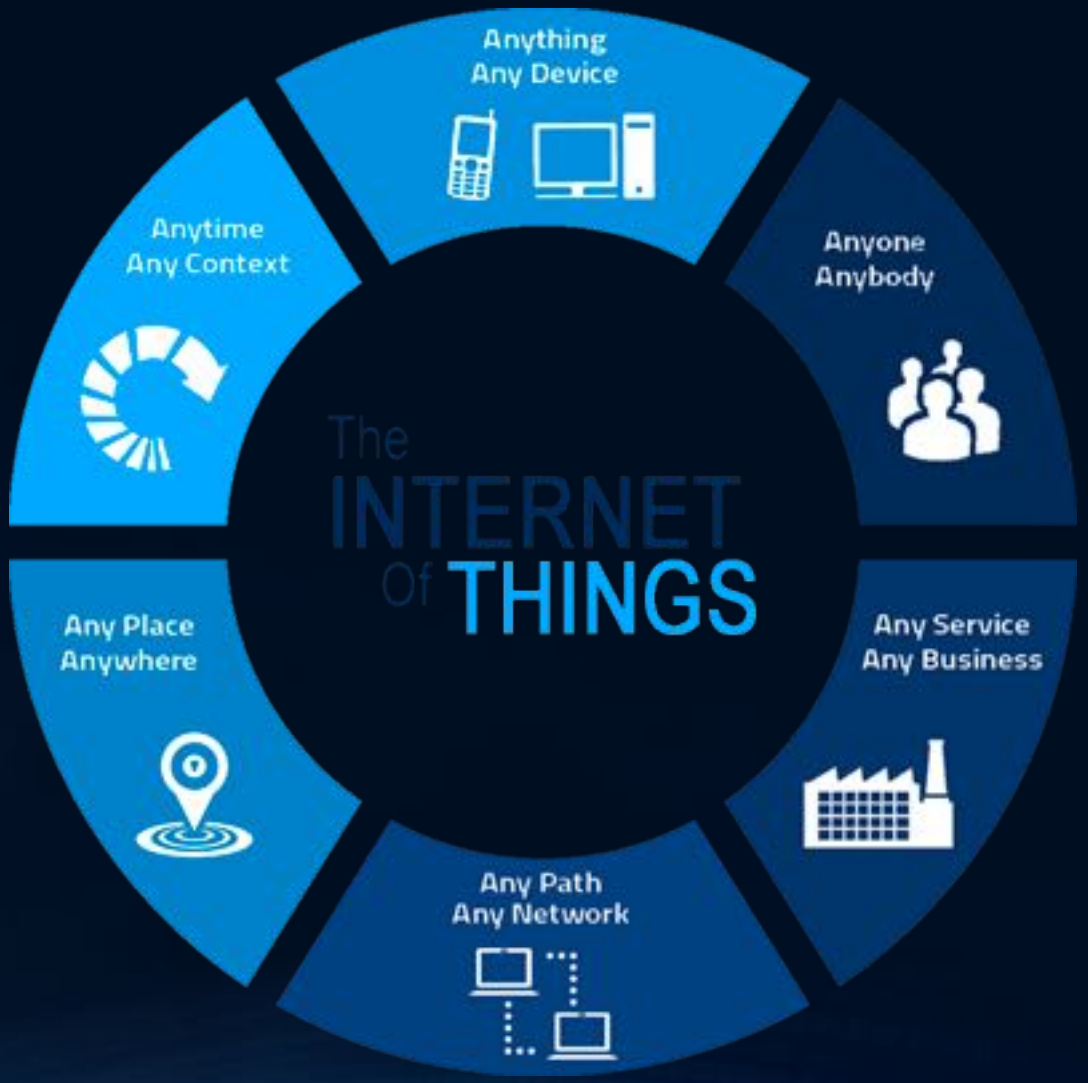
What's required behind …

