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Transforming the Built Environment

Joseph P. Bocchiaro III, PhD, CStd, CFS D, CFS, ISF, C
 Principal Consultant
 The Serini Group / Advanced Planning Solutions

EMERGING TECHNOLOGIES

APPA Institute Course #115
 DATE: 09/15/2022 APPA INSTITUTE, PROVIDENCE, RI

1

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2

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

3

COURSE DESCRIPTION

To succeed in an always-connected world, project teams must be aware they are now designing for a future where technology is critical to the successful use and operation of the building.

This presentation will review ten of the most important trends impacting building planning and design, including network infrastructure, cloud computing, digital media, network endpoints, multimedia systems, collaboration tools, alternative power sources, building intelligence, advanced visualization tools, and artificial intelligence.

4

LEARNING OBJECTIVES

At the end of this program, participants will be able to:

- Identify emerging information and communications technologies
- Discuss innovations in networks, personal computers, information appliances, and digital video
- Understand how to use virtual reality and skills simulation
- Discuss how technologies are changing the 21st century campuses

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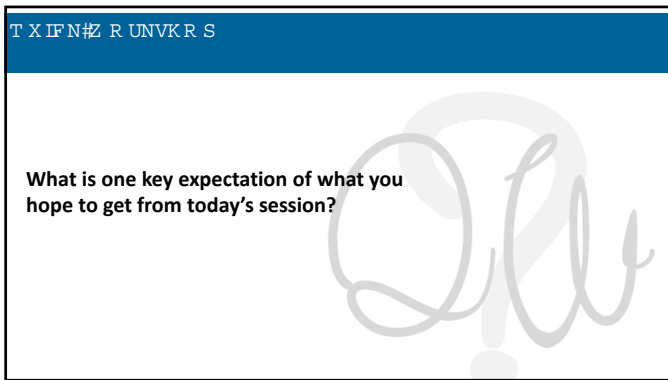
TODAY'S AGENDA

- **WHY WE CARE?**
 - GLOBAL TRENDS & THE MARKET'S PERSPECTIVE
- **TOP TEN EMERGING TECHNOLOGIES**
 - FROM NETWORK TO NODE TO SUSTAINABILITY SERVICES
- **INTEGRATING TECHNOLOGY & DESIGN**
 - SPACE & BUILDING DESIGN IMPACT: ASPIRATIONAL GOALS
- **Q&A DISCUSSION**

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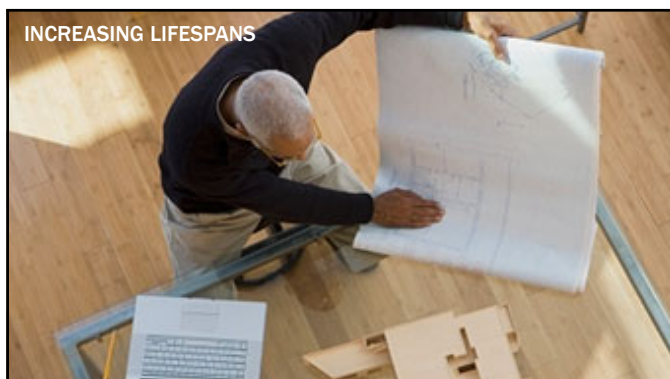
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6 DISRUPTIVE FORCES IN 2022*

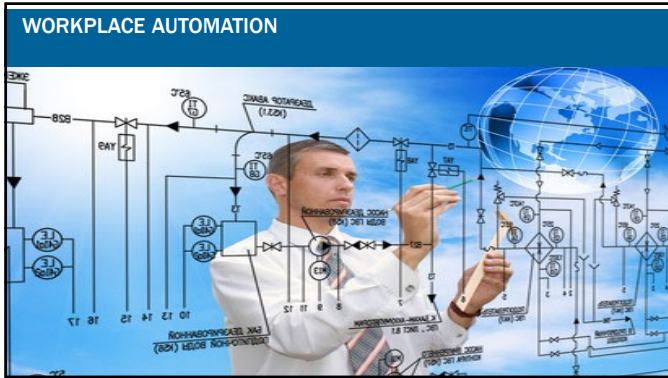
- Increasing global lifespans *changing the nature of careers and learning*
- Workplace automation nudges human workers out of rote, repetitive tasks increasing demand in service sector
- Massive increases in sensors and processing power make the world a programmable system
- New communication tools require *new media literacies* beyond text
- Social networking drives new forms of *production and value creation*
- Increased global interconnectivity puts *diversity and adaptability* at the center of organizational operations
- *Pandemic, Supply Chain, Inflation, Ukraine War* are driving uncertainty, changes in consumption habits

* Source: Institute for the Future/Apollo Research Institute 2020

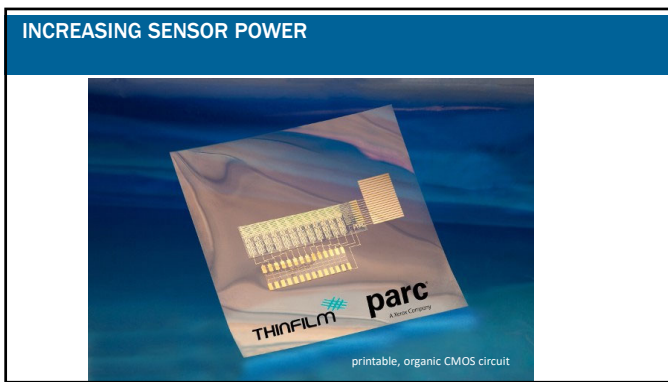
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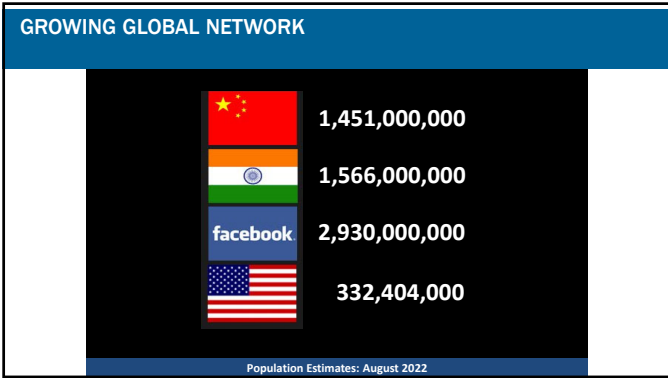
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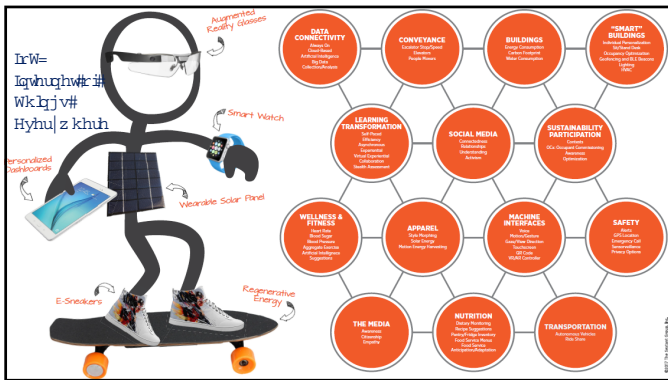
18

YOUR NEXT CLIENT

- Always On, Connected
- Active, Social & Visual
- Expect Full & Immediate Access to Media and Information
- Creates & Consumes Media
- Visual, Multi-sensory
- Connect Living & Learning
- Technology Is Cool
- Prefer Authenticity to Hype
- Want To Collaborate
- Global Thinkers; Connected to Others, World-wide



19




20

THE GREAT GLOBAL GRID: EXPECTATIONS

Unlike the current World Wide Web, the "Great Global Grid" will be primarily a visual medium.

— Michael Malone
"Internet II: Re-booting America"



21

WHY ISN'T IT LIKE MY PHONE?



22

WHY ISN'T IT LIKE MY TABLET?

