



关于无线传感网络的进展情况

无线传感器网络(Wireless Sensor Networks, WSN)就是由部署在监测区域内大量的廉价微型传感器节点组成,通过无线通信方式形成的一个多跳自组织网络。并以其低功耗、低成本、分布式和自组网的特点带来了信息感知的一场变革。

很多人都认为,这项技术的重要性可与因特网相媲美:正如因特网使得计算机能够访问各种数字信息而可以不管其保存在什么地方,传感器网络将能扩展人们与现实世界进行远程交互的能力。它甚至被人称为一种全新类型的计算机系统,这就是因为它区别于过去连线而可到处散布的特点以及集体分析能力。

关于无线传感网络的进展情况

无线传感器网络所具有的众多类型的传感器,可探测包括地震、电磁、温度、湿度、噪声、光强度、压力、土壤成分、速度和方向、流量等周边环境中多种多样的现象。具有广阔的应用前景。这些潜在的应用领域可以归纳为:军事、航空、反恐、防爆、救灾、环境、医疗、保健、家居、工业、商业等领域。

无线传感器网络是一种全新的信息获取平台,能够实时监测和采集网络分布区域内的各种检测对象的信息,并将这些信息发送到网关节点,以实现复杂的指定范围内目标检测与跟踪,具有快速展开、抗毁性强等特点。

美国商业周刊和MIT技术评论在预测未来技术发展的报告中,分别将无线传感器网络列为21世纪最有影响的21项技术和改变世界的10大技术之一。

About Digi International








- NASDAQ Global Select Market: DGII
 - Founded in 1985 成立于1985年
 - \$170M+ USD annual revenue, no debt
- Based in Minneapolis, USA
- Offices Worldwide 全球设立 office
- Over 20 million devices connected in Fortune 500, government, retail, telecommunications, medical, financial, industrial and embedded applications.
- 全球公认的第一大设备联网（有线/无线）厂家
 - Device/terminal servers and serial adapters 串口服务器、串口卡
 - Remote sensors, zero client display and USB connectivity solutions

Embeddable Modules, Chips, Development Tools

Data Center and Device Networking

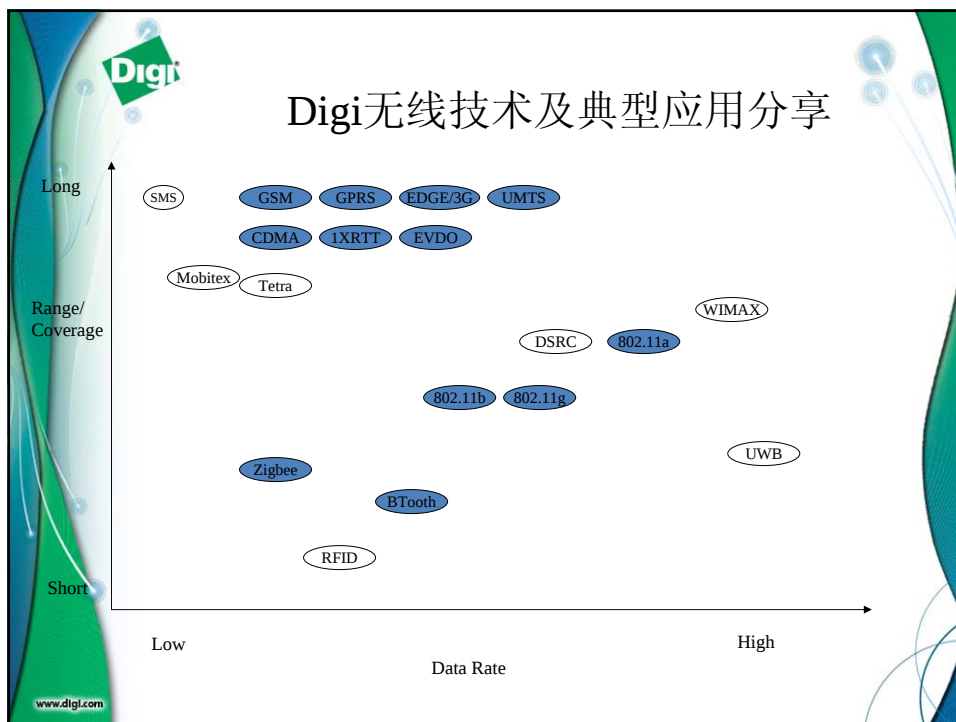
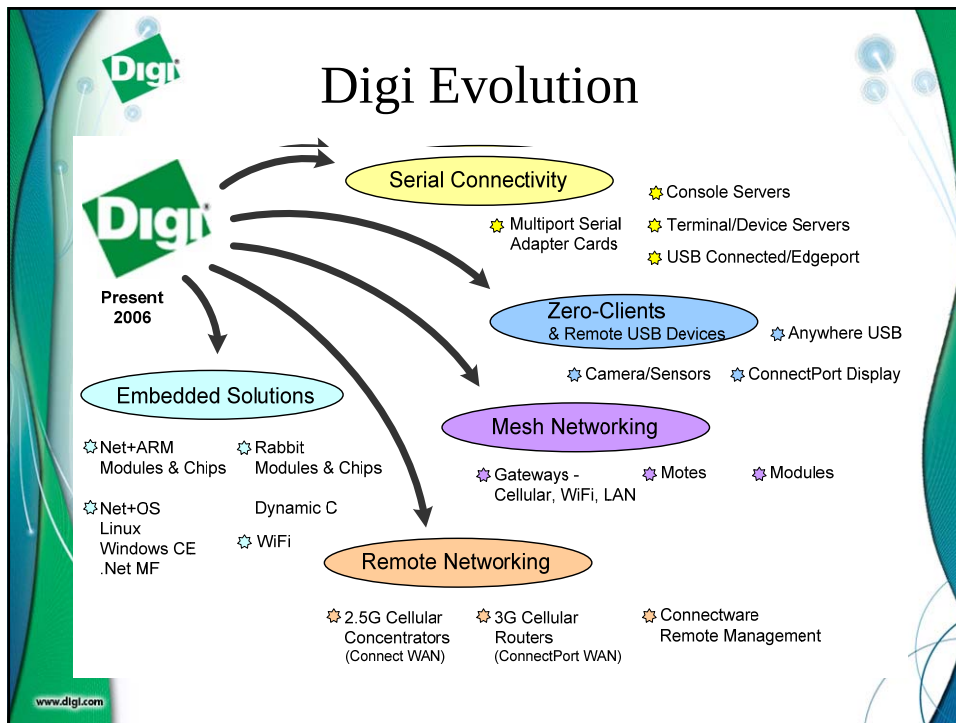
www.digi.com

Making Wireless M2M Easy




The screenshot shows the Digi International website with the headline "Wireless-enable devices anywhere" and "Digi Pioneers Drop-in Networking". The website features a navigation bar with links to Products, Applications, Technology, Support, News, About us, and How to buy. Below the headline, there is a section for "Latest News" and a "Which industry solution is right for you?" section with icons for various industries. The website is displayed in a Microsoft Internet Explorer browser window.

