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Department of Rehabilitation Science and Technology

School of Health and Rehabilitation Sciences

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Electronic Aids to Daily Living: Implementing Technology Solutions to Meet Patient Goals

VA-PRC Virtual Grand Rounds

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Conflict of Interest Statement

- *No conflicts have been disclosed.*

Definitions

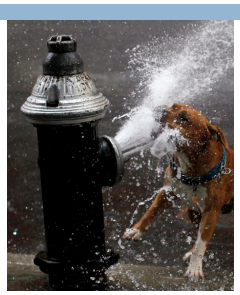
- Electronic Aids to Daily Living = EADL
- Environmental Control Unit = ECU
- EADL = ECU = Smart Home
- Smart Home = Home Automation
- Mobile Device = Smartphone = Tablet
- AAC = Augmentative and Alternative Communication
- Veteran = Patient = User = Consumer
- AT = Assistive Technology
- $\sqrt{294849} = 543$

Objectives

1. Identify one characteristic of an appropriate user of mobile devices for EADLs.
2. List two components of EADL systems.
3. Understand to cost associated with AT and consumer EADL systems.

Drinking From A Fire Hose

- There are simple solutions, they just don't fit everyone
- Lots of options, thus lots of information
- Constantly changing field of products



Outline

- Overview of Electronic Aids to Daily Living
- What, Who, and Where?
  - EADLs and Patients
  - Usage environment
- Evaluation Process
- EADL examples
- Quick reference guides
- Questions / comments

Overview of EADLs (ECUs)

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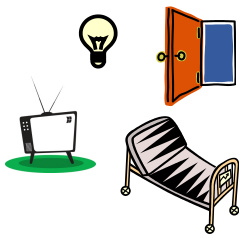
- EADLs provide a means for someone with limited functional mobility or dexterity to interact with their environment
- Most any device can be controlled
  - A Light or fan
  - Television, radio, and cable box
  - Air conditioner thermostat
  - Telephone
  - Hospital bed
  - Window blinds or drapes,
  - Door locks and openers
  - Cameras



ECU System Components

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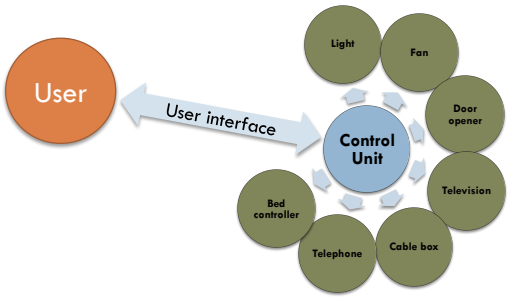

The Patient – A Holistic Approach

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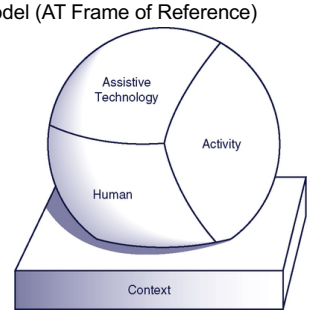
HAAT model (AT Frame of Reference)



Cook & Polgar, 2008

The Patient – Most Important

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User

- Anyone who needs alternative access to items used in daily life
  - Television, cable box
  - Hospital bed, nurse call
  - Door, light switches
- Quality life and independence are important factors
- Example diagnoses: ALS, SCI, TBI, Locked in Syndrome

The Patient – Considerations

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User

- Physical ability?
  - Determines access method
  - Evaluate with simple technology
  - Consider progression
- Cognitive ability?
  - Determines EADL complexity
  - Static or dynamic interface
- Mental Status
  - Level of tolerance, patience, and/or PTSD
  - Help to determine device applicability
- Home environment?
  - Determines EADL type and applicability
  - House, apartment, or long term care facility
  - Single or multi-room

User Environment

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- Control area
  - Single room
    - Typically the bedroom
    - Mounted to bed frame
    - Generally simpler installation
  - Multi-room
    - Mobile - control multiple rooms
    - Wireless base station or self contained
    - Typically wheelchair based
    - Mobile unit is battery powered – possibly by wheelchair
- Mounting
  - ECU, switch, and/or microphone
  - Wheelchair, bed, and/or floor stand