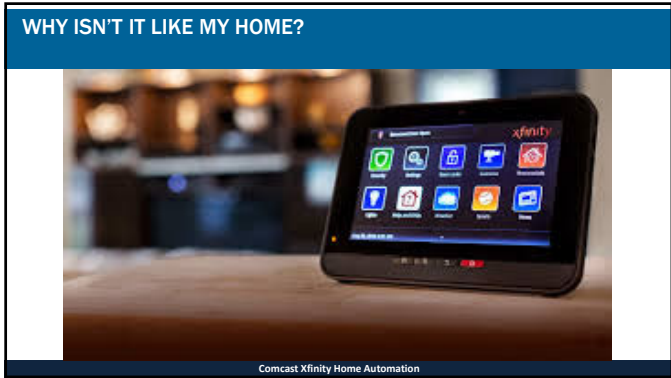


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WHY ISN'T IT LIKE MY CAR?



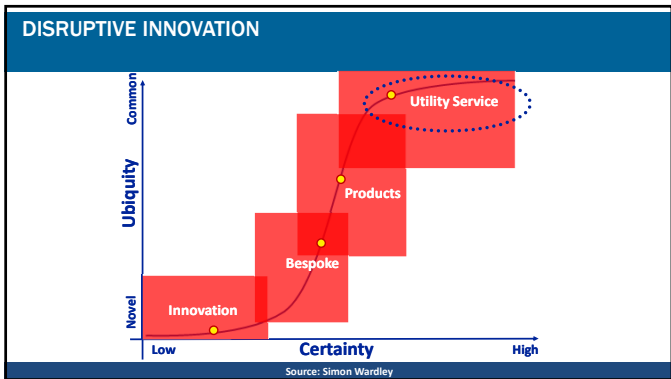
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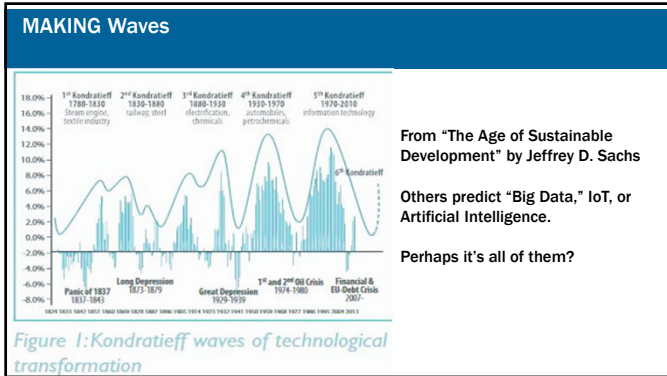
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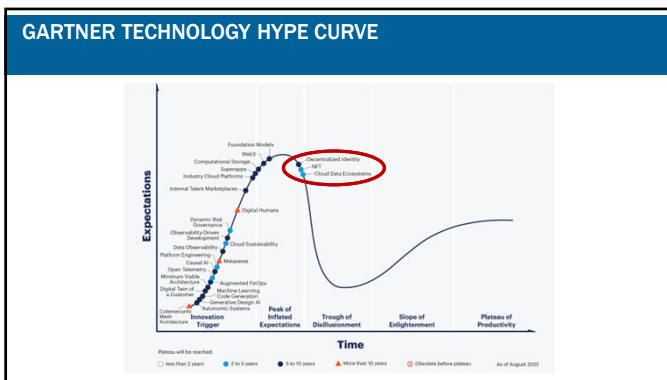
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Why focus on new technology?

What happens if we don't?

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BILL GATES...

“

We always *overestimate* the change that will occur in the next two years and *underestimate* the change that will occur in the next ten.

”

31



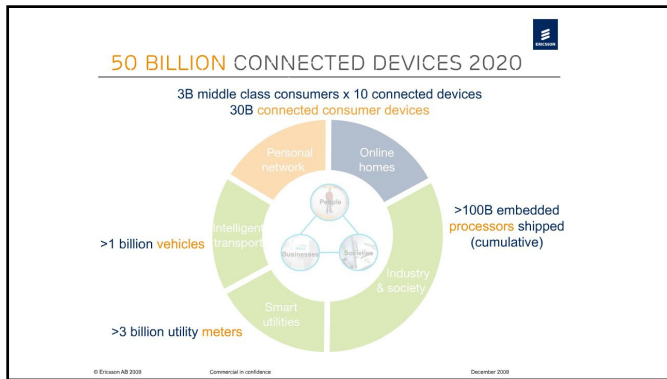
TEN EMERGING TECH TRENDS

32

COPPER
FIBER
WIRELESS

1. UBIQUITOUS HIGH-SPEED NETWORKS

33



34

BANDWIDTH, THE 4TH UTILITY

- **Copper Cable**
 - Performance Gains With Copper Continue To Be Realized
 - 100 Mb / 1 Gb / 10 Gb
- **Optical Fiber**
 - 9.5% Annual Growth For Fiber
 - Strong Demand For Advanced IT & Emerging Multimedia Services
 - 100 Gb

35

BANDWIDTH, THE 4TH UTILITY: TOWARDS 5G

Antenna
Structured Cabling
DAS Equipment
Cellular Equipment

Approximately 80% of wireless calls happen indoors
In-building networks are key to delivering 4G data speeds

Corning Incorporated

36

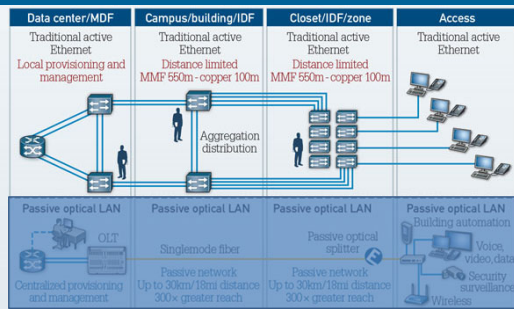
5G CELLULAR SERVICE

- 5G brings three new aspects to cellular communications:
- Greater speed (to move more data)
- Lower latency (to be more responsive)
- Ability to connect a lot more devices at once (for sensors and smart devices)
- Warning: Low-e Glass



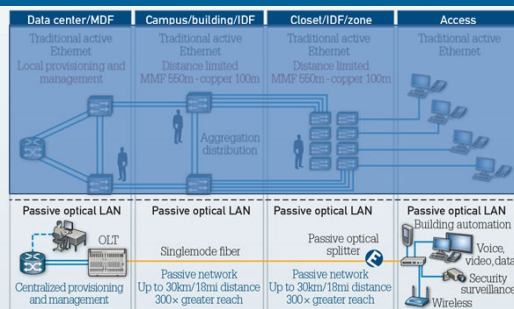
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TRADITIONAL COPPER IT INFRASTRUCTURE



38

GIGABIT PASSIVE OPTICAL NETWORK (GPON)



39

AND NOW "LI-FI:" VISIBLE LIGHT COMMUNICATIONS

- Li-Fi uses common household LED (light emitting diodes) lightbulbs to enable data transfer, boasting speeds of up to 224 gigabits per second
- Secure device-device filesharing
- Secure transactions
- Phones or phone cases equipped
- Up to 10 Gbps



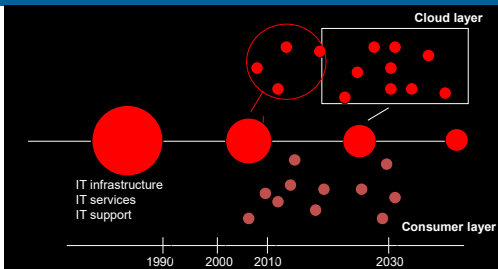
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SAAS
BIG DATA
PREDICTIVE ANALYTICS

2. CLOUD COMPUTING

41

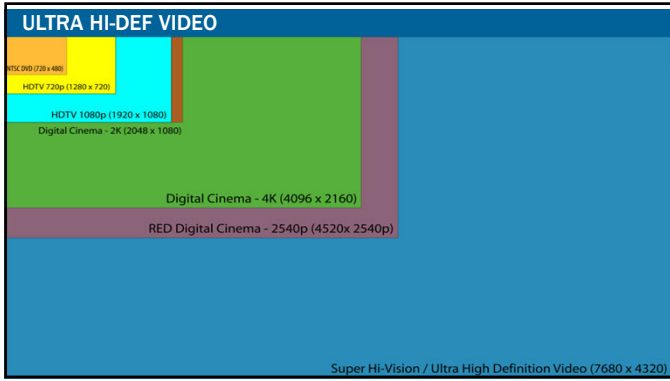
FROM DESKTOP TO "THE CLOUD"