www.digi.com

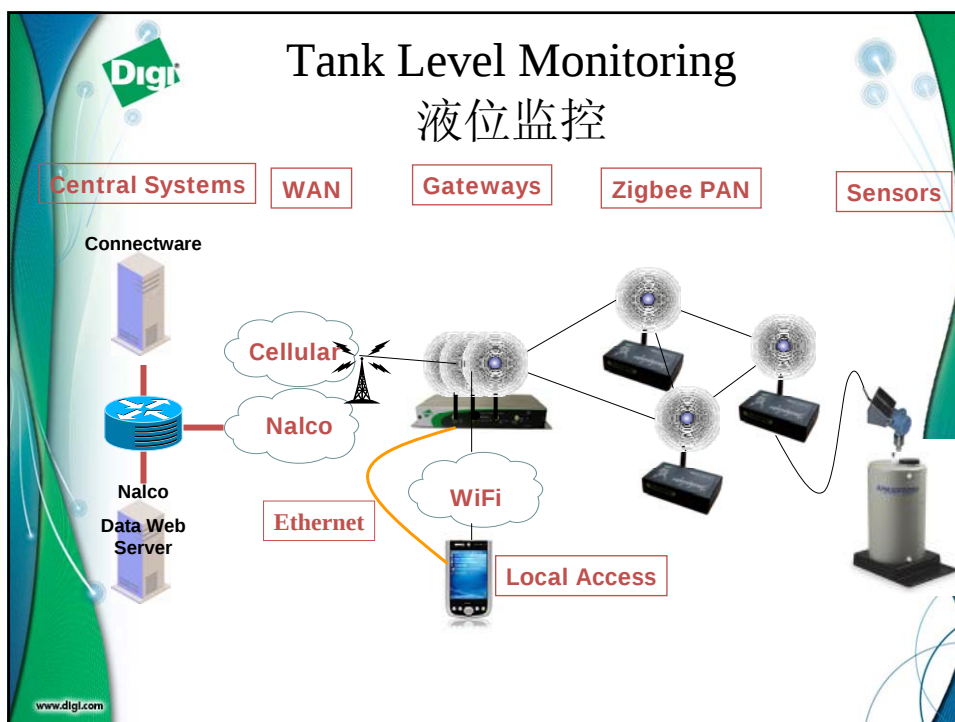


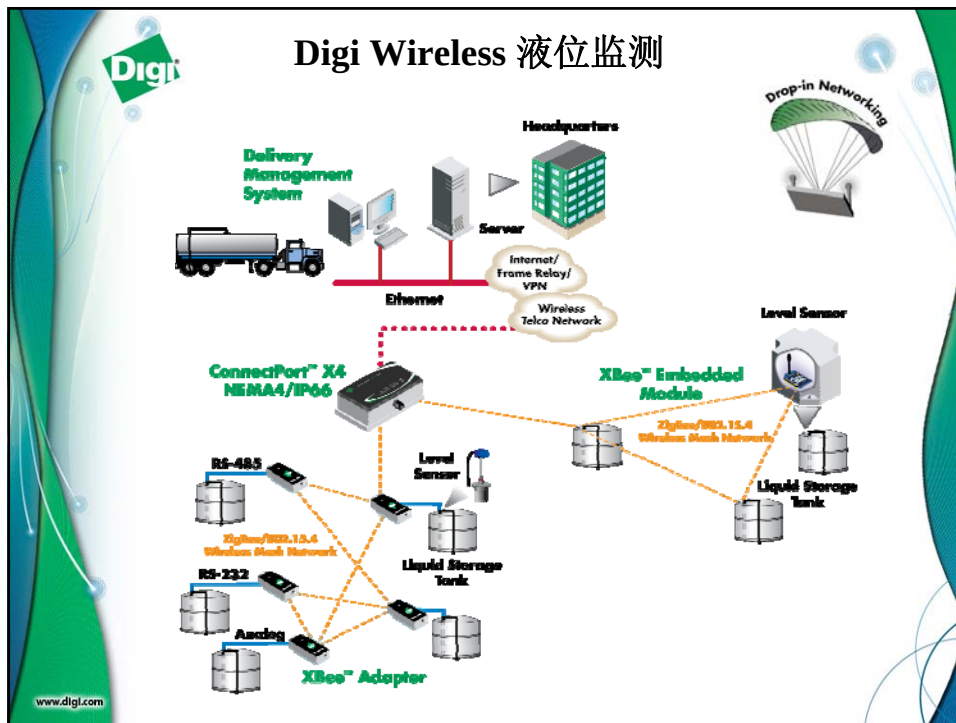


Digi 全系列无线技术及产品

- Zigbee -----xbee 嵌入、外置式应用模块,完整 mesh功能及多种接口RS232/422/485,usb/DI/O,模拟量4-20ma/0-10V/压差, 1wire等
- Wi-fi 系列----connect wi-me嵌入式模块; connectport W系列外置式无线设备联网服务器 (802.11a/b/g)
- Cellular 蜂窝系列: 2.5G/2.75G/3G 设备联网及无线路由器
- RF 数传电台: xstream/xtend modem
- 各种通信互相转换网关connectport gateway
- 未来.....3.5G/4G等等

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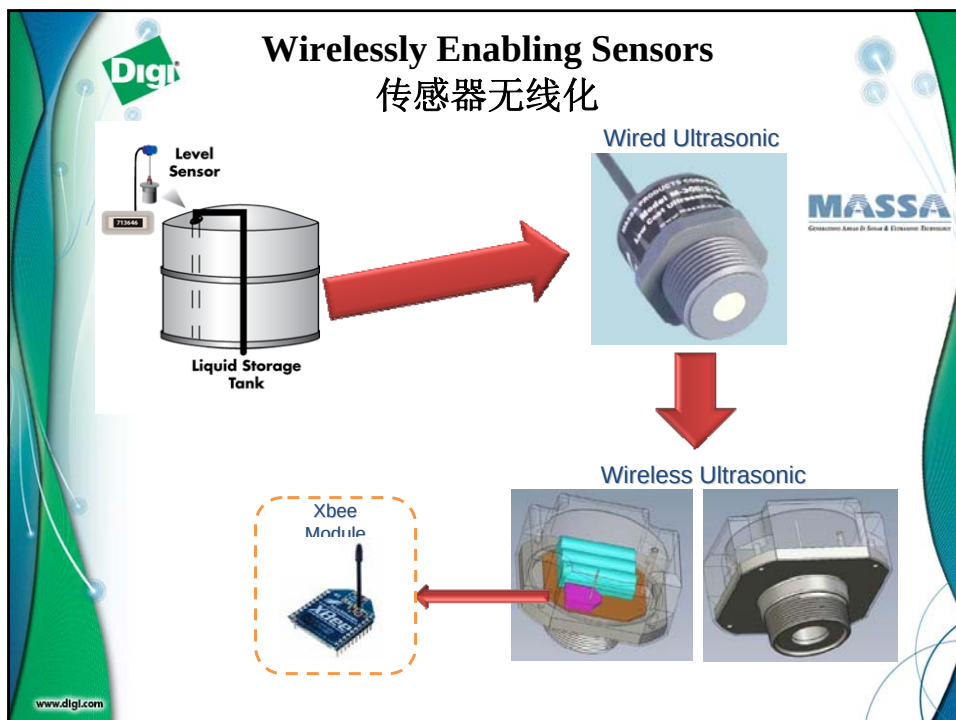


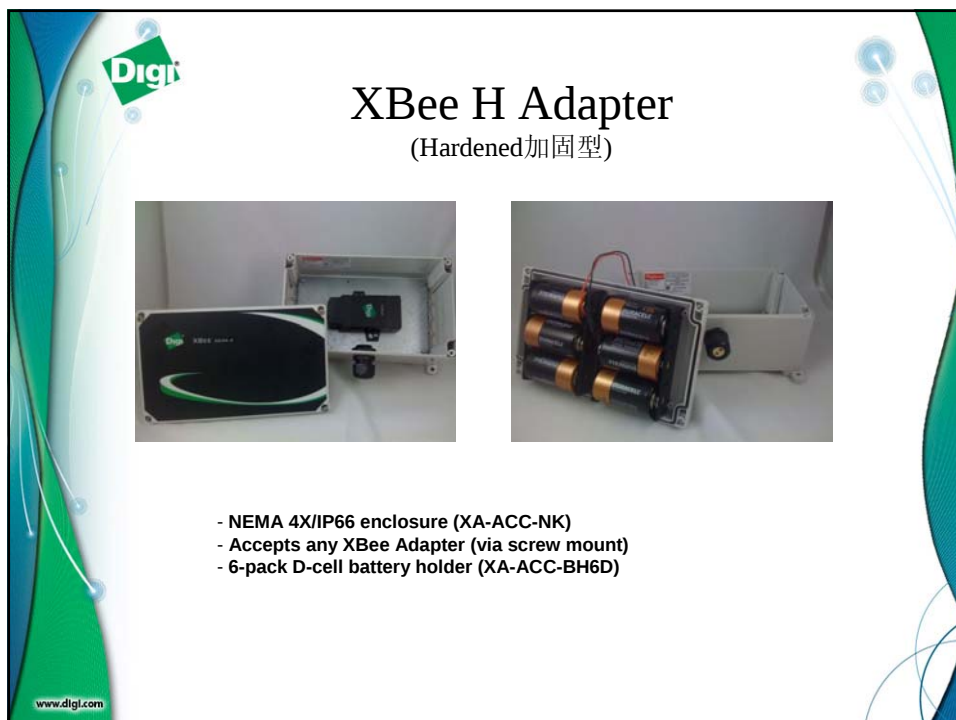
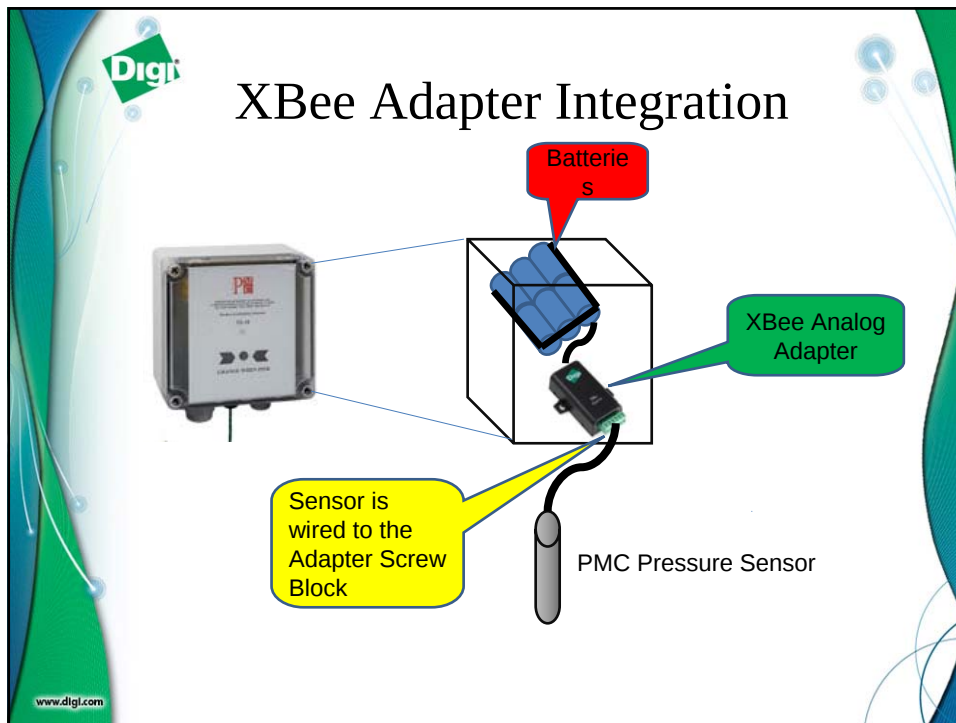
Tank Monitoring Sensors