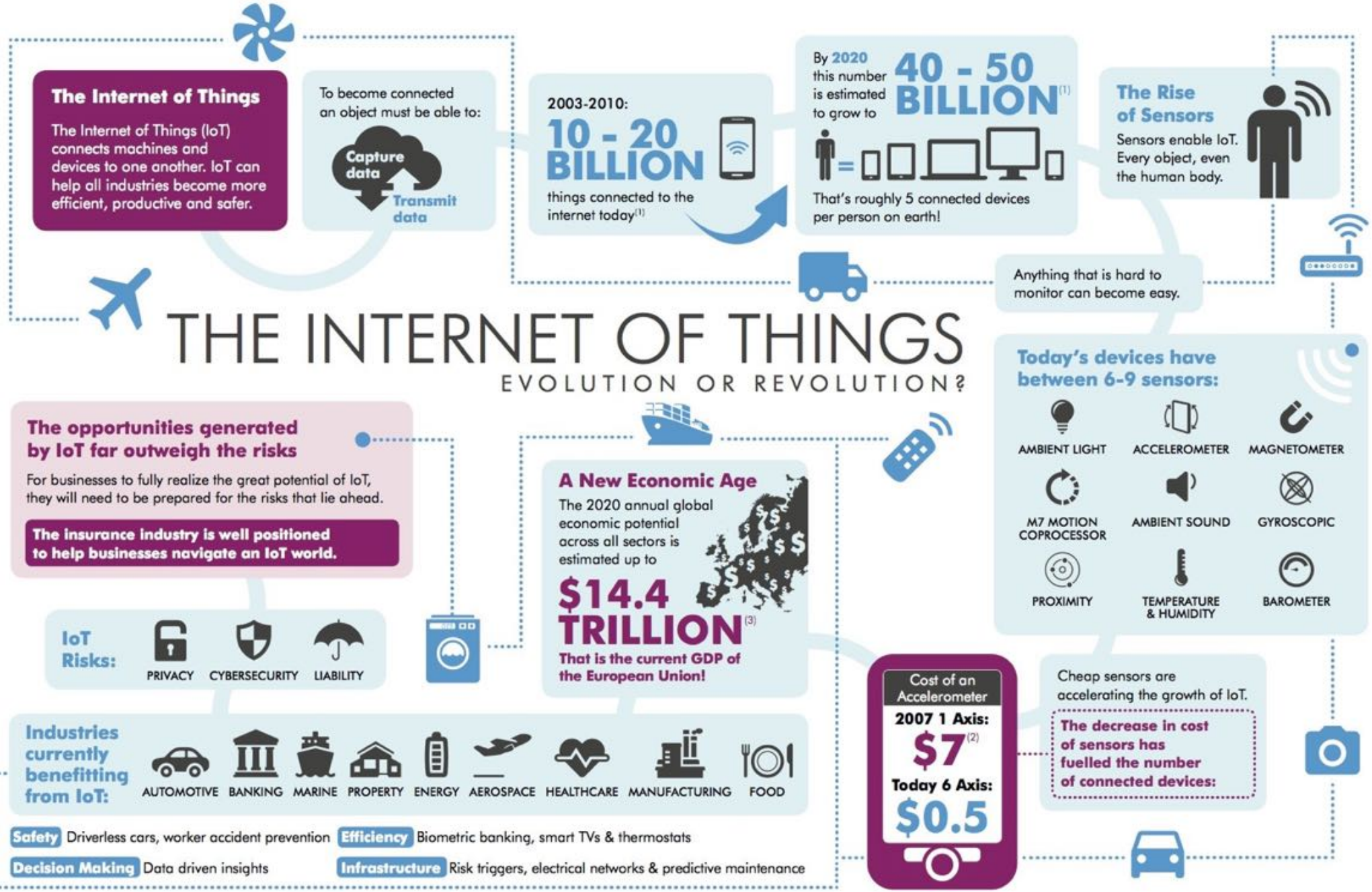
Data Flooding – 4V



Source: IBM