Source: Richard Katz, Educause 2009

42





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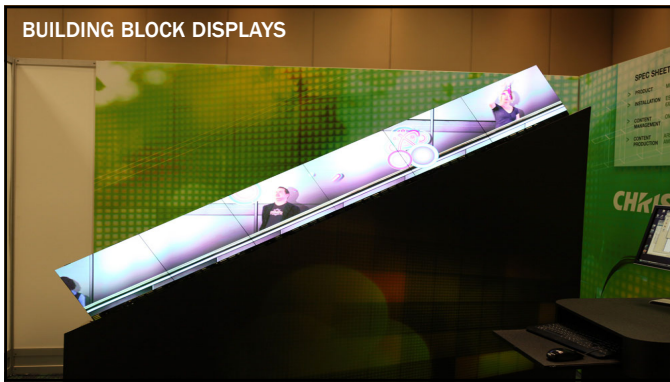
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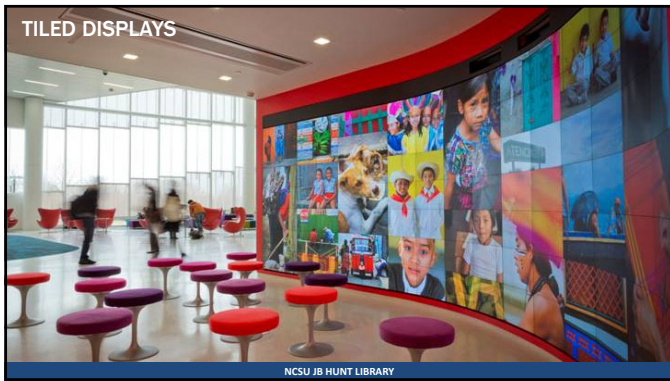
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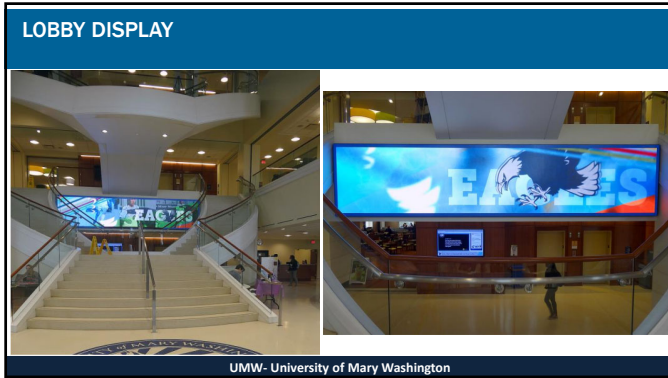
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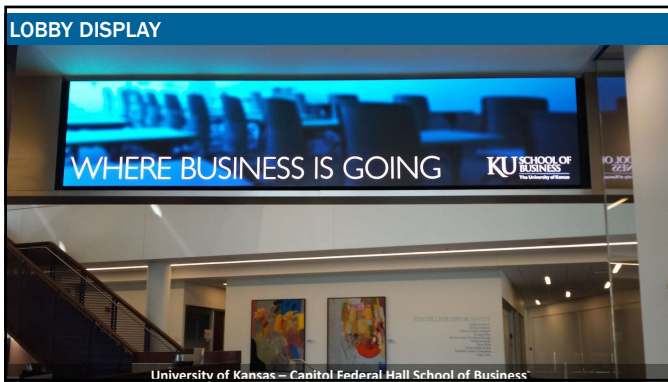
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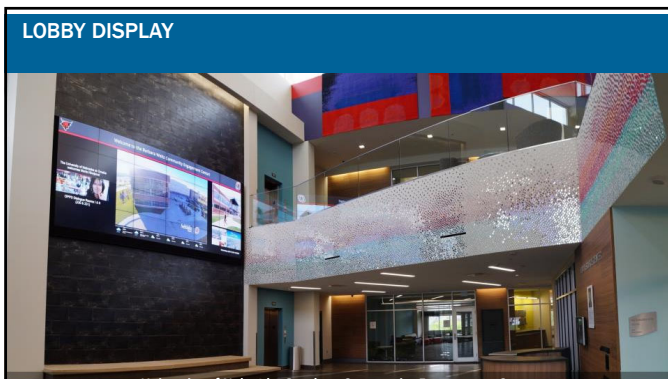
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54

NEW AV DISPLAY POSSIBILITIES



21:9 Native Displays; Microsoft Teams Front Row

Heckler AV Wall / Meeting Kit

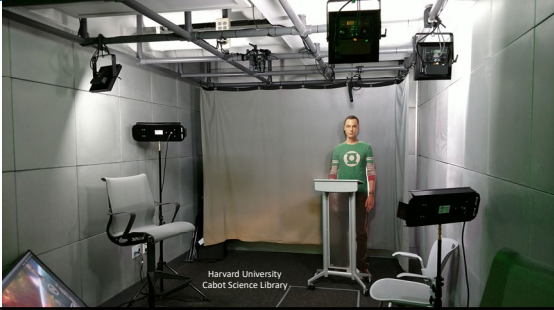
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GOSH DARN REALLY BIG DISPLAYS! UBIQUITOUS AV IS HERE



56

CONTENT DEVELOPMENT



Harvard University
Cabot Science Library

57

ESPORTS!



58

THIN CLIENT
BRING YOUR OWN DEVICE

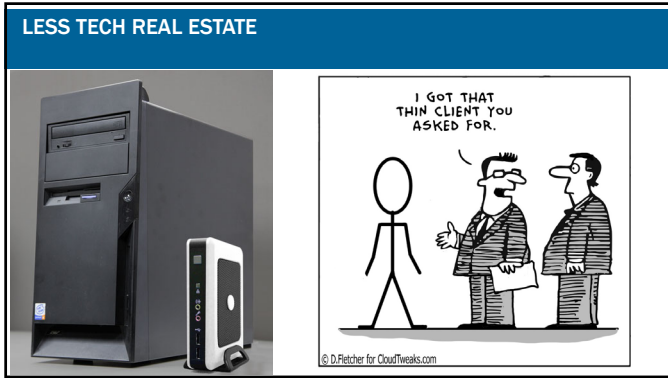
4. POWERFUL FLEXIBLE END POINTS

59

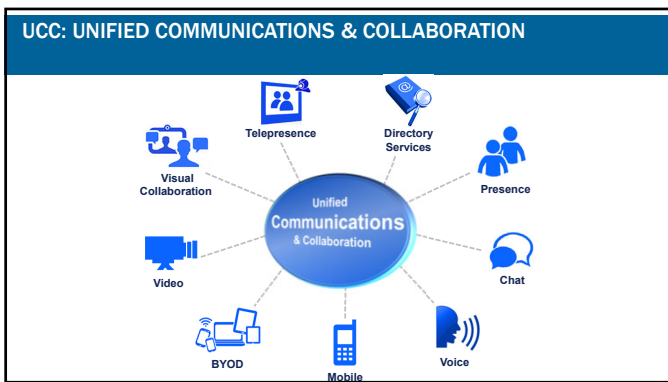
BRING YOUR OWN DEVICE (BYOD)