User Environment

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- Installation location
  - Hospital/facility – temporary
    - Simple installation for evaluation or trialing
    - Control limited to nurse call, hospital bed, TV, light, or fan
    - Home automation systems might not work well in commercial building
    - Education of staff is important
    - Select more durable devices
    - Single patient room is ideal
  - Hospital/Facility – long term
    - Same items as above
    - Depending on desired complexity a vendor installation might be required
  - Home
    - Requires home visit / evaluation by ECU vendor
    - Important for vendor to train patient, family, and/or caregiver(s)

User Interfaces - Direct

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- Standard / adapted control
  - Most efficient access method
  - Keyboard, mouse, touch screen, mouth stick, joystick, chin joystick, etc.
- Voice control
  - Totally hands free – typically more sensitive
  - Switch initiated – more forgiving
  - Various menu structures and complexities
  - Consider user vocal amplitude and phonation capability
  - Disposition is important (Back ground noise)
  - Backup indirect switch access is a good idea

User Interfaces - Indirect

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- Scanning
  - Options are incremented through and selected when highlighted
  - Inefficient access method
  - Requires consistent and accurate switch activation
  - Single switch - selects and auto scanning
  - Double switch - one scans and one selects
- Directed scanning
  - More efficient, but more complex than normal scanning
  - Directional scanning control
  - Available option for some alternate communication devices
- Coded access
  - Very efficient, but not used often
  - Morse code

Control Unit (EADL)

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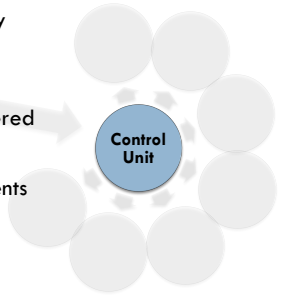
- Mobile or stationary
  - Wheelchair usage
  - Multiroom usage
- Battery or AC powered
- Battery backup
- Mounting requirements



Transmission Methods -Remotes

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- Infra-red (IR)
  - Television remote
  - Line of sight communication - bad
  - Portable
  - Learning remotes
- Radio Frequency
  - Simple remotes
  - Garage door openers
  - Not line of sight communication – good

Transmission Methods - Automation

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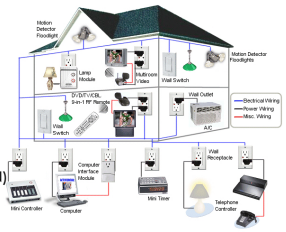
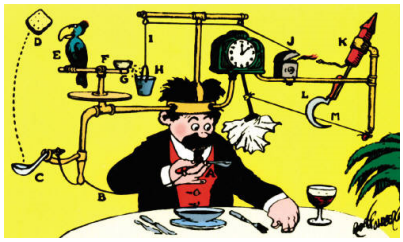
- Home Automation Systems
  - Used to control lights, doors, thermostats, etc.
  - Power-line
    - Uses existing AC house wiring
    - Inexpensive
    - Sensitive to power-line noise
    - House wiring affects operation
    - X10, Insteon
  - Home networks
    - Wired local area network (LAN)
    - Wireless RF networks
      - Z-wave, Wifi, Bluetooth
    - Wi-Fi becoming more viable



The Evaluation Process



Evaluation Process

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- Is similar to a complex power wheelchair prescription
- Collaboration!!!
  - Multiple team clinical team members are helpful
  - Helpful when caregiver or significant other is present
- Evaluation Basics
  - Multiple sessions typically
  - Determine Patient goals and desires
  - Cognitive and physical ability
  - Appropriate access methods
  - Environmental factors

Evaluation Process

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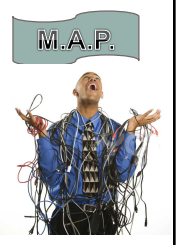
- Initial device demonstration and trial
  - 1-2 hour session
  - Multiple system options compared, contrasted, & demonstrated
  - Multiple access methods trialed with Patient
- Long term trial (inpatient) or multiple outpatient sessions.
  - Patient trails multiple devices for short periods
- Patient / Evaluator select solution, and discuss implementation options