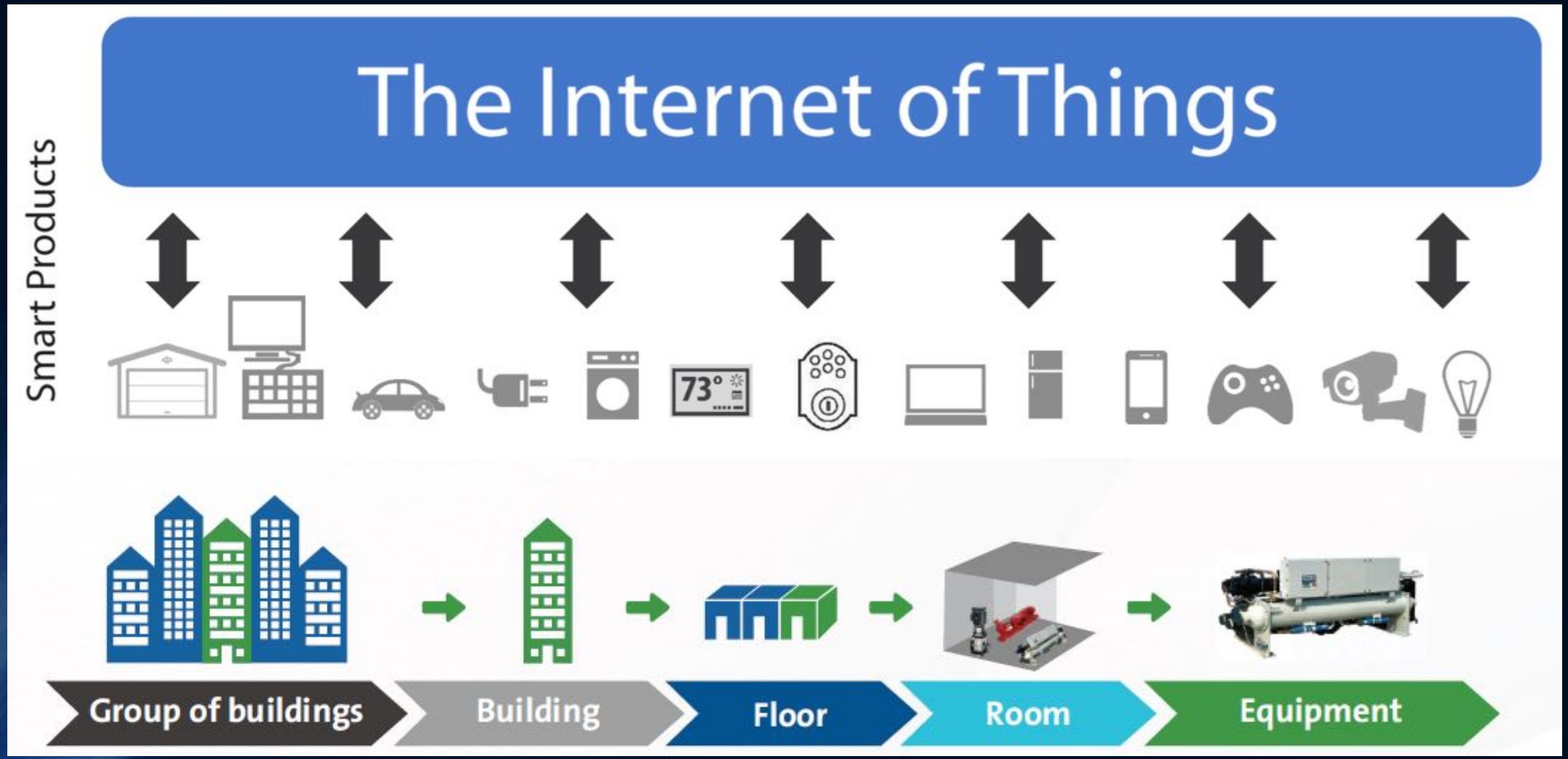
The era of IoT - Connecting the unconnected