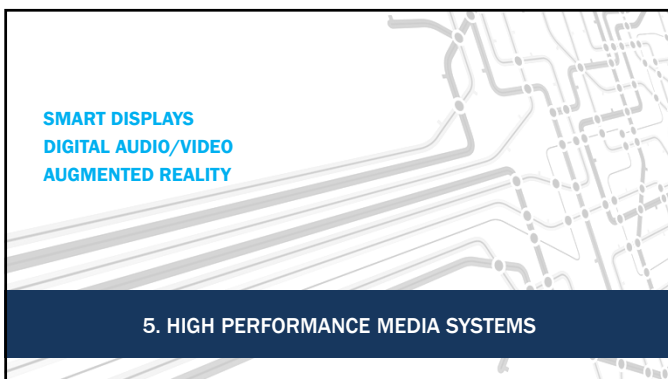
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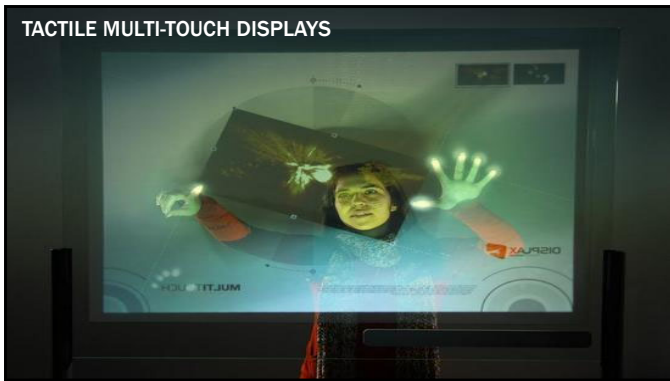
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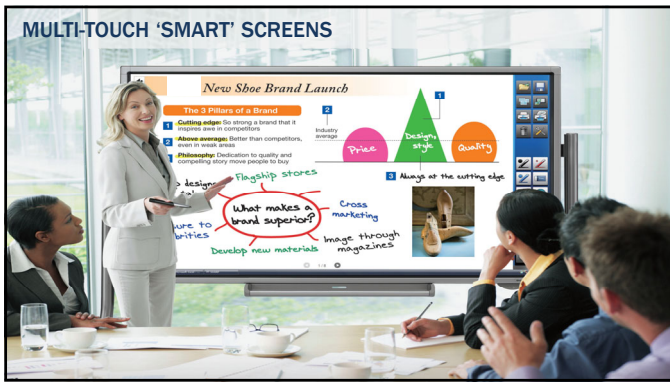
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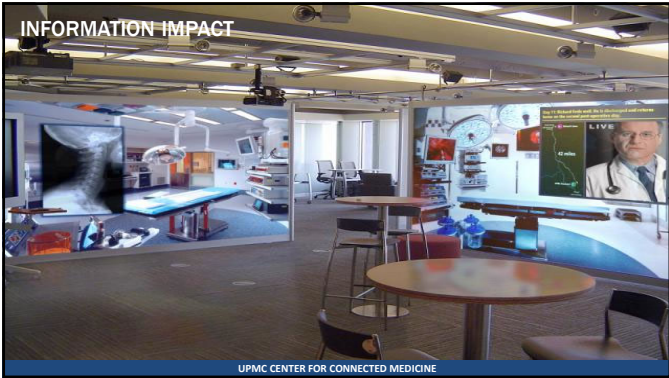
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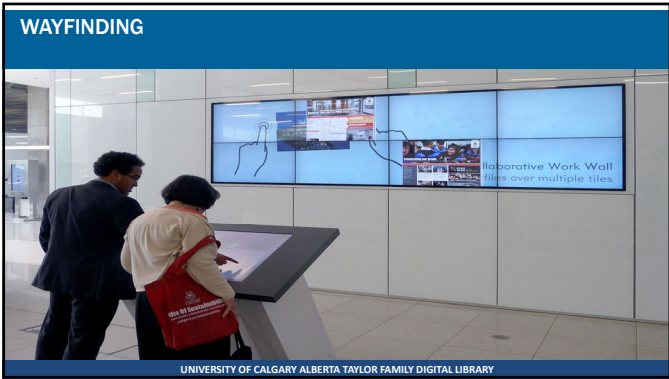
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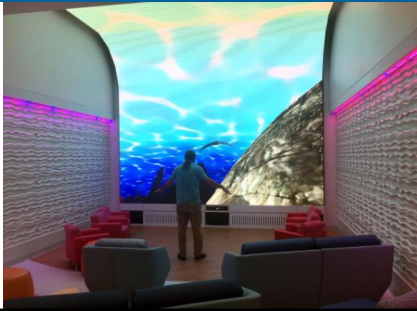


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INTERACTIVITY: GESTURE



70

SMART AV SYSTEMS

BOARDROOM / CONFERENCE ROOM / CLASSROOM

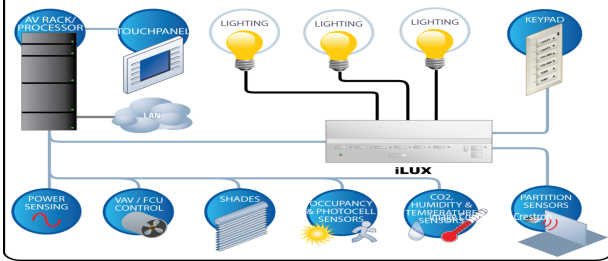


Image Courtesy of Crestron

71

FACILITY MANAGEMENT SYSTEM

RoomView® FULLY INTEGRATED FACILITY MANAGEMENT SYSTEM

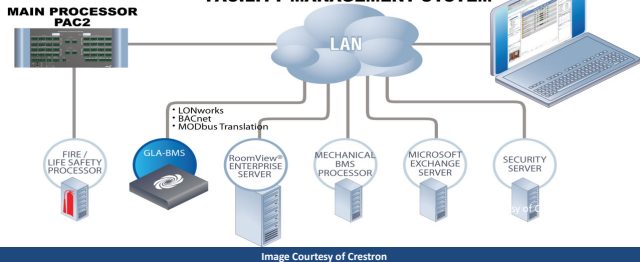
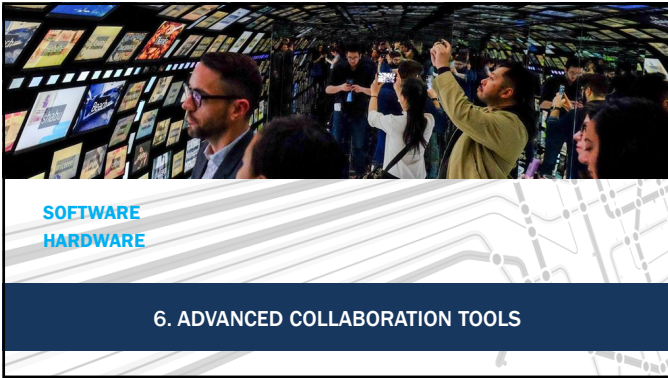


Image Courtesy of Crestron

72



73

VIDEOCONFERENCING / TELEPRESENCE

- Video Conferencing
- Web Conferencing
- Virtual / Continuous Presence
- Distance Learning

HyFlex Classrooms, Version 1.0

74

K D U Y D U G # K E [# O L Y H # W X G I R

- <https://youtu.be/P49hyHYPOQg>
- Harvard B School
- Up to 60 participants on individual screens
- Local PBS TV station
- 2015

HyFlex Classrooms, Version 1.0

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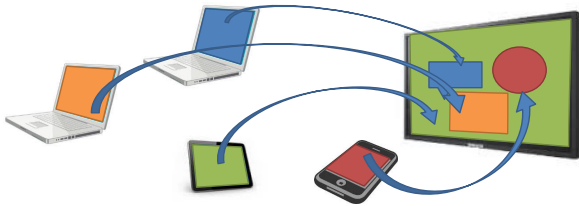
DIGITAL IN AN ANALOG WORLD



77

COLLABORATION TOOLS

GROUP WIRELESS COLLABORATION

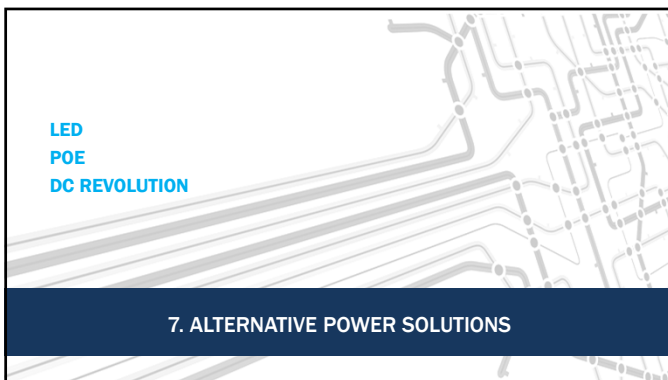


- Multiple users collaborating on a single screen on a common document; Content can come from many different devices; saved to the cloud