The M.A.P To Success…or hidden treasure

Applying M.A.P to The Evaluation Process

- Integrating multiple devices in a patient's home
  - Mounting
    - Single or multiple locations?
    - Moveable mounts?
  - Access
    - Independent or setup required?
  - Power
    - Cable management!
    - Prefer wall power with battery backup
- Common systems:
  - Call bell, hospital bed, TV, telephone, computer, AAC etc.
- Available Vendors?
- What existing devices / systems are available?



Let's Talk About Specific Devices

Remember this is a moving target!

- AT Products
  - Organized by access methods
- Landline Telephones
- AAC Integration
- Wheelchair Integration
- Home Automation Products
  - Standalone
  - Professional / DIY Home Controllers

Assistive Technology Products

Commercially available products designed for the disabled population

Pros	Cons
Features designed for alternative access Customizable buttons and layout More auditory and visual feedback options App layout intended for scanning	Sometimes dated technology Expensive Not always local vendors

Devices – Direct Input, Simple

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- Wireless Remote Plugs
  - X10 PalmPad, Slimfire remotes
  - Wireless Lamp remotes (Lowes, etc.)
  - Insteon RemoteLinc
  - Many options (Amazon, etc.)

Devices – Indirect Input

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- Relax II
  - Switch Input (1-2), visual and auditory feedback
  - IR learning (4 devices, 10 commands each)
  - Preprogrammed RF X10 (10 devices)
  - Battery powered
  - Requires X-10 RF transceiver


Ablenet

- Saje Pocket Mate
  - Switch input, with auditory and visual feedback
  - IR learning (256 devices) and X10
  - Battery and AC powered
  - Can control an IR telephone


Saje

Devices – Direct & Indirect Input

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- Primo!
  - Touch screen and switch input (1-2)
  - Auditory and visual feedback
  - IR learning (many devices)
  - Preprogrammed IR X10 or Insteon
  - Ready for Sero! phone control
  - Battery and AC powered
  - Requires IR receiver for X10 or Insteon


$2,700
Ablenet

Devices – Voice Control

30

- Pilot One
  - Voice or switch input (1-2) with auditory and visual feedback
  - Must train to user voice and commands
  - IR learning (10 devices, many commands each)
  - Preprogrammed IR X10 (4 devices)
  - Ready for Sero! phone control
  - Battery and AC powered
  - Requires X-10 IR commander


$2,100
Ablenet

- VoiceIR
  - Broadened Horizons, $ 449
  - Optional switch input, with auditory feedback
  - Must train to user voice (1-4 users)
  - IR learning (120 commands)
  - Battery and AC powered
  - Requires X-10 IR commander


$449
Broadened Horizons

Devices – Voice Control

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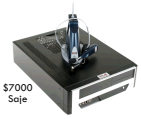
- Quartet Simplicity AIO
  - Voice or switch input (1-2) with auditory feedback
  - Must train to user voice and commands
  - IR learning (6 devices)
  - Preprogrammed X10 (64 devices)
  - Built in telephone
  - Battery and AC powered
- Saje Roomate Plus
  - Switch input, with auditory feedback
  - Voice control, but no voice training needed
  - IR learning and X10
  - Built in telephone
  - Use as speaker phone (optional) or headset
  - Interfaces to a computer via Bluetooth

$8,000
Quartet



$7000
Saje

Devices – Computer Based

- All Computer access options
  - Switch, touch screen or voice control
  - Head mouse or eye tracking
  - Windows tablet PC
  - Bluetooth, Wifi
  - Audio and visual feedback flexibility
- Many based SmartBox Grid software and hardware
- Computer Pros/Cons
  - EADL, AAC, computer access
  - Games, books, social media access
  - Remote access help
  - Vulnerable to Internet dangers