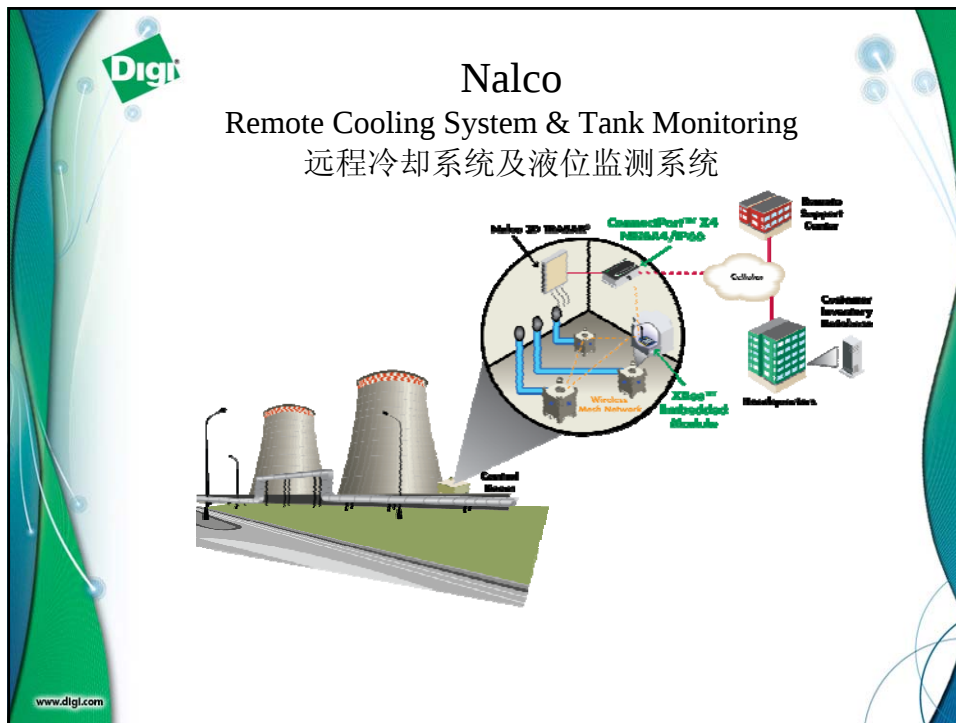
- Ultra Sonic level sensors 超声波
- Differential Pressure sensors 压差
- Load Sensors 负荷



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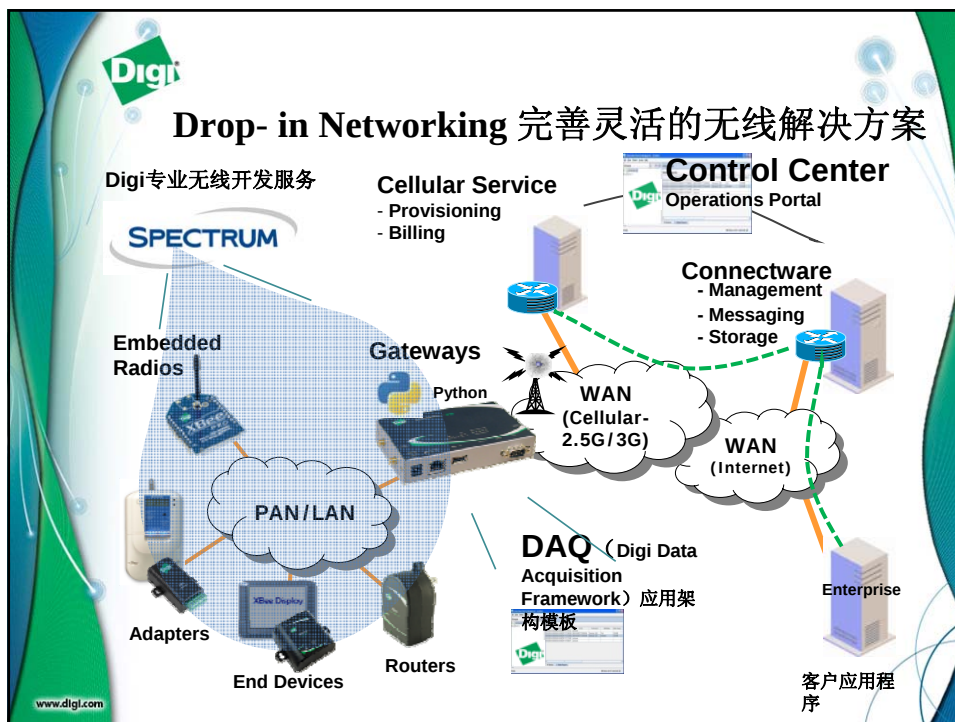
Web Search to Landing Page

The screenshot shows a Google search for 'wireless tank monitoring'. The search results include a link to 'Digiprog Wireless Tank Monitoring'. The landing page for 'Digiprog Wireless Tank Monitoring' is displayed, showing the company's logo, a list of products, and a description of the system. The landing page also includes a 'Webinar' link and a URL: <http://www.automationworld.com/webcast-4384>.

Webinar

<http://www.automationworld.com/webcast-4384>

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Digi Drop-in Networking Technologies 技术

用于建立“即插即用”方案...但他们不是“即插即用”的

- 在网关上需要Python编程，如资料缓存、数据过滤、封包处理等；
- 对于嵌入式xbee解决方案，需要在模块级别的规划设计，主要是将TTL信号与传感器、仪表等接口转换处理
- 是完整方案，非单个产品，包括传感器(或连接传感器的各种适配器)、无线网络（已经具备MESH),网关（可编程）；管理网络软件；
- 融合了zigbee/wi-fi/cellular(GPRS/CDMA/3G)/以太网、串口等多种通信方式

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如何构建无线传感网络—传感器

- 传感器单元

传感器节点通常是一种非常小型的计算机，一般由以下几部分组成：

1. 处理器和内存（单片机，一般能力都比较有限）。
2. 各类传感器（温度、湿度、声音、加速度、全球定位、压力、流量、气体等）。
3. 通讯设备（digi xbee module or adapter）。
4. 电池（一般是干电池，也有使用太阳能电池的）。
5. 其他设备，包括各种特定用途的芯片，串行并行接口等（USB, RS232, RS485, ANALOG I/O, DI/O）

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XBee Sensors

Compact Battery Powered Sensors with Integrated ZigBee

- ZigBee wireless sensors zigbee无线传感器
 - Temperature, humidity, light 温度、湿度、光线
- Small form factor can be mounted anywhere 小巧容易安装在任何地点
- Long-life battery 电池寿命长
 - up to 2 years depending on duty cycle
- Easy to install/configure 容易安装配置
- Integrates with Digi DiN products 直接整合在DIN
 - Integrate with custom Python® development environment (on CPX gateways) for events, triggers and data logging
- ZigBee - compatible with
 - Digi XBee ZNet 2.5 (formerly Series 2) module
 - EmberZNet 2.5x mesh stack



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1wire 传感器

Watchport/D – Distance
sensor 距离

Watchport/T Temperature
sensor 温度

Watchport/H - Humidity &
Temperature sensor 温湿
度

Watchport/W - Water
Detection sensor 干湿

Watchport/A - Accelerometer/Tilt sensor 加速
度

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Point to Multipoint Radios 点对多点电台

Product Name 名称	Frequency 频点	Power Output 输出功率	Indoor Range 室内 Outdoor Range 室外	Data Comm
XBee	2.4 GHz	1 mW	30 meters 100 meters	DSSS 802.15.4
XBee PRO	2.4 GHz New 900	50 mW 100mW (EIRP)	100 meters 1200 meters	DSSS 802.15.4 Freq. Hopping
XStream	900 MHz 2.4 GHz	100 mW 50 mW	450 meters 32 kilometers	Freq. Hopping
Wi-ME / Wi-FM	2.4 GHz	100 mW	100 meters	DSSS 802.11