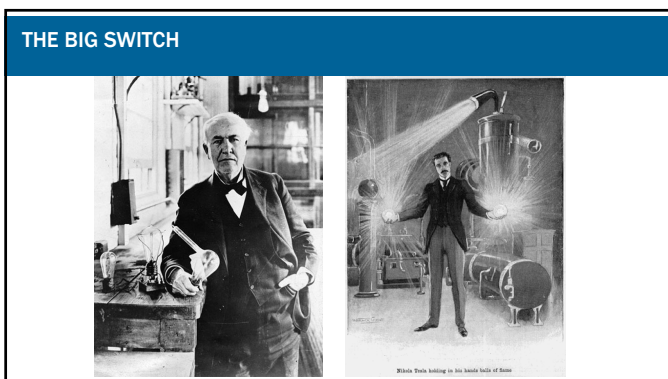
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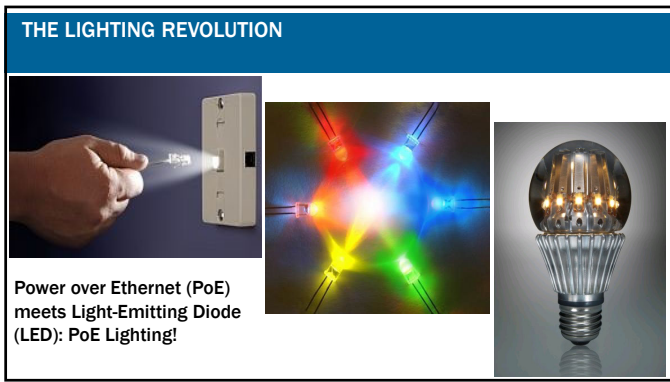
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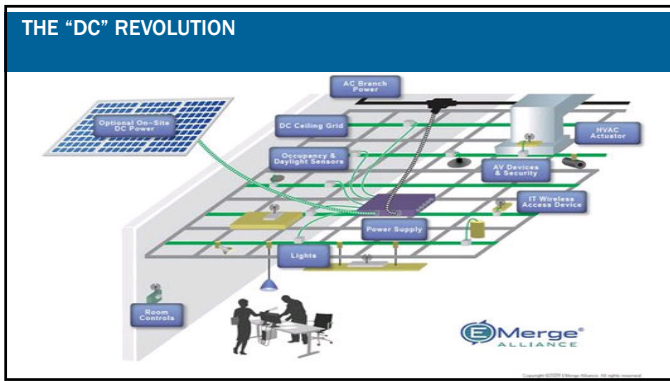
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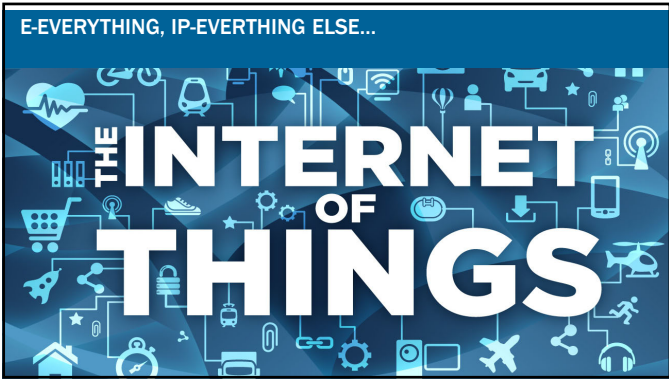
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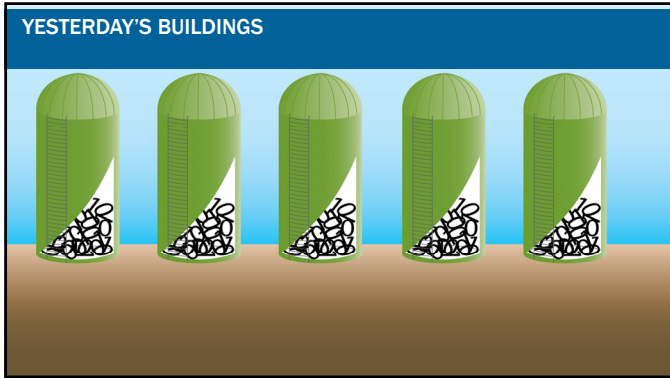
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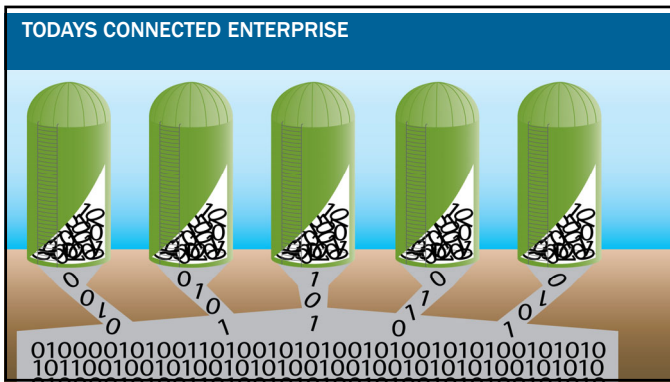
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89

SMART BUILDING

"A process of conceiving, designing, constructing, commissioning, and operating buildings, which leverages technology to optimize the goals and objectives of the built environment."

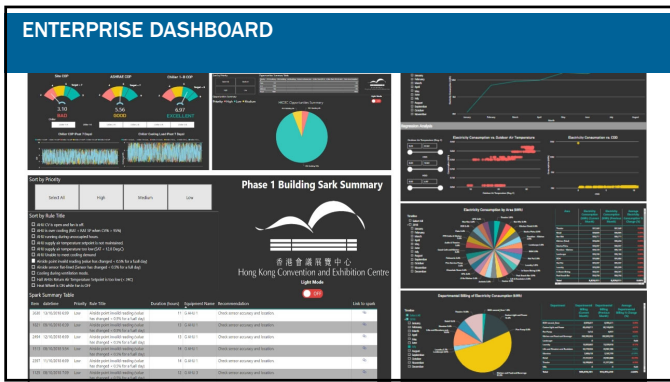
— Integrated Building Technology Task Force

infoComm
INTERNATIONAL

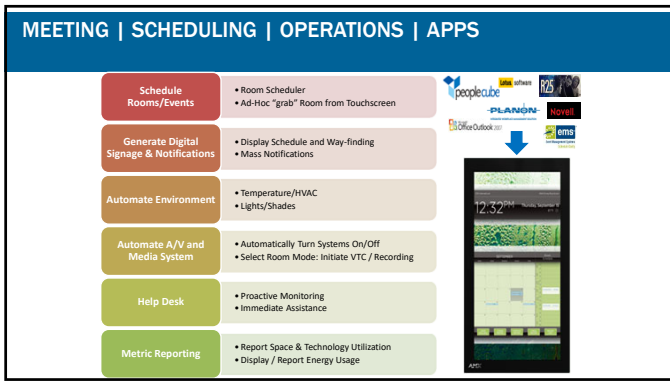
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SENSORS & BEACONS

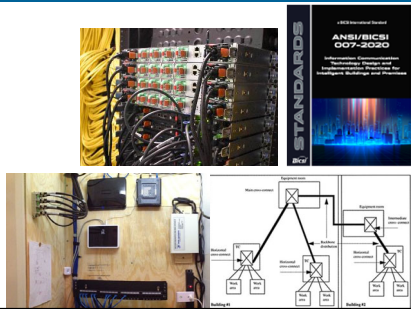
- Beacons: NFC feature on smartphones (Near-Field Communications)
- Microphones (level, frequency distribution only)
- Cameras (facial expressions and occupancy counts only – or facial recognition)
- Photo Radiometer
- Proximity, Motion
- Brainwave States scanner
- CO and CO2
- Weather
- Vibration, Footstep
- Others?