Devices – Computer Based

- Servus, Zygo USA
- Break Boundries REACH
- ASI AutonoME

autonoME ECU/SGD tablet

All in One microphone/
sip and puff system

Floorstand

autonoME
command center

Devices -Telephone Access

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- Ablephone AP 5000 (Vocally Infinity)
  - Voice controlled telephone dialer
  - Must train to user voice
- Ablephone AP 1000
  - Switch based solution
  - Auditory feedback for dialing
  - Must train to user voice for dialing
- Sero!
  - IR controlled phone
  - Needs Primo!, Pilot, or other ECU for hands-free operation
  - Auditory and visual feedback
  - Simple AAC features


$219
EnableMart


$579
Ablenet


$1,195
Ablenet

Devices - Telephone Access

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- TalkIR
  - Konftel 200AUX teleconference phone
  - Remote control speaker phone
  - Full IR control of phone functions
  - Use with Voice IR for hands-free phone operation
  - Can be switch adapted

- Serene RCX-1000
  - Remote control speaker phone
  - Switch control on remote and phone
  - Use with Vocally Infinity for total hands-free operation

Devices – Door Access

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- *OpenSesame*
  - *Various remote options*
  - *ECU remote interface to any contact closure from an EADL system*

Devices – AAC Integration

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- Augmentative and Alternative Communication (AAC) devices with IR control ability
  - Talk to Me, FRS, Tobii/Dynavox
  - Many more…

Devices – Wheelchair

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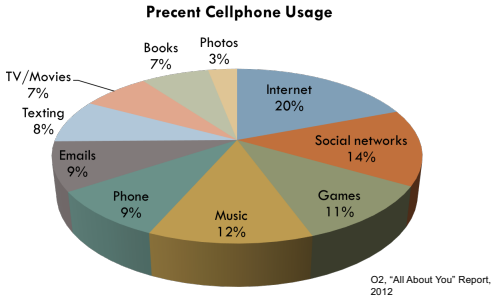
- Quantum
  - Q-Logic enhanced display or joystick for IR control
  - Bluetooth mouse / switch interface
- Permobil
  - R-Net Omni or Joystick for IR control
  - Bluetooth mouse and Input-Output Modules
- Sunrise (Quickie)
  - Similar to Permobil

Consumer Products: Mobile Devices

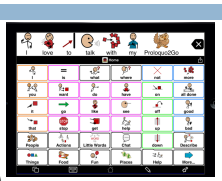
- The ***Phablet…***



O2, "All About You" Report, 2012

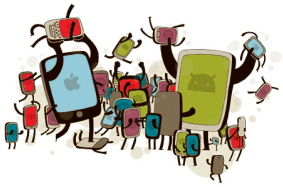
Consumer Mobile Devices (What Can They Do)

- Communication
  - Augmentative & Alternative Communication (AAC) Apps
- Connectivity
  - Telephone, Email, Text Messaging
  - Social Networking (Facebook, etc.)
- Environmental Control
  - Lights, TV, Cable, Doors, Thermostat
- Cognitive Aid
  - Reminders, Calendars, Apps



Consumer Product Based EADLs

- Control Unit and/or user interface based on cellphone or tablet.
- Typically requires Wifi and Internet access
- Apple, Google, and Microsoft Oh My!



Tablet or Phone Centered EADLs

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- Pros
  - Consumer products (cost efficient and appealing)
  - Access
    - Conductive mouth stick for touch screen access on mobile devices
    - Switch Control
    - Voice Control (sort of)
- Cons
  - Scanning on Apps can be very tedious
  - Voice activation not integrated into home automation apps typically

Standalone Devices

Consumer electronic products meant to control one or two types of devices

Pros	Cons
Competitively priced	**App controls only one type of device** (typically)
Easy to install	Apps have limited accessibility features
Some can be controlled by home controller systems	Vendor Install?