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Mesh PAN Radios

Mesh PAN 电台



Product Name 名称	Frequency 频段	Power Output 输出功率	Indoor Range 室内 Outdoor Range 室外	Mesh Protocol
XBee	2.4 GHz	1 mW	30 meters 100 meters	Ember 2.5 Zigbee 2006 Zigbee 2007 Digi Mesh
XBee-PRO	2.4 GHz	50 mW 100mW (EIRP)	100 meters 1200 meters	Ember 2.5 Zigbee 2006 Zigbee 2007 Digi Mesh
XBee 900	900 MHz	100 mW 50 mW	450 meters 32 kilometers	Digi Mesh



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Long Range Radios

长距离电台



Product Name 名称	Frequency 频段	Power Output 输出功率	Indoor Range 室内 Outdoor Range 室外	Data Comm
XTend Pt-Pt.	900 MHz	1 Watt	900 meters 64 kilometers	Freq. Hopping
XTend Pt-Pt.	900 MHz	1 Watt	900 meters 64 kilometers	Freq. Hopping Digi Mesh
XPress	900 MHz	125 mW	300 meters 24 kilometers	DSSS



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Digi XBee Adapter Products

适配器产品



- Versions - Now
 - XBee RS232 – DB9
 - XBee RS485 – Terminal Block
 - Xbee Sensor – RJ45
 - XBee Digital IO – Terminal Block
 - **XBee Analog IO – Terminal Block (0-10 volts, 12 bit or 4-20 mA)**
- Optional NEMA4X/IP65 with Class I Div II & Class I Div I certifications

- Battery or External
- 电池或外部供电
 - N-Cell battery
 - 2/3 AA Lithium coming
- Supports all “XBee” form factor
 - Mesh
 - Point to Multipoint

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XBee USB & Pwr Harvest RS-232

USB和供电RS-232



- XBee USB
 - USB Host Connected
 - Quick connect to a PC
 - Drivers compatible with other MaxStream USB products
- XBee Powered RS 232
 - Parasitically powered
 - Simple serial connectivity
 - RS232 Only

- Small Form Factor
- Supports all XBee formats at a PRO level

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如何构建无线传感网络—网络

- 无线通信网络

我们目前的主要无线通信方式:

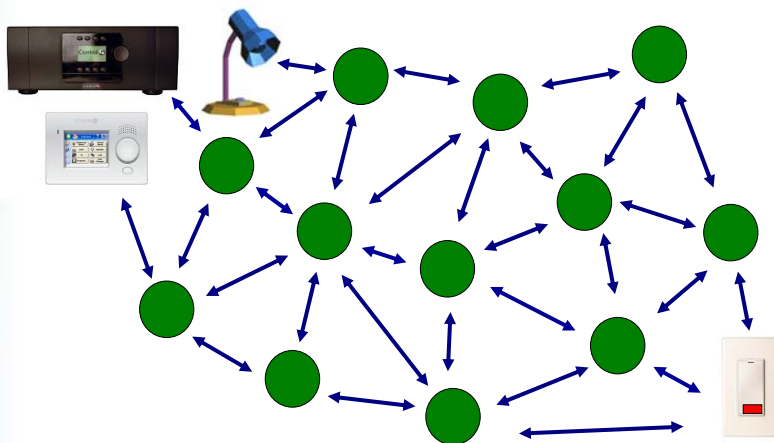
监测区域----zigbee Mesh/Digi MESH

网关----zigbee to ethernet/wi-fi/GRPS/3G/RF

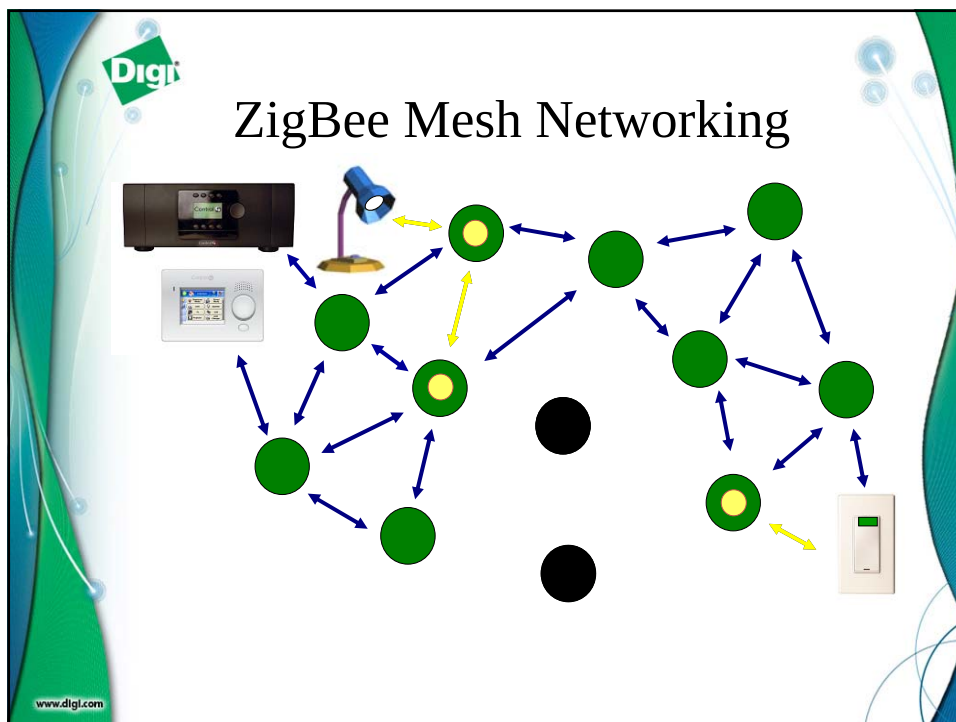
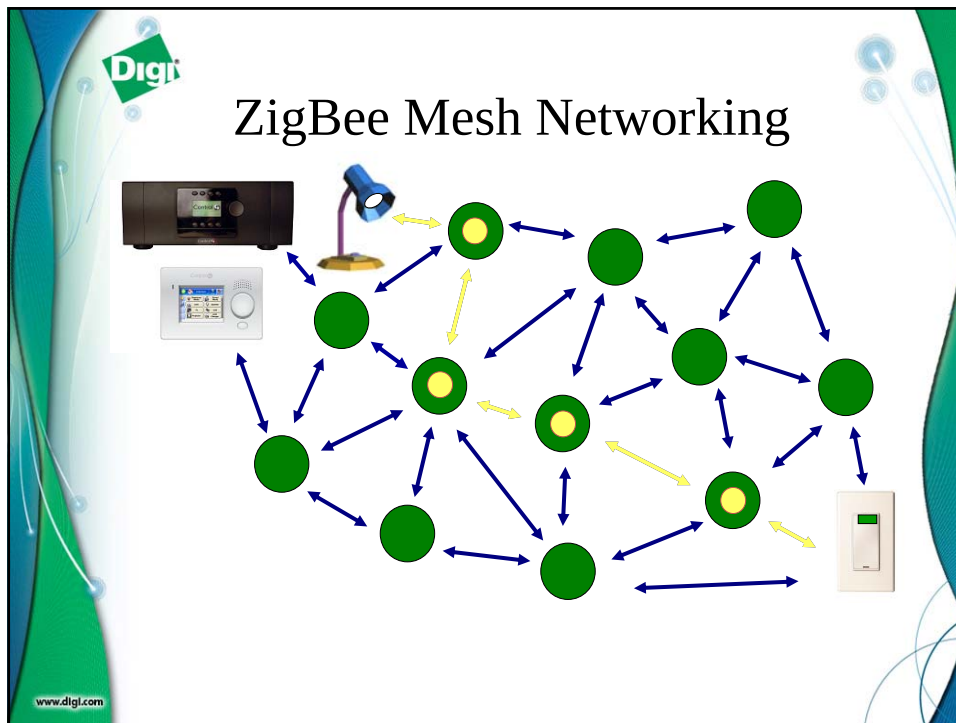
www.digi.com