97

INTELLIGENT BUILDING READINESS

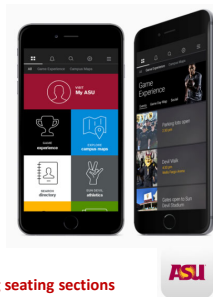
- Accommodate current converged technologies: AV over IP, SE over IP, BMS/BAS, etc.
- Acknowledge inevitable future technologies
- Centralize technology in data rooms
- PoE: Power over Ethernet
- Distribute active network switches throughout building
- Standards-Based (BICSI, TIA, AVIXA)
- IT Personnel in Facilities Department



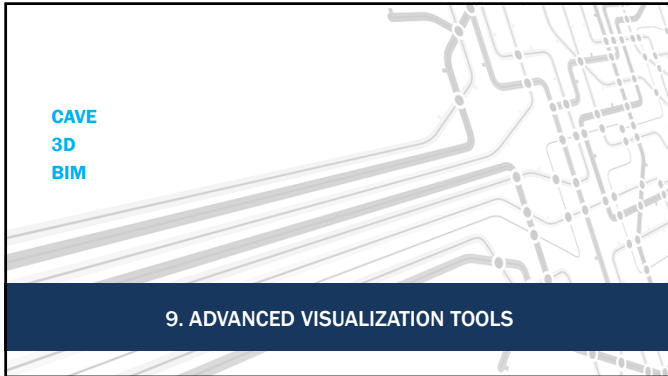
98

SMART BUILDINGS —> SMART CAMPUS

- Digitally connected people
 - Don't have patience for inefficiencies
 - Expect advanced capabilities in communication, convenience, customization and community.
- Cost of basic sensors: 40 cents
- Parking lot entry and occupancy
- Student meal card balances, meal calorie counts
- Water usage beyond a specific time threshold
- Trash can overall weight/volume
- Fun use in a sports venue:
 - Fans light up their smartphones in unison
 - Sound sensors support cheering competitors among seating sections



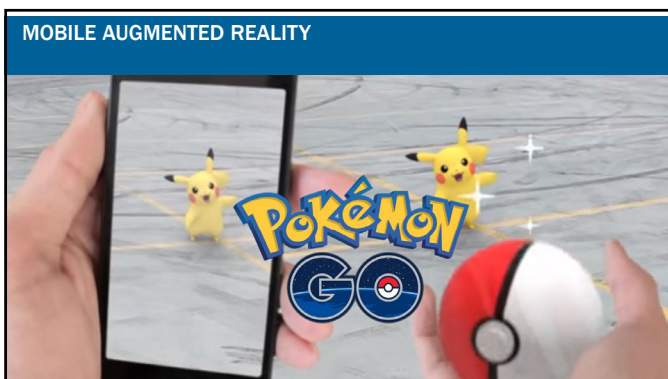
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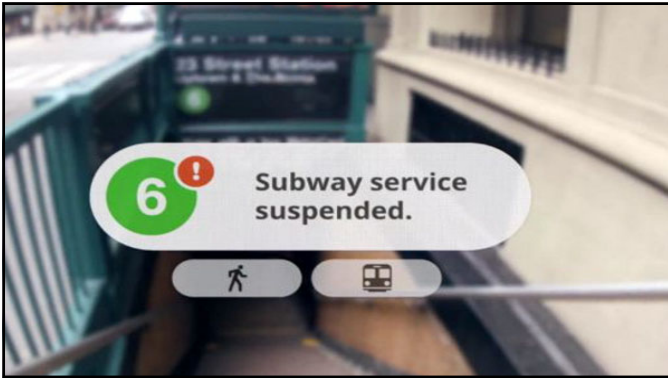
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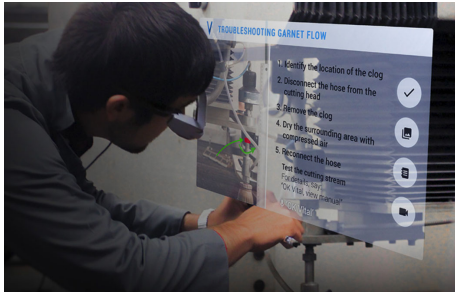


104



105

AI-DRIVEN AR GLASSES WITH REMOTE COLLABORATION



EPSON Moverio and
VITAL Enterprises

106

COMPUTER AIDED VISUAL ENVIRONMENTS (CAVE)

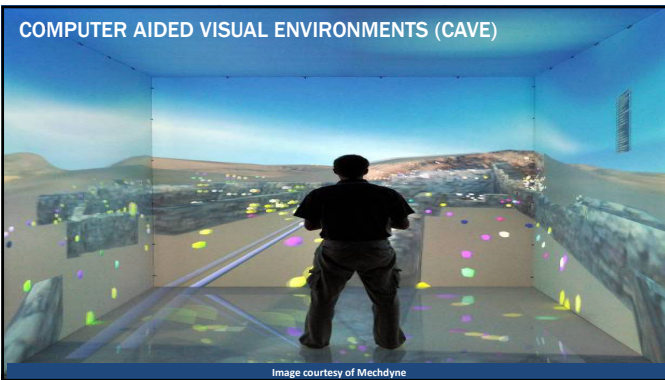


Image courtesy of Mechdyne

107

3D VISUALIZATION



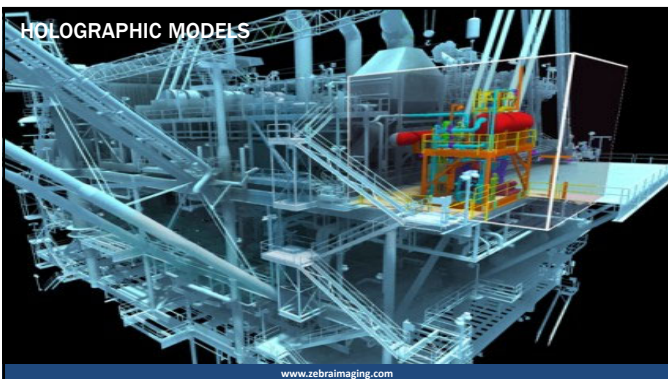
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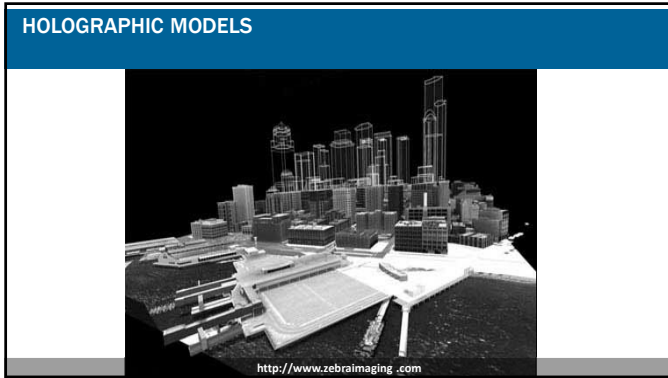
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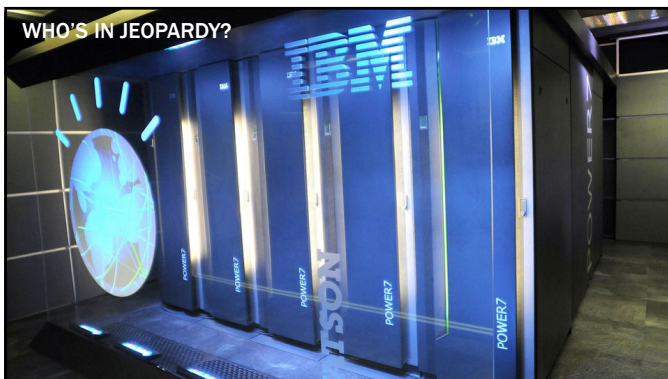
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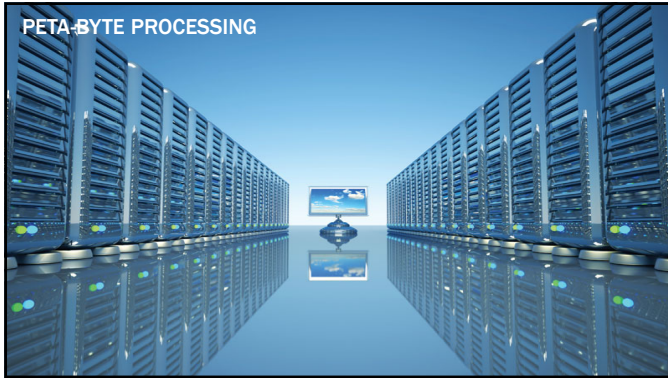
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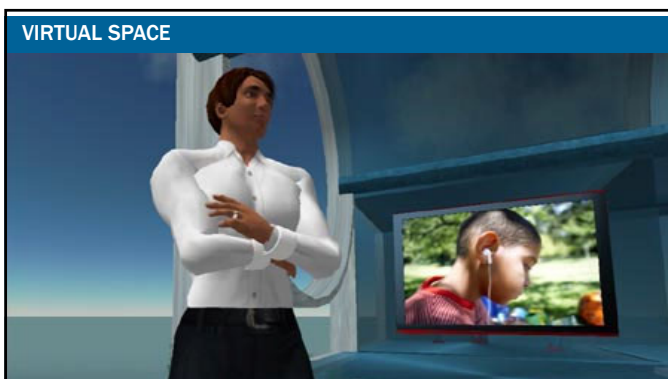
ARTIFICIAL INTELLIGENCE