• Standalone Devices, Examples 1

- Doors Locks
  - Kwikset Kevo, $220, Bluetooth
  - August, Schlage, Yale, and more
- Garage Door: Liftmaster MiQ,
  - Linear GD00Z, can work with any garage door opener, should work with Open Sesame door opener
- Security Cameras:
  - Ring, Nest Cam, etc.
  - No great hands free options for exterior

Standalone Devices, Examples 2

- Thermostat
  - Nest, $249
  - HoneyWell and others, $100 - $300

Standalone Devices, Examples 3

- Lights
  - Belkin WeMo, $40 / light
  - Hue, $200 for 3 lights

Standalone Devices, Examples 4

- IR Adapters
  - Harmony Hub, Wi-Fi
  - Blumoo, Wi-Fi
- Wifi connected smart devices with Apps
  - Samsung TVs, cable boxes (Verizon, Comcast)
  - Home Theatre (Sony, Onkyo, Pioneer, etc.)

Standalone Devices, Examples 5

- Hospital Beds
  - Linak Twindrive – for leisure bed lines
- Consumer Beds
  - Use Bluetooth to control bed functions

Home Controllers

Consumer electronic products meant to control an entire home full of devices

Pros	Cons
Competitively priced	Apps have limited accessibility features
One app controls everything	Some require monthly subscription fee
Easy to install	Who Insalls?
Constantly improving	Not many DIY options offer full IR control

Home Controllers, DIY v/s Pro

Do-it-yourself (DIY)	Professional
Less expensive	Expensive
Who installs / trains?	Quality install
Support ?	Quality training and support
Apps not all well developed	Well developed apps
Purchase at big box stores = Home Install	
Not all support IR without additional hardware	

Home Controllers, DIY Examples 1

- SmartThings
  - $99 Hub
  - Voice Via Shortcut App and Ivee
  - IR possible in future
- Iris
  - $99 Hub
  - Free Basic service, or premium features, $10 / month
  - Voice via Ivee or premium service
  - Available at Lowes and professional install

Home Controllers, DIY Examples 2

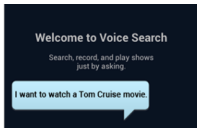
- Amazon Echo or Google Home
  - Requires other devices
  - Great voice control
- ISY994i, $350
  - Insteon, IR
  - Mobi Linc App allows voice
- INSTEON Hub

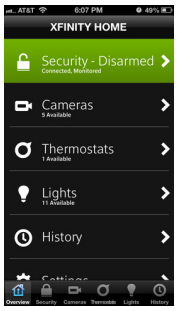
Home Controllers, Professional Examples 1

- Control 4
  - Most popular system
  - Voice Control using Amazon Echo
  - Relatively low cost entry point
  - $700 for entry level base station

Home Controllers, Professional Examples 2

- Cable and Security Companies
  - Most require monthly subscription fee
  - Fios, Comacast
    - Security and control = monthly fee!!
  - Direct TV, Apple, etc. has voice search
  - ADT





What Is The Right Solution?

- The SHORT answer…
  - It all depends on the user
  - Match user abilities with access method and desire control with EADL device options
  - Identify a champion

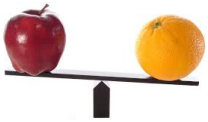
- And the LONG answer…

What Is The Right Solution?

- Current environmental access?
- What does the Patient want to control?
- Where will the EADL be used?
- Use best access method based on abilities
- Does the Veteran have a mobile device?
  - Type, current usage, and motivation?
- Wifi and Internet in usage environment?
- Is a family or friend motivated to help out with EADL?

When to use what?

- Assistive Technology Products
  - Need an interface with the most adaptive feedback options
- Consumer Standalone Products
  - Only need to control one type of device
  - Cost effective
- Consumer Home Controllers
  - Multi device control
  - Similar to Traditional EADL (Quartet)
  - DIY
    - Most cost effective
    - Veteran family / friend can setup
    - Not many IR options currently
  - Professional
    - Installation and training by professional



Benefits of Consumer Products

- Lower cost than traditional EADL systems
- Integration
- More devices able to be controlled
- Access automation from anywhere
- Potential for better voice control algorithms

Challenges of Consumer Products

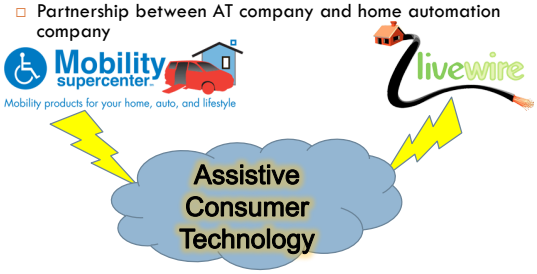
- It is the "Wild West" of home automation
- Access methods are still maturing
- Advanced technology is more likely to have bugs
- Not as streamlined as dedicated AT solutions
- Home automation vendors not familiar with AT population
- Who provides support?