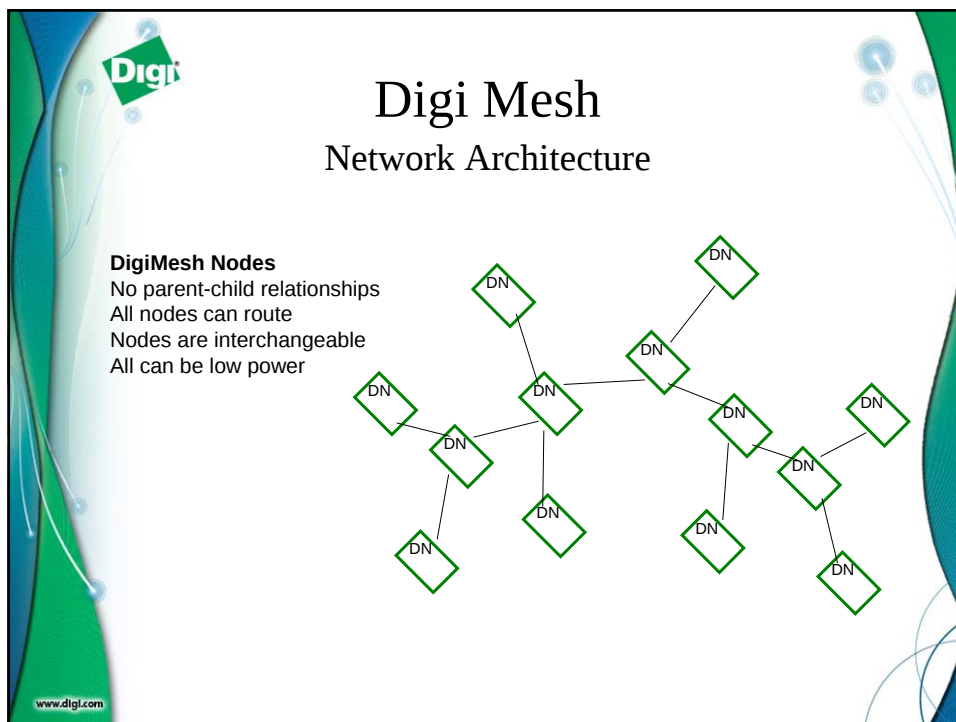


ZigBee Mesh Networking



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如何构建无线传感网络—基站

- 无线传感网络基站

无线传感器网络中的基站的作用是从各个传感器节点收集数据，集中处理然后提交给用户。因此，基站一般有更强的数据处理和通讯能力以及更持久的电力。

Digi connectport X 网关

The slide features a green and blue wave pattern on the left and right sides, with a small 'Digi' logo in the top left corner. The website address 'www.digi.com' is visible in the bottom left corner.

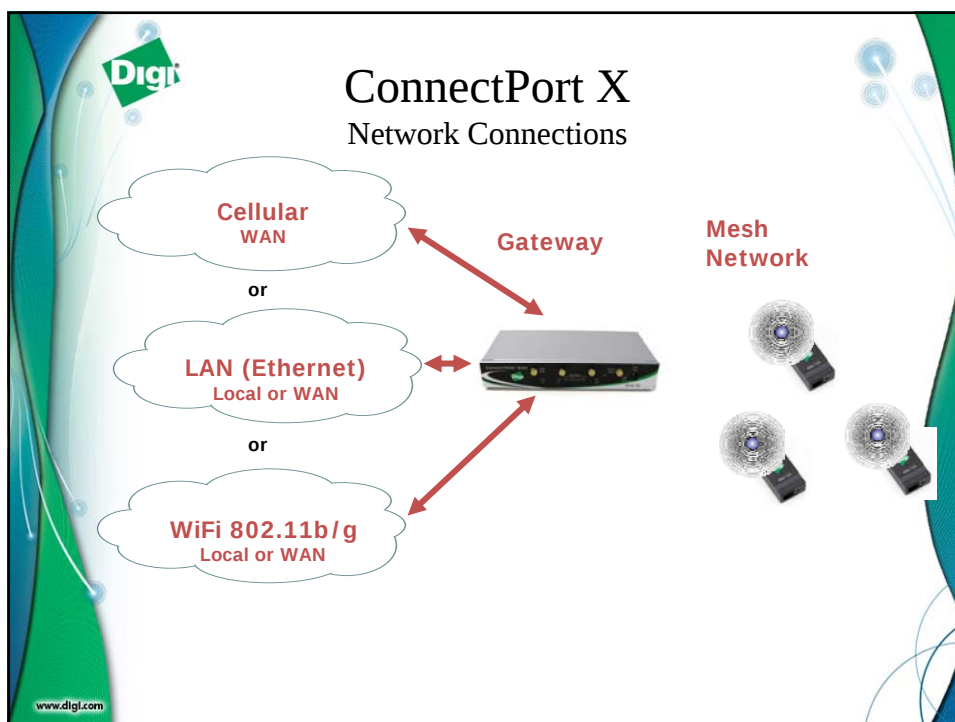


ConnectPort X Gateways

网关

- Mesh和点对多点网络的兼容性网关系列
 - Different Form Factors and different options allowing the ability to optimize configurations
 - Global certification and homologation
 - Class I, Div II Certifications
 - NEMA 4X Versions available soon
- 强大的路由，VPN和管理能力
- 易于采用Python编程
- 方便OEM定制
- Digi 提供DAQ 应用模板及应用案例，方便用户快速完成应用开发

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ConnectPort X8

- **Network Flexibility 网络弹性**
 - 3G EVDO or HSDPA for Wireless WAN
 - 2.5G EDGE/GPRS and 1xRTT Wireless WAN
 - Ethernet for WAN or LAN
 - 802.11.b&g for WAN or LAN
- **Mesh and Point to Multipoint Connectivity Mesh和点**
 - XBee form factor radios
 - 802.15.4
 - Zigbee
 - XStream Series 3 with Digi Mesh
- **Security 安全**
 - IPSEC/SSL Tunneling on WAN Connections with DES, 3DES or AES Encryption
 - 128 bit encryption on the Zigbee/802.15.4 Network
- **Commercial/Industrial Grade 商业/工业级**
 - Enclosed card/module to reduce breakage/theft
 - External antennas with standard connectors
 - Extended operating temperature, -20° to +60°C
 - Hardened enclosure with built-in mounting flanges
 - Real-time clock
- **Connectware Enterprise Management 企业级管理**
- **Additional PCIe Options include internal GPS and GB Storage**
- **附加GPS和GB级存储的PCIe选项**



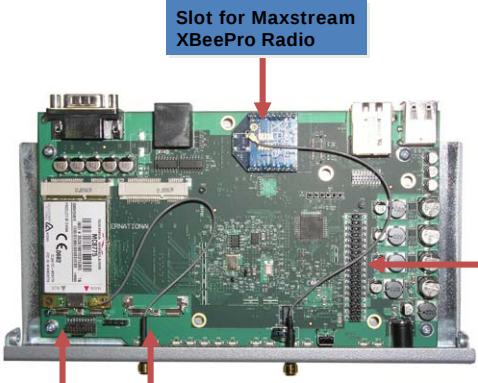




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ConnectPort X8 Inside内部



Slot for Maxstream XBeePro Radio

Serial Expansion Connector

2 PCIe Slots
 -Digi PCIe Embedded WiFi
 -3G or 2.5G WAN Modules*
 -PCIe USB Storage
 -PCIe GPS Module

*GSM always takes the left slot

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- Dynamic, object-oriented language
- 动态的，面向对象的语言
- Extensive libraries
- 广泛的库文件
- Works well with other languages
- 与其它语言配合得很好
- True “Open Source”-> no royalties
- 真正开放源码，无版税
- Runs on a wide range of operating systems运行于广泛的操作系统 - Windows, Linux/Unix, Mac OS X, OS/2, Amiga, Palm Handhelds, and Nokia mobile phones. Python has also been ported to the Java and .NET virtual machines
- Used by Google, Yahoo, uTube, NASA, Honeywell, Disney, IBM, National Weather Service
- 被以上客户使用
- Supporting Rel 2.5 downloadable from <http://www.python.org/>

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如何构建无线传感网络—中心端

- 系统应用计算机，实现整个系统的应用程序及管理网络的功能；
- 1 我们提供AT或API 方式方便客户编程，与有线系统最大的区别是无线有地址的概念；
- 2 我们提供网络管理平台connectware manager

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Digi Connectware Manager

- Enterprise-Class device management platform 企业级的设备管理平台
 - A device's WebUI/CLI is one-to-one 设备的 Web 用户界面或命令行界面都是一对一的
 - Connectware Manager is one-to-many 是一对多的
- Essential management tool for large Drop-in Networking deployments
- 此工具针对大型的分布系统实施。

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What You Can Do with Digi Connectware Manager?

• Commission/Configure devices	• 设定/配置设备
• Remotely upgrade device firmware	• 远程升级设备固件
• Remotely reboot devices, reset defaults	• 远程重启设备或恢复初始值
• Track devices (asset management)	• 跟踪设备状态
• Monitor devices and connections	• 监视设备和连接状态
• Set filters and send alarms – Disconnects and reconnects – Weak signal (RSSI) – Misbehaving devices (sending/receiving tons of data)	• 设置过滤和告警 – 断线和重连 – 信号微弱 (RSSI) – 设备异常 (发送/接收数据风暴)
• Collect and analyze traffic information	• 收集和分析流量信息