By 2029, sufficient computation to simulate the entire human brain, which I estimate at about 10^{16} (10 million billion) calculations per second (cps), will cost about a dollar.

— Ray Kurzweil,
Foreword to "The Intelligent Universe"
by James Gardner



116

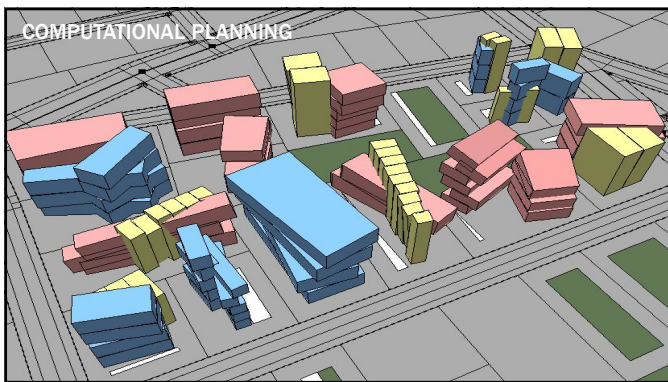


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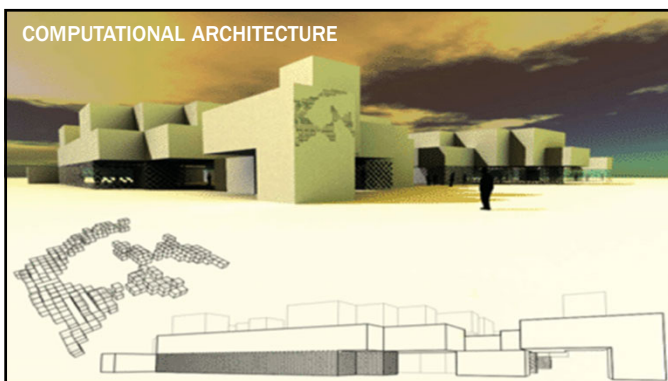
THE METAVERSE

- Social Infrastructure
 - Physical interaction
- Virtual Social Infrastructure
 - What's missing with Facebook/Instagram/Twitter etc.?
 - Virtual social interaction (Avatars)
- Advances: Haptic Devices
 - Graspable
 - Wearable
 - Touchable

118



119



120

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 - Suhvhqdwirg#Urrp v
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- Dqdarj #/xqvhw
- Hdvh0r0xvh/#rz #p dlvhgddgh/#xssruddedh
- Fuhdwh#deudj|#v|vwhp 0z lgh#vdggdugv
- F rgyhuj hg#DY 2W#DYrIS
- D YDV=#DY #dv#h#huyIfh



124

IR X QGDWIR QDO#W

- P lqj ljh#krsv
- Sdgg#ru#J #hgg#h|rqq
- Shuydvlyh# lhdvv#Erqghfwyl
- Dvvp h#p qlsuhvhw#n# vwhdp lqj #yghr
- lqwhdjhqwhExlq lqv#h#W# vudwhj |



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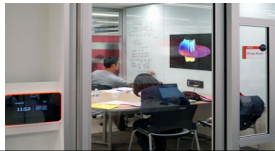
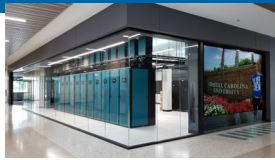
- Ohvvrqv#lurp #kh#sdggp If
- Ohvvrqv#lurp #kh#survhw/#h#lw
- Ohvvrqv#lurp #hfwyh#krvhu#hyhqw
- Edadgh#SWHG #lk#Erqighgh/# sulydf |#h lq lq#/#qfovvrq
- R ffxsdqf |#r qvuro
- Hp hujhqf |#hvsrqghw
- Dwhqdwrg#D ljkwhj #ru#dp hudv



126

UR EX VW#WHF K #Q IUD VWUX F WX UH

- Vp duw#xlgjvjv#p duw#lw#qwhughw#z#Wk.lg.v
- G lvvlexxvhg#Dqwhggd#v/vhvp v
- R xwlgjh#Bdqw#Gxfv#Bdgnv
- VGJ v#Vxwvllqdeh#Ghyhosp hqv#J rdor
- Ylvledh#Bfhdneudhng#hfk



127

IDFX ON\ #G HYHOR SP HQ W\$\$



128

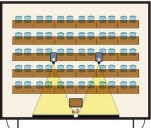


WHAT'S NEXT?

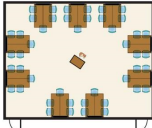
129

H [DP SOH=HDF WYH#CHDUQ IQ J #WUDQ VIR UP DWIR Q


1350 SF Classroom



FIXED LECTURE
60 seats
+ can be reconfigured to active format (by semester)
+ 22.5 SF / student



FIXED ACTIVE
45 seats
+ can be reconfigured to lecture format (by semester)
+ 30 SF / student

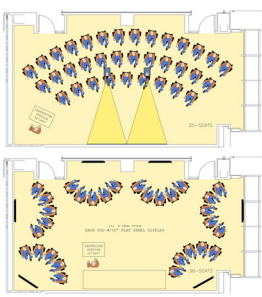


FIXED ACTIVE
60 seats
+ unusual proportion
+ not reconfigurable
+ most efficient layout for active learning
+ 22.5 SF / student

130

DF WYH#CHDUQ IQ J #G HF IVIR Q V

- Number of students per group
- Define the flexibility needed
- Define the adaptability needed
- Students at tables, armchairs or hybrid
- Size / shape / configuration of furnishings
- Space for instructor at each student group
- Campus-provided tools per student group
- Writing surfaces per student group
- Role of lecture component
- Location of instructor "home base"
- Role of Teaching Assistants