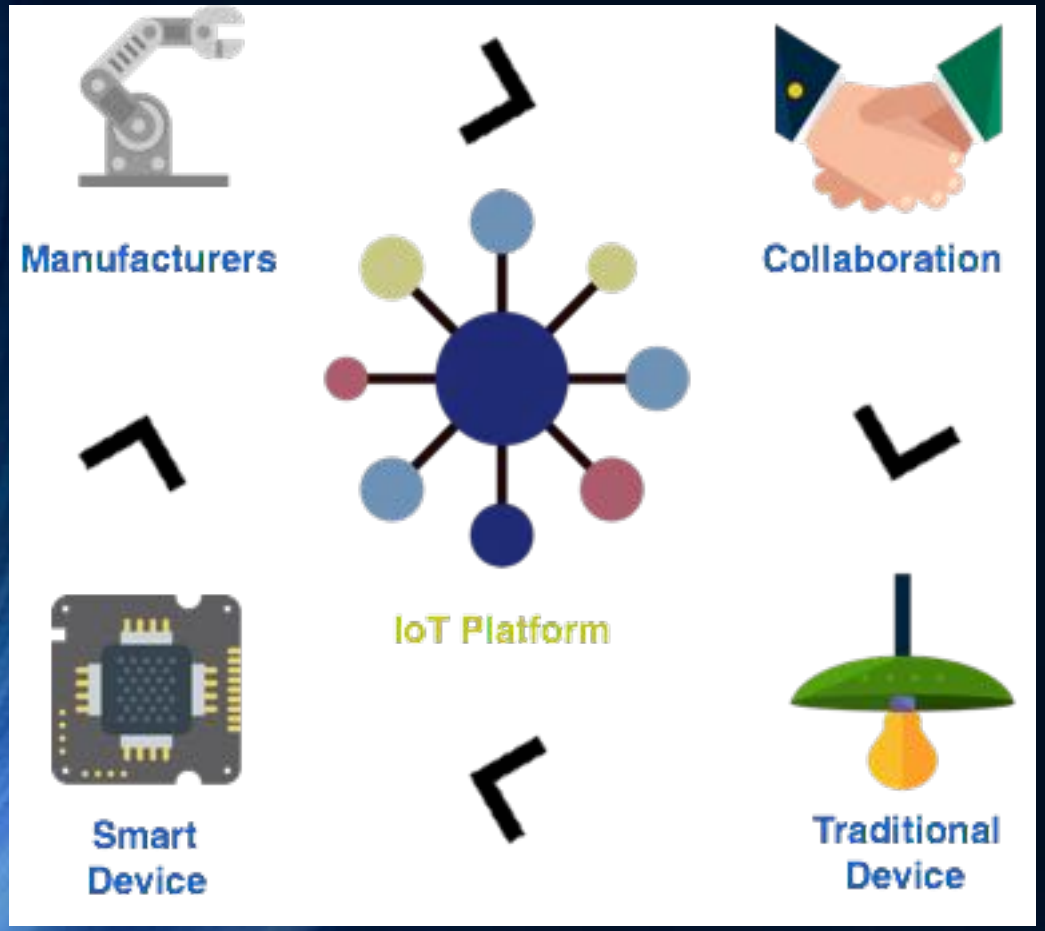

The Internet of Things
The Internet of Things (IoT) connects machines and devices to one another. IoT can help all industries become more efficient, productive and safer.
To become connected an object must be able to:
Capture data
Transmit data
2003-2010:
10 - 20 BILLION
things connected to the internet today[1]
By 2020 this number is estimated to grow to
40 - 50 BILLION[1]
That's roughly 5 connected devices per person on earth!
The Rise of Sensors
Sensors enable IoT. Every object, even the human body.
Anything that is hard to monitor can become easy.
THE INTERNET OF THINGS
EVOLUTION OR REVOLUTION?
Today's devices have between 6-9 sensors:
AMBIENT LIGHT
ACCELEROMETER
MAGNETOMETER
M7 MOTION COPROCESSOR
AMBIENT SOUND
GYROSCOPIC
PROXIMITY
TEMPERATURE & HUMIDITY
BAROMETER
The opportunities generated by IoT far outweigh the risks
For businesses to fully realize the great potential of IoT, they will need to be prepared for the risks that lie ahead.
The insurance industry is well positioned to help businesses navigate an IoT world.
A New Economic Age
The 2020 annual global economic potential across all sectors is estimated up to
$14.4 TRILLION[3]
That is the current GDP of the European Union!
IoT Risks:
PRIVACY
CYBERSECURITY
LIABILITY
Cost of an Accelerometer
2007 1 Axis:
$7[2]
Today 6 Axis:
$0.5
Cheap sensors are accelerating the growth of IoT.
The decrease in cost of sensors has fuelled the number of connected devices:
Industries currently benefitting from IoT:
AUTOMOTIVE
BANKING
MARINE
PROPERTY
ENERGY
AEROSPACE
HEALTHCARE
MANUFACTURING
FOOD
Safety Driverless cars, worker accident prevention
Efficiency Biometric banking, smart TVs & thermostats
Decision Making Data driven insights
Infrastructure Risk triggers, electrical networks & predictive maintenance

Source: AIG

IoT @ smart buildings



Case 1: New maintenance services model



What common problem we face today?