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Mesh Network Extensions

延伸

管理网关后面的Mesh设备

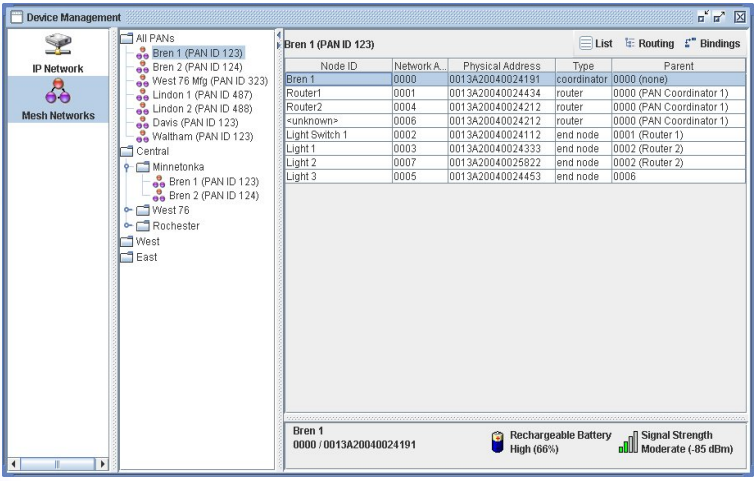
- Manage Zigbee devices behind the gateway
- Display nodes and relationships, network bindings, node descriptors
- Configure gateway Zigbee radio
 - PAN ID, Node ID, Scan Channels, Scan Duration, Statistics
- Network operations performed by the gateway via the ZigBee API
 - Discover devices
 - Query ZigBee nodes for profiles, descriptors, endpoints, radio configuration settings, radio statistics, bindings, etc.
 - Set radio configuration settings on each ZigBee node

- 显示节点和关联，网络绑定，节点描述符等
- 配置Gateway的Mesh电台
 - PAN ID, 节点 ID, 扫描信道, 扫描周期, 统计
- 在网关上利用ZigBee API执行网络操作
 - 发现设备
 - 询问每个ZigBee节点的信息，诸如参数，描述，端点，电台配置参数，电台状态，绑定等
 - 对每一个ZigBee节点的电台进行参数设定

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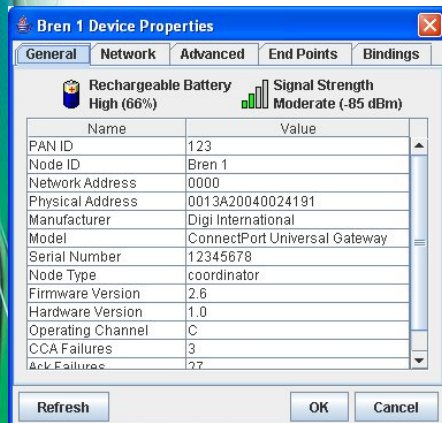



Mesh Networks View



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Node View (Click Down/Drill Down)



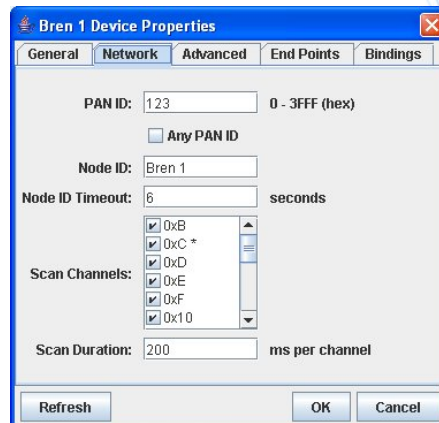
Bren 1 Device Properties

General Network Advanced End Points Bindings

Rechargeable Battery High (66%) Signal Strength Moderate (-85 dBm)

Name	Value
PAN ID	123
Node ID	Bren 1
Network Address	0000
Physical Address	0013A20040024191
Manufacturer	Digi International
Model	ConnectPort Universal Gateway
Serial Number	12345678
Node Type	coordinator
Firmware Version	2.6
Hardware Version	1.0
Operating Channel	C
CCA Failures	3
Ack Failures	27

Refresh OK Cancel



Bren 1 Device Properties

General Network Advanced End Points Bindings

PAN ID: 123 0 - 3FFF (hex)

☐ Any PAN ID

Node ID: Bren 1

Node ID Timeout: 6 seconds

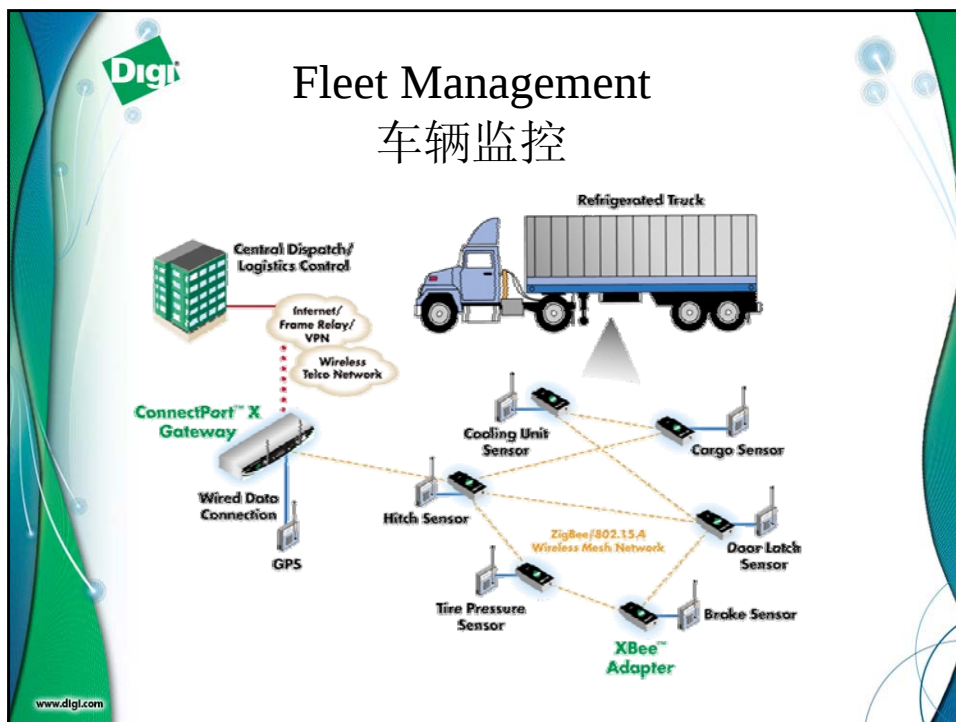
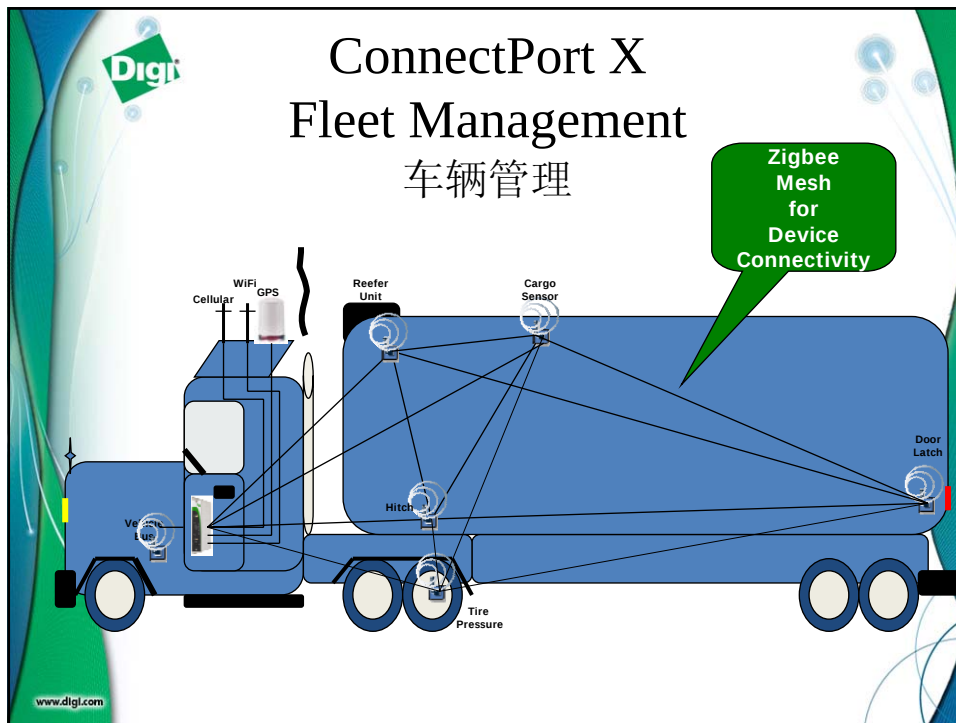
Scan Channels: ☒ 0xB ☒ 0xC ☒ 0xD ☒ 0xE ☒ 0xF ☒ 0x10