Case Study: Mobile Device

- Patient
  - 30 year old male C5-6 spinal cord injury
  - Lives in house alone, has power wheelchair
  - Uses Android cell phone currently with touch access
  - Wants to be able to lock front door and control thermostat
- Questions
  - AT, Standalone or home control system?
  - Professional install?
- Selected system
  - Control 4

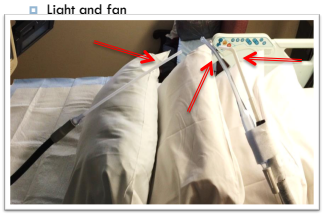
Possible Solutions – The Perfect Storm

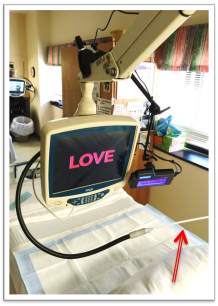
- Reach out to AT vendors
  - Provide education to vendors or family / Veteran about options and setup
- Partnership between AT company and home automation company



Case Study: Hospital Integration

- **Before:** Inpatient Vet with SCI using 3 sip & puffs to control:
  - Nurse call, TV, and telephone
- **After:** Use Primo ECU mounted on TV arm to control:
  - Nurse call, TV, and telephone
  - Light and fan





Case Study: Traditional v/s Mobile Devices

Requirements

- Patient
  - Good vision, limited fine or gross motor in upper extremities
- Desired access options
  - Switch scanning with visual and auditory feedback
- Devices to control
  - Lights, TV, landline

Traditional v/s Mobile Device EADL

Traditional System

- Possum Primo!, $2700
- Two switches, $150
- Sero! landline telephone, $1400
- Three light modules, $120
- **Total Parts: $4420**

Mobile Device System

- Patient supplied iPhone
- Blue 2, $150
- Logitech Harmony Hub, $150
- Three Wemo light modules, $150
- **Total Parts: $450**

Devices – Reference Guide

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- AT lab ECU quick reference guide

Environmental Control Units: AT Lab Equipment

	Pilot One	Primo	Relax II	Simplicity AIO	Voice IR	Other
Device						
Vendor	AbleNet	AbleNet	AbleNet	Quartet	Broadened Horizons	Various
Voice Activated	Yes	No	No	Yes	Yes	No
Switch Activated	Yes	Yes	Yes	Yes	No[10]	No
Dynamic Touchscreen	No	Yes	No	No	No	No
Auditory Feedback	Yes	Yes	Yes	Yes	Yes	No
Visual Feedback	Yes	Yes	Yes	No	Yes	No
IR Control	Yes	Yes	Yes	Yes	Yes	Yes / No
X-10 Control	Yes[2]	Yes[2]	Yes[4]	Yes*	Yes[2,3]	Yes[9]
Insteon Control	Yes[3,5]	Yes[3,5]	Yes[3,5]	Yes	Yes[3,5]	Yes
Sero! Phone Control	Yes	Yes	No	No	No	No
Talk IR Phone Control	Yes[3]	Yes[3]	Yes[3]	Yes[3]	Yes[3]	No
IR Learning	Yes	Yes	Yes	Yes	Yes	No
Control Quantity	11 IR, 4 X10	Many IR, 8 X10	4 IR, 10 X10	120 IR	120 IR	1-16
AC Power	Yes	Yes	Yes	Yes	Yes	No
Battery Power	Yes[1]	Yes	Yes[6]	Yes[8]	Yes[7]	Yes
Cost	$2,100.00	$2,700.00	$729.00	$449.00	$449.00	$20.00 - $60.00
Strengths	Easy to learn IR commands, X10 pre-programed, no setup required for Sero! phone.	X-10 pre-programed, customizable menu system, no setup required for Sero! phone.	Easy to program, X10 pre-programmed.	Easy voice directed programming.	Voice direct programming, macros, auto muting	Simple to use, inexpensive, small.
Weaknesses	Fixed menu structure and device and names, trained to a single user.	Time consuming to program.	Must train all IR commands, and make labels if cusomizing commands.	Must train all IR commands, trained to a single user.	Only 4 separate main keywords, must repeat keyword for each command, very sensitive.	Small buttons, only simple ECU control, no IR control.