要聞港聞 2005年06月27日 香港被謔凍感之都

舉報冷氣太凍　17日200宗
香港被謔凍感之都

《市民體驗》
「早晚坐巴士人少，覺得特別凍，無論你坐邊個位都會覺得寒氣逼人，如果無件外套一定搵唔住。」
廖小姐　307號線巴士常客

【本報訊】香港已由「動感之都」變為「凍感之都」，環保團體「地球之友」呼籲市民舉報將室內冷氣溫度調得過低的場所，短短十七天已接獲二百多宗投訴。其中最低溫的為一酒樓男廁，溫度只有攝氏十六度，而負責推動本港旅遊業的香港旅遊發展局，其位於尖沙嘴的旅客諮詢及服務中心，室溫也只有十九度，是名副其實的「城市雪房」。　記者：郭中礎、謝穎詩、林社炳

「我會選擇坐種下較多，因為食零行出行入，走緊部份冷氣就唔會覺得太凍。」
馮先生　鑽記常客

「有時天氣特別熱，所以入到酒店，都唔覺空調溫度好凍。」
胡先生　鴻爾光顧文華東方酒店

「行公司買
唔
，只
着
吊帶小背心一定頂唔住，必定會帶備件外套。」
黎小姐　太古廣場常客

本港室內空調溫度之低，世界知名，多份國際權威旅遊刊物如《 Lonely Planet》及《國家地理旅遊雜誌》（ National Geographic Traveler），都提醒旅客夏天來港旅遊，進出室內場所都應帶備一件薄衣，以免着涼。

交通工具投訴最多

地球之友自本月五日，發起「城市雪房」舉報行動，呼籲市民舉報室溫低於二十五點五度的室內場所，至本月二十二日共收到逾二百宗舉報，涉及二百六十六個地點，當中交通工具接獲的投訴最多，共六十四宗，其中九廣東鐵車廂被指只有十六至十八度，城巴車廂只得十九度。

投訴商場的有五十三宗，食肆也有三十一宗，其中包括多個旅客熱點，如中環鑓記酒家、尖沙嘴北京樓、中環國金商場、觀塘 APM商場等。

而投訴政府機構的則有十九宗，包括旅遊發展局、香港及沙田中央圖書館及中環郵政總局等。

最凍洗手間僅16度

至於在城市雪房名單中高居榜首的，是位於九龍灣德福商場的稻香超級漁港的男洗手間，溫度竟低至十六度，較政府推動的二十五點五度，足足低了九點五度。

地球之友環境事務經理朱漢強昨日在記者會上稱，香港空調過凍已惹來多份國際旅遊刊物批評，令香港由動感之都變成凍感之都。「我哋唔係話反對開冷氣，但大家根本唔需要凍到得十六度嘅廁所。」他尤其不滿旅發局特別在網頁上提醒遊客，在進入餐廳或室內場所宜帶備薄外套，但旅發局尖沙嘴旅客諮詢及服務中心，室溫卻只有十九度。

本報記者昨日曾到多個列為城市雪房的地點，包括文華東方酒店、太古廣場連卡佛百貨等，進入室內不一會兒，即感到陣陣寒意；至於被列為最凍雪房的九龍灣稻香超級漁港男洗手間，廁格明顯「涼浸浸」；位於尖沙嘴的旅發局旅客中心，職員都要穿上外套保暖。

防滑倒男廁要低溫

旅發局否認旅客中心溫度太低，並指出曾在該中心五個不同位置量度室溫，結果顯示平均溫度為二十四點五度。九龍灣稻香超級漁港解釋，洗手間要保持較低室溫，以免地面濕滑令客人滑倒。九鐵指會跟進投訴，並稱車廂溫度預設為二十四度，冷氣系統設有溫度感應器，當出現溫差會自動調節。