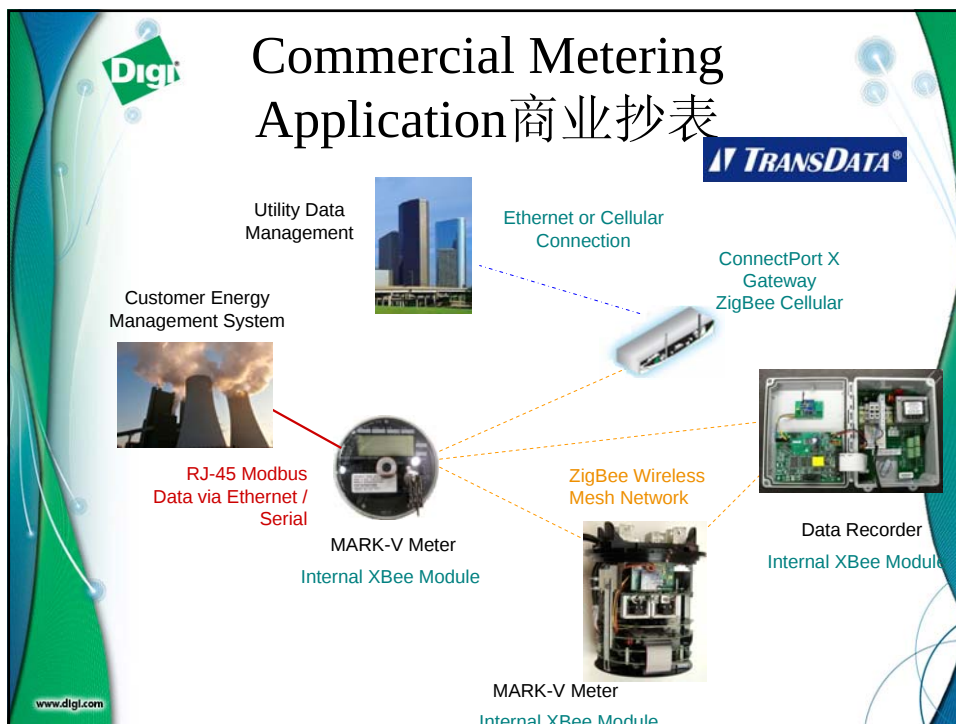
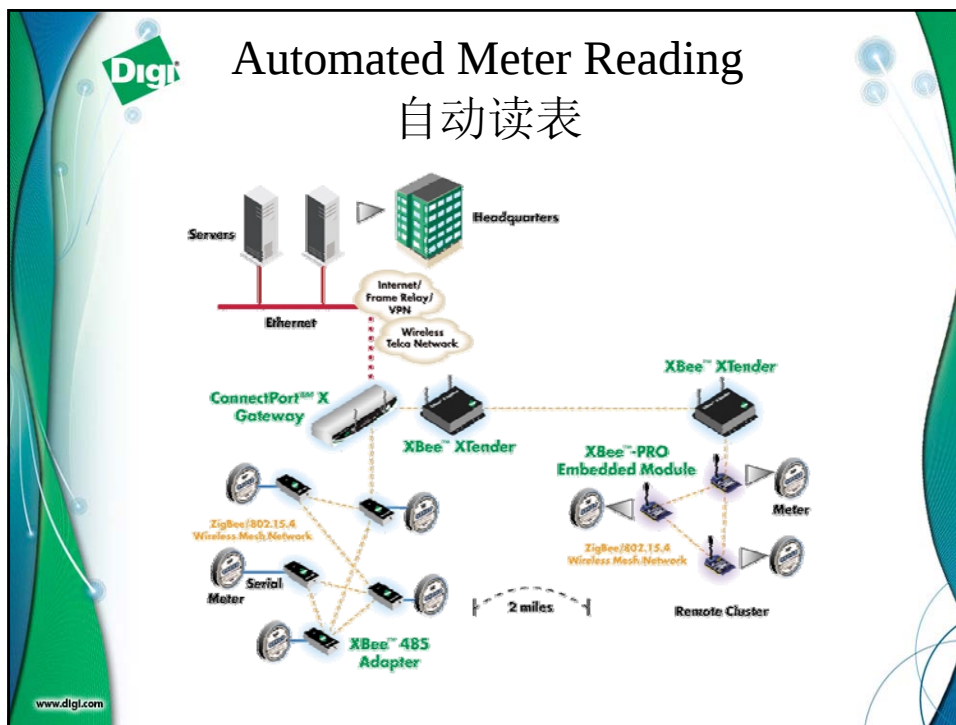
Scan Duration: 200 ms per channel

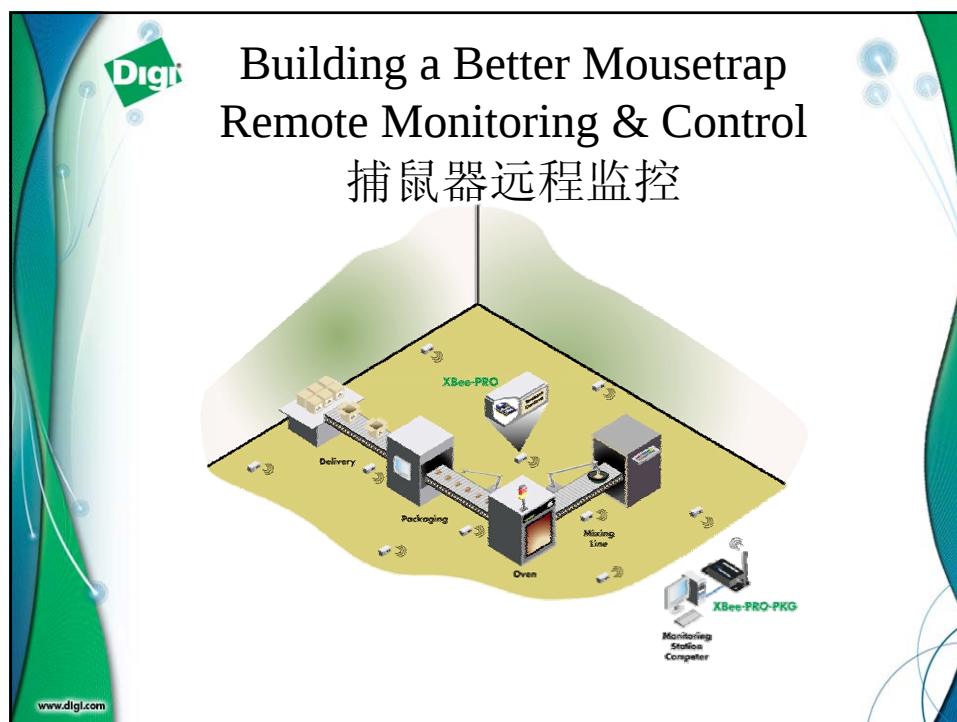
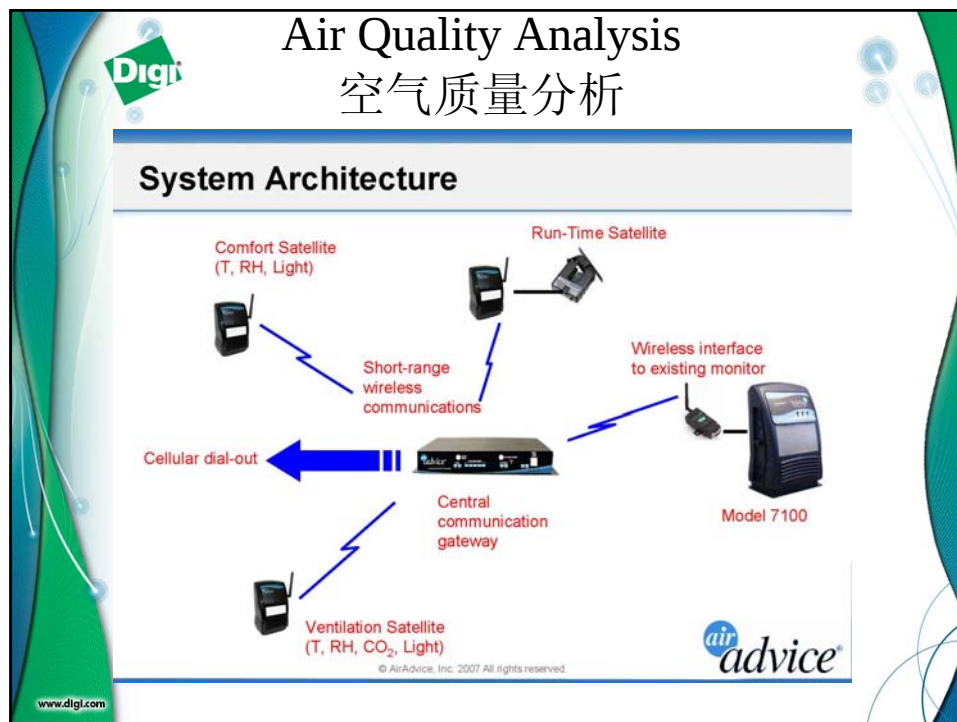
Refresh OK Cancel