Devices – Reference Guide, cont.

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- AT lab telephones

Telephones: AT Lab Equipment

	Sero!	Ablephone 7000VC	Talk IR	Voice Dialer 6000 (Infinity III)
Device				
Vendor	AbleNet	Ablephone	Broadened Horizons (Konfetel)	Ablephone (EnableMart)
Voice Activated	No[1]	Yes	No[3]	Yes[2]
Switch Activated	Yes	No	No	No
On Screen Menu	Yes	No	Yes	No
Auditory Feedback	Yes	Yes	Yes	Yes
Visual Feedback	Yes	Yes	Yes	No
IR Controlled	Yes	No	Yes	No
Primo! / Pilot Controlled	Yes	No	No	No
Voice IR Controlled	No	No	Yes	Yes
Stand Alone Telephone	Yes	Yes	Yes	No
Speaker Phone	Yes	Yes	Yes	-
Phone Number Storage	Yes	Yes	Yes	Yes
Cost	$1,195.00	$579.00	$749.00	$219.00
Strengths	Primo! And Pilot control with default settings, has limited AAC features, operates as a normal phone.	Inexpensive, easy setup,fully voice controlled, voice prompted training and setup.	Loud, sturdy, comes with remote control.	Inexpensive, works with any phone, easy setup, voice prompted training and setup.
Weaknesses	Expensive, needs Pilot, Primo!, or other ECU / AAC for voice control.	Commands trained to a single user, not as "refined" mechanically as the Sero!.	No ECU is pre programmed to control this telephone. Not great auditory or visual feedback	Must use additional phone to operate tottaly hands free or with switch, commands trained to a single user.

Questions

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Access Methods – Touch Input

- Fine or gross motor control
- Capacitive stylus or mouth stick
- Stylus holder
- Screen size
- iOS: Assistive Touch
- Android: Easy Touch, etc.

Access Methods – Switch Scanning

- Wired
  - RSL Steeper Pererro, $27
    - iPhone 4 and older
  - Zygo ZyBox X, $245
  - AbleNet Hook, $170
    - iPod Music control only
- Wireless
  - Tecla Shield Uno / Dos, $350
    - iOS 7, iOS Voice over, Android App
  - RJ Cooper BSI, $114
  - Ablenet Blue 2, $150

Access Methods - Mouse Control

- Android
  - Bluetooth mouse
    - Normal desktop model
    - Bluetooth module on wheelchair
  - USB Wired
    - Requires USB On-The-Go cable
    - Only works with certain devices
      - Samsung works well
  - Mouse cursor is very small
    - Apps available to enlarge cursor, but don't work on all devices

Access Methods – Built-in Voice Control

- Android
  - Active listening on newer phones = totally hands free*
- iOS
  - [illegible]e
  - [illegible]h
- Check weather, make calls, web search, etc
- Can't control apps

Access Methods – Voice Control Apps

- Shortcut, Free
  - WeMo, Nest, SmartThings, Lockitron
  - Android, Google Glass, and iOS (soon)
- Tasker + Autovoice, $2.99 + $1.57
  - Android voice macros
  - Can control Vera home controller
- MobiLinc, $20-$50
  - iOS and Universal Devices ISY home controller
  - Voice plug in, totally hands free
- VoicePod, Free
  - Subscription fee
  - App or hardware
  - App can be totally hands free

Home Automation is Not New