地球之友表明，會繼續追擊冥頑不靈的機構，若有關場所不將室溫調升，會在下月把雪房名單經互聯網發布，並附上聯絡方法，讓市民直接致電投訴。

冷氣最凍五大地點

被投訴地點	量度日期	溫度
長江中心 Café de Central	8月1日	18℃-20℃
荃灣廣場夏麵館	6月10日	19℃-20.5℃
海洋公園零售店舖	8月4日	19.3℃-20.9℃
荃灣吉野家	7月26日	19.4℃
港鐵西鐵線車廂	6月8日	19.8℃

資料來源：環保觸覺

Thermal Comfort Control - Challenges

- No thermal comfort sensor - subjective
- People do not know their preferred temperature
- Changing thermal preferences
- Diverging preferences to a group of people

How to tackle the challenge?

Thermal Comfort

" The condition of mind that expresses satisfaction with the thermal environment"

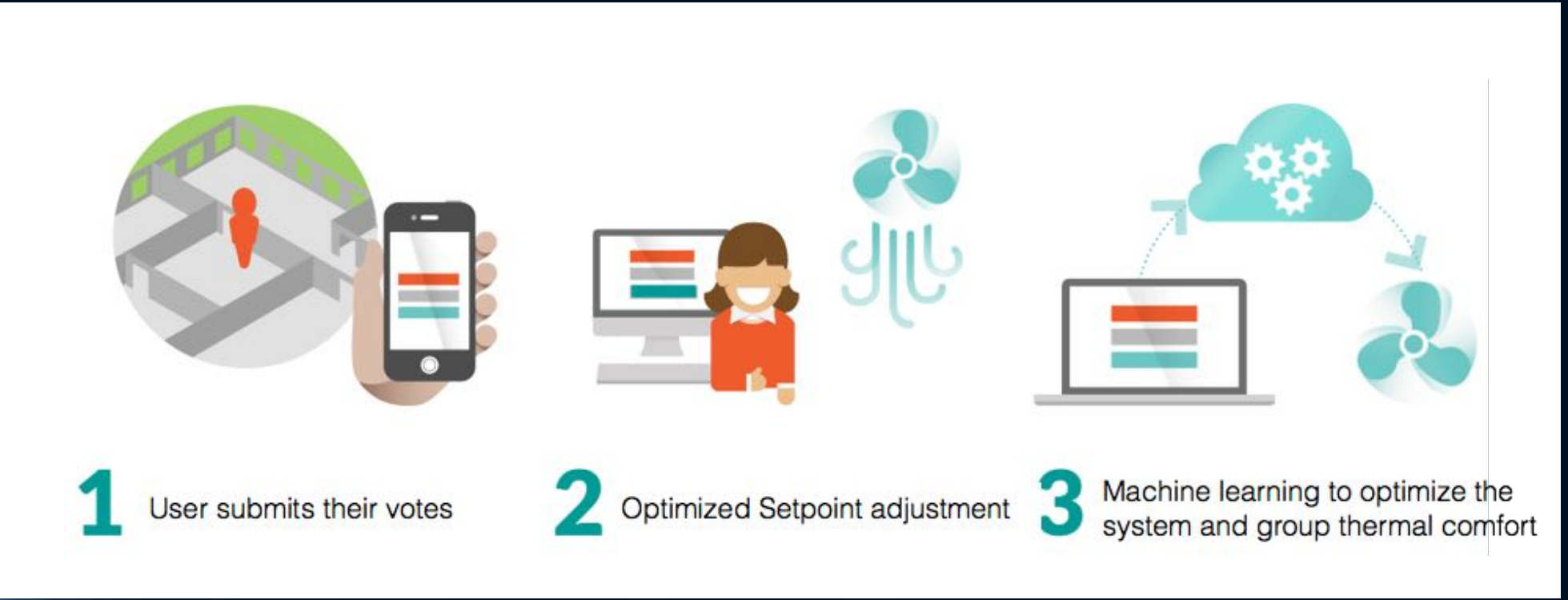
American Society of Heating, Refrigerating, and Air-Conditioning Engineers ***(ASHRAE)***