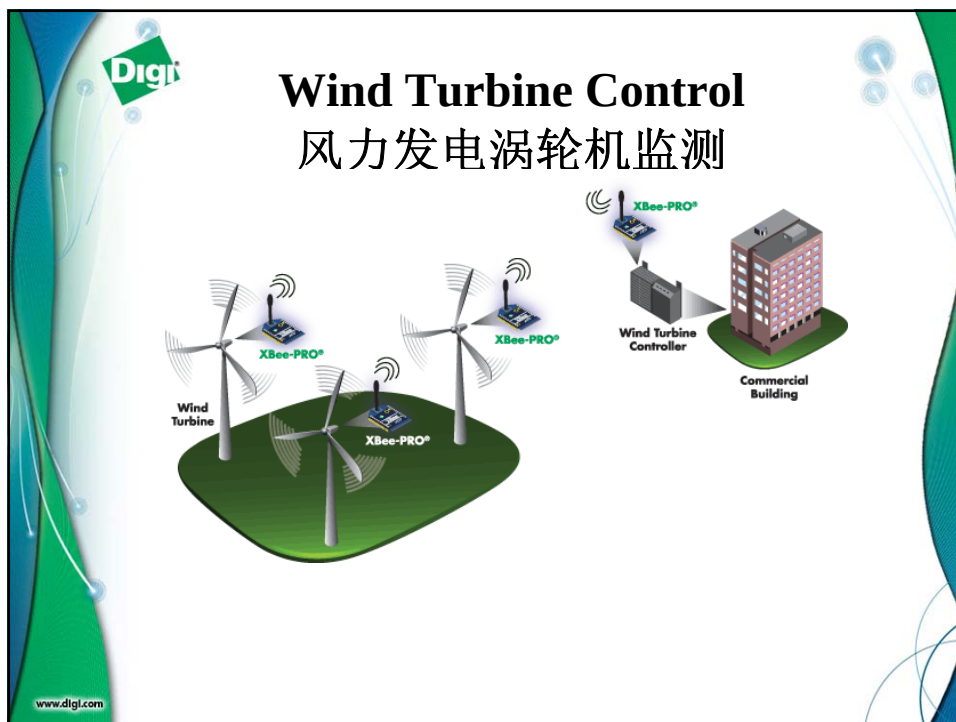
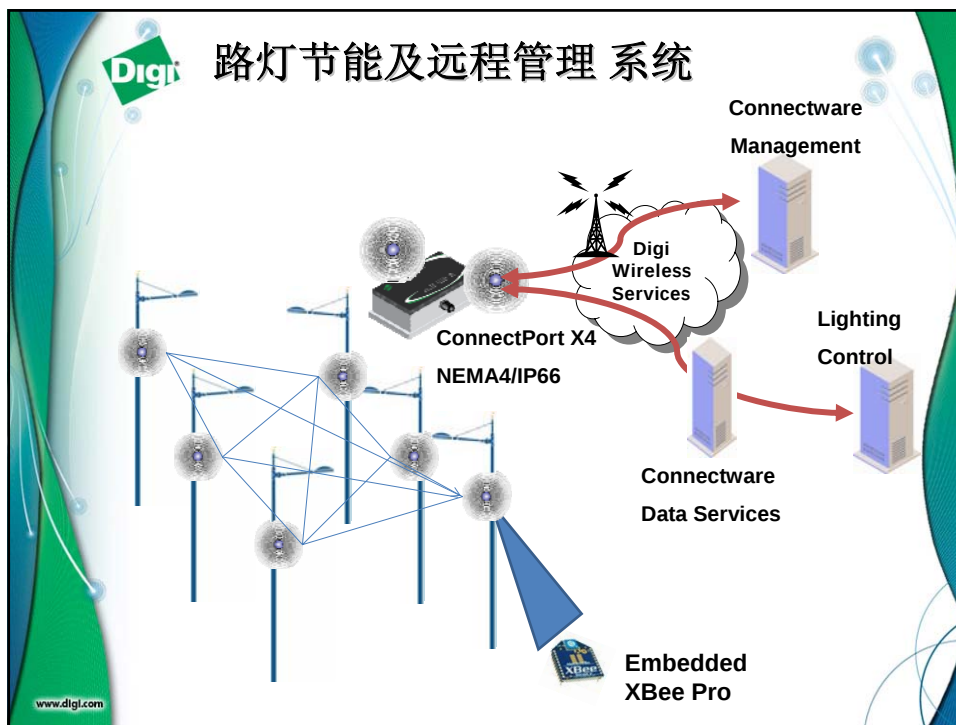
典型应用案例

- 液位监测
- 移动车载
- 智能能源管理
- 自动抄表
- 智能灌溉节水
- 楼宇自动化
- 资产管理（桥梁大坝工程机械等）
- 无线宽带视频监控
- 环境监测（药厂图书馆车间公共场合等）
- 石油矿业（流量计温度压力监测）
- 冶金设备点检











The Challenge

How do I collect information to efficiently apply scarce water resources?
如何有效地采集并使用有限的水资源

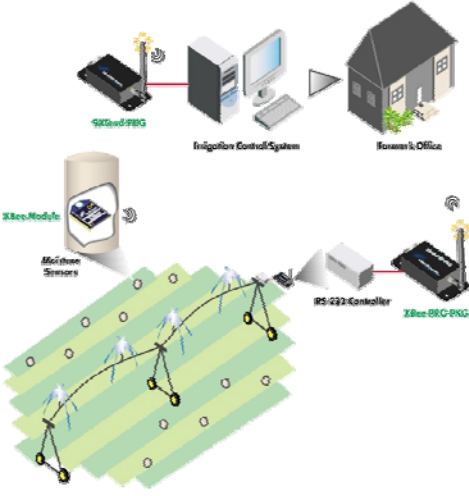


- Pulling wire is very expensive, and likely not feasible
拉线非常昂贵而且不易实施
- Limited power at the end-points 节点没有电源
- Large number of end node devices 节点设备众多
- Long distances to cover (Great for RF) 灌溉范围大

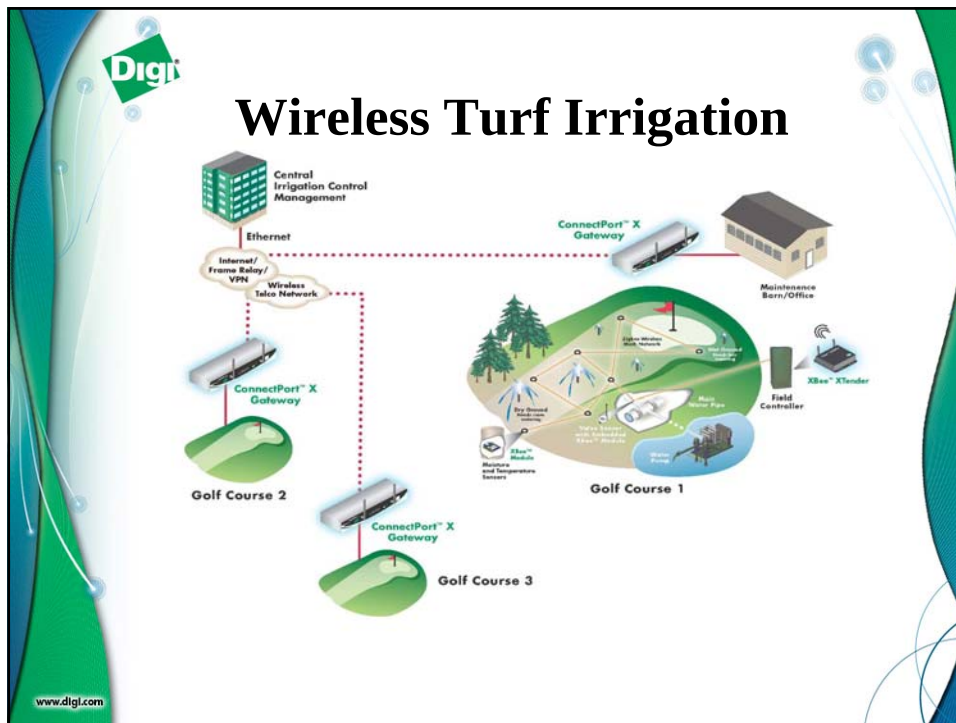
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Wireless Crop Irrigation

无线灌溉系统



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Digi How A Smart Water Solution Comes Together

Digi Gateways
DAQS
Frameworks

WeatherTrak
ET Pro Controller

Turf Management
Software

Moisture
Sensors

➔

Before WeatherTRAK.
Water and dollars pour down the drain from typical landscape overwatering.

Unsightly puddles and sidewalk stains mar the property's appearance
Hardscapes slick from overwatering led to potential slip/fall liabilities
Water usage for 2 months: 545,075 gallons
Water bill for 2 months: \$3,544

After WeatherTRAK.
Bottom-line savings achieved through smart outdoor water management.

- Dry hardscapes are safer for customers and employees
- Water usage for 2 months: 304,543 gallons
- 2-month water savings: 240,532 gallons (44%)
- Water bill for 2 months: \$2,153
- 2-month water bill savings: \$1,391 (40%)

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无线传感网络构建关键点

- 1 功耗与供电
- 2 选择适合的网络拓扑结构
- 3 通信距离、抗干扰等因素
- 4 管理整个节点及网络
- 5 实际工程实施难度
- 6 成本
- 7 网络规模及实时性或可确定性

Digi 其他无线技术及产品&应用

- Wi-fi 高性能设备联网服务器、模块、核心板、设备网卡
 - 3G 路由器系列及串口无线联网服务器
WCDMA/CDMA2000
RF 远程数传电台900Mhz/2.4Ghz
- 详细信息请访问www.digi.com 或与我们交流