131



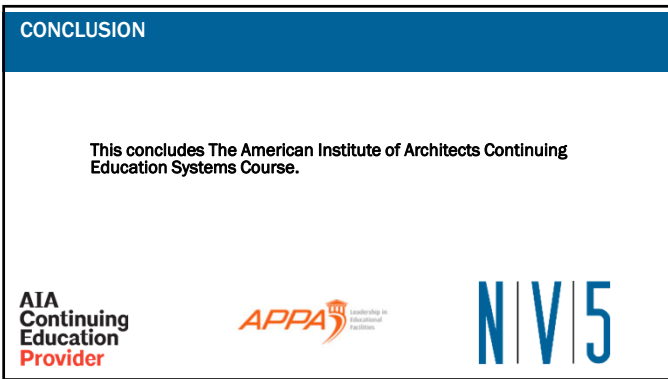
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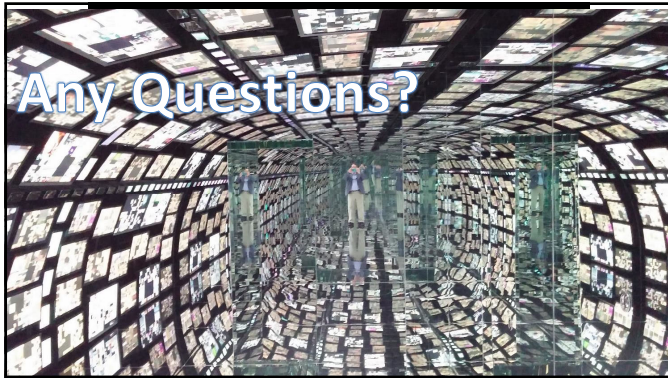
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135



136

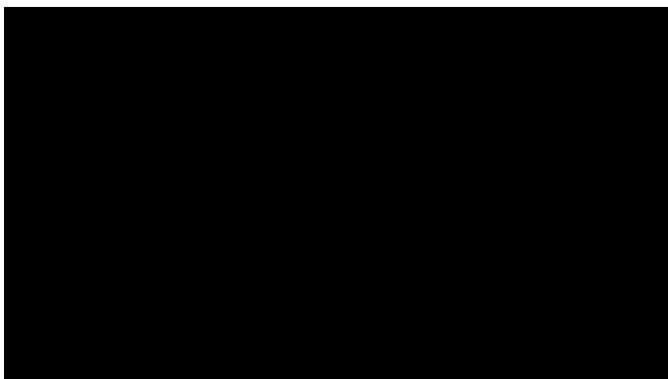
NV5 ENGINEERING & TECHNOLOGY CAPABILITIES
NV5

Audiovisual
 IT Structured Cabling, DAS, Outside Plant, Network Electronics
 Electronic Building Security
 Acoustics and Vibration Control
 Specialty Lighting: Theatre, Studio
 Intelligent Building Technology
 Healthcare Technology
 Emergency Response Systems
 All MEP

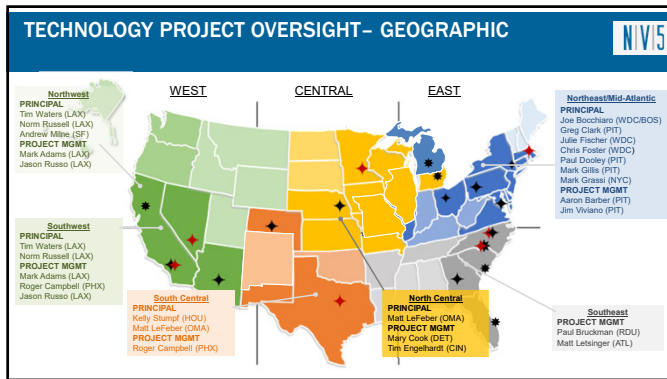
Joe.Bocchiaro@NV5.com
Joseph Bocchiaro III, Ph.D., CStd, CTS-D, CTS-I, ISF-C
(617) 933-9226

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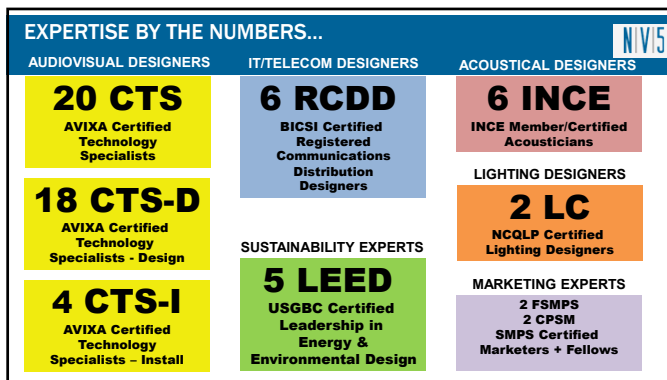
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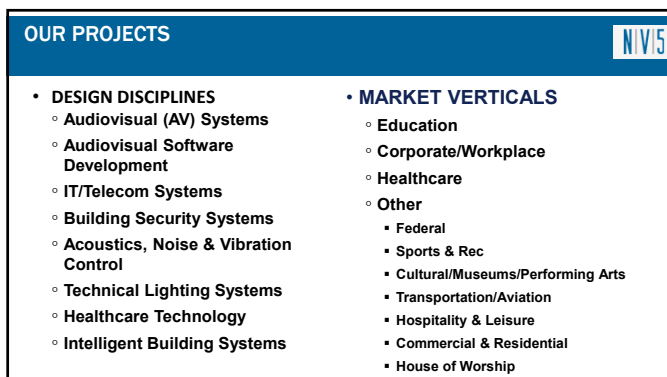
138



139



140



141

DISCIPLINE – AUDIOVISUAL SYSTEMS


NIV5

OUR AV DESIGN EXPERTISE...

"NV5's design approach for AV systems and facilities supports our clients' goals for innovative, intuitive, and reliable multimedia-based meeting, presentation, production, and performance spaces."

The systems we design include:

- Audio playback, speech reinforcement, conferencing, recording and paging
- Video playback, conferencing, recording, editing & streaming
- Rich media capture & distance learning systems
- Visual/data display using projection, flat screens, and LED walls; both passive and interactive
- Wired and wireless collaboration systems
- Control system, user interface & software design
- Digital signage for information and impression



142

DISCIPLINE – IT & TELECOM SYSTEMS


NIV5

OUR IT DESIGN EXPERTISE...

"NV5's expertise in IT/Telecom low voltage fiber optic and copper cabling infrastructure and Wi-Fi systems design supports our clients' requirements for robust and reliable data and communications networks."

Our services include:

- Wired and wireless intra- and inter-building structured cabling plans
- Physical plant cabling infrastructure, including cable trays, ductways, conduits, and outlets
- Main (MDF) and intermediate distribution (IDF) rooms locations and layouts
- Network electronics systems to support voice, data and television services
- Public Safety and Cellular distributed antenna systems (DAS)



143

DISCIPLINE – BUILDING SECURITY SYSTEMS

NIV5

OUR SECURITY DESIGN EXPERTISE...

"NV5's planning and design for Building Security Systems addresses our clients' needs for highly secure facilities with reliable access control, alarm and surveillance systems."

Our services include:

- Security & risk assessment & planning
- Security management systems (SMS)
- Video surveillance & analytics
- Exterior and interior access controls systems
- Physical security monitoring systems
- Intrusion detection/perimeter detection systems
- Applied principles of Crime Prevention Through Environmental Design (CPTED)
- Security Operations/Command Center (SOC) design



144

DISCIPLINE – ACOUSTICS, NOISE & VIBRATION CONTROL

OUR ACOUSTIC DESIGN EXPERTISE...

“Designing practical and aesthetic acoustic solutions supports our clients’ needs for optimal aural quality in their workplace, learning space, healthcare facility, or performance environments.”

Our services include:

- Room Acoustics, Speech Intelligibility, and Reverberation Control
- Sound Isolation / Acoustic Privacy
- Building Systems Noise & Vibration Control
- Sound Masking Systems
- Specialty Vibration Control
- Sound Measurement, Modeling, and Predictive Analysis
- Environmental Noise Control



145

DISCIPLINE – TECHNICAL LIGHTING

OUR LIGHTING DESIGN EXPERTISE...

“Designing Lighting Systems and related infrastructure for Studios and Theatres supports our clients’ needs and goals for flexible and effective broadcast, recording, performance and teleconference spaces.”

Our services include:

- Videoconferencing Suites
- Broadcast and audio & video recording studios, control rooms, editing suites & support spaces layout assistance
- Theatre stage, backstage/loft & seating layout assistance and sightline studies
- Lighting fixture layout, selection, mounting, zoning, circuiting & rigging
- Lighting and Show Control systems
- Theatrical rigging, curtains & supporting equipment



146