Factors:

i. metabolic rate
ii. clothing insulation
iii. air temperature
iv. radiant temperature
v. air speed
vi. humidity

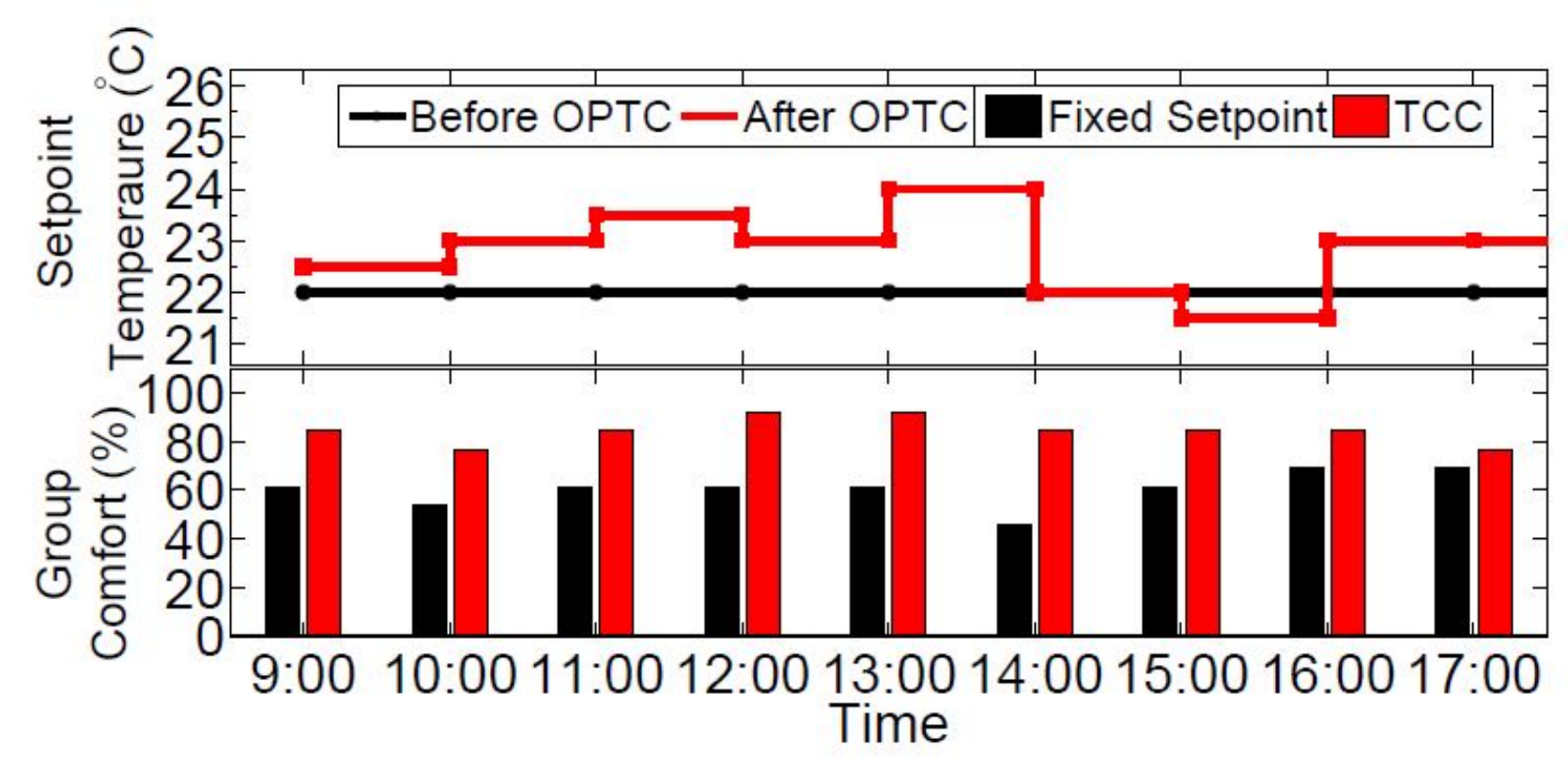
How can the facility operator knows?

Thermal Comfort



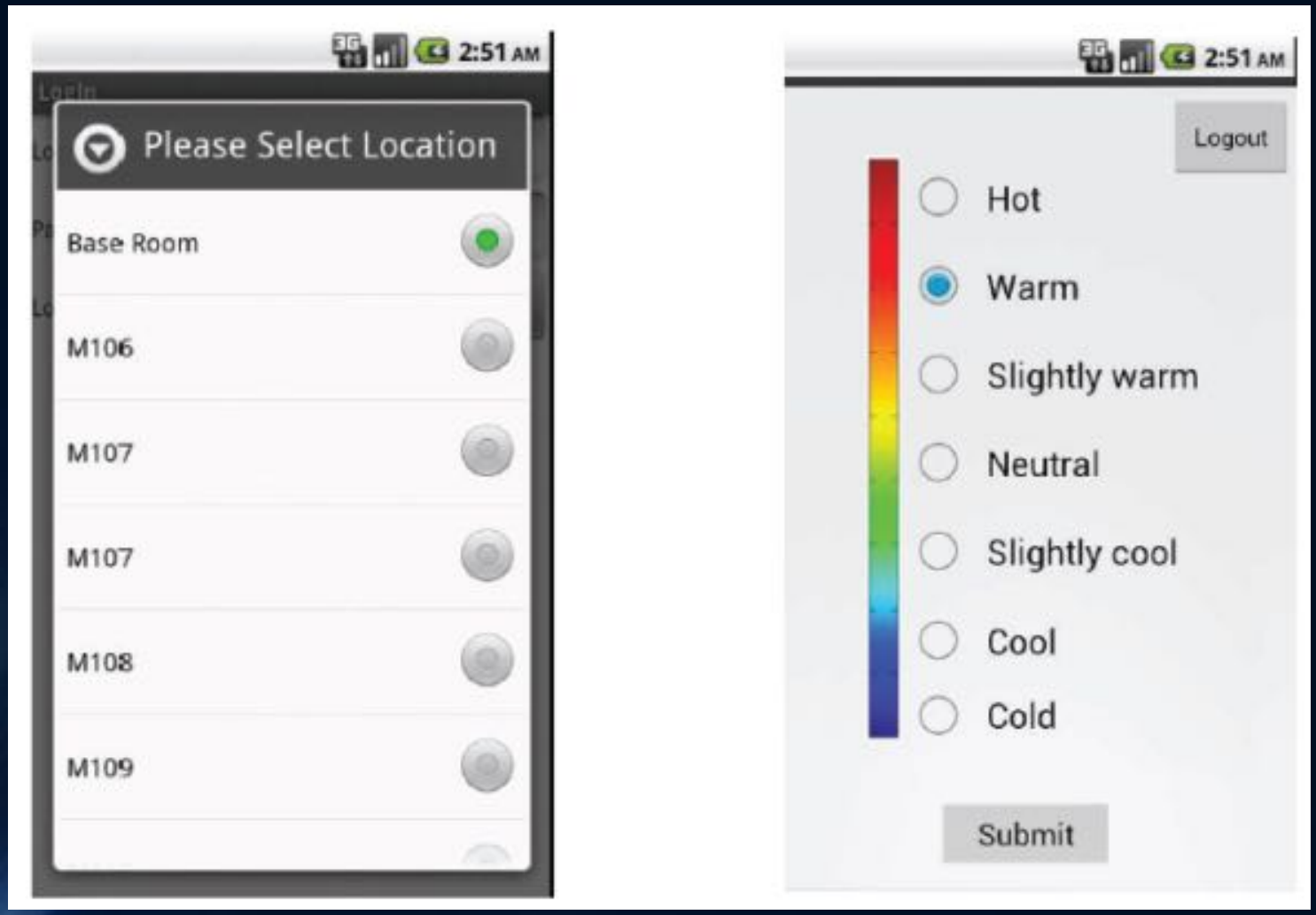
Source: Comfyapp.com

Group comfort improvement



Overall improvement: 33.8%

Smart Office Control App



Smart City Perspective

- Smart Mobility
- Smart Economy
- Smart Government
- Smart Living
- Smart Environment
- Smart People

Thank You!

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