Multimedia University
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HOCHSCHULE DER MEDIEN

PERSONAL CLOUD

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CLOUD SERVICES

Cloud Services

- Idea: information technology (IT) as a commodity
  - ⇨ like electricity from a wall socket
  - ⇨ or TV from the air
- Anything as a Service (XaaS)
- IT migrates into the “cloud”, i.e. into the Internet
  - ⇨ whole computers (“virtual machines”)
  - ⇨ operating system environments
  - ⇨ application software
  - ⇨ data, documents, multimedia objects

CLOUD SERVICES FOR PERSONAL USE

Usage of cloud services in the personal environment

- home application
- mobile application

Public offers

- Internet drives: Dropbox, Google Drive …
- licensed content (e.g. MP3, E-Book): Apple, Amazon …
- office in the web: e.g. Google Docs & Spreadsheets …
- webmail: the classical cloud application
- calendar, contacts: e.g. Google

Fundamental principle:

- store, manage and manipulate data objects in the web

MEETING THE NEEDS IN THE PERSONAL ENVIRONMENT

Reasons for the usage of cloud services in the personal environment

- global access to personal data objects
  - ⇨ from PC, laptop
  - ⇨ from smart phone, tablet
  - ⇨ from media players including TV, home audio systems
- data storage, data backup, data synchronization
  - ⇨ office documents on PC, laptop
  - ⇨ photos, videos from a camera
  - ⇨ calendar dates, contacts
  - ⇨ bookmarks

⇒ Cloud services are indispensable.

DOWNSIDE OF PUBLIC CLOUD SERVICES

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- Insufficient data privacy protection
- Relinquishment of intellectual property rights
- Enhanced eavesdropping by secret agencies
- Costs
  - ⇨ The first few gigabytes of storage are free
  - ⇨ non-neglectible fees apply for any additional storage
  - ⇨ e.g. Dropbox: 99$ per 100 gigabytes and year
  - ⇨ for comparison: 1000 gigabytes external hard disk ~ 60$
- Locked-in effect
  - ⇨ proprietary data formats
  - ⇨ proprietary protocols

SOLUTION

- solution for enterprises: „Private Cloud“
  - ⇨ Run an own cloud platform
  - ⇨ Requires big computing centres
- downsizing a private cloud for personal use
  - ⇨ Referred to as „Personal Cloud“
  - ⇨ Low cost, low power
  - ⇨ A small cloud server installed in a home network
  - ⇨ Also accessible from the Internet
  - ⇨ In the 80s: “Personal Computers” as personal clients
  - ⇨ New today: “Personal Clouds” as personal servers
- demonstration
  - ⇨ Final year project,
    bachelor thesis of a student (Ralph Konyen)

GENERAL IDEA

- Raspberry Pi single board computer
  - ⇨ Use as an inexpensive server in the home network
- “LAMP”: free runtime environment
  - ⇨ Linux Operating System: Raspbian (Debian derivate)
  - ⇨ Apache Webserver
  - ⇨ MySQL Database Management System
  - ⇨ PHP web programming language
- OpenSSL: encrypted data transport (HTTPS et al.)
- Owncloud 5.0: free cloud server software
- Installation behind DSL router or similar residential gateway
  - ⇨ HTTPS port forwarding
  - ⇨ NO-IP dynamic DNS service

RASPBERRY PI MODEL B REV. 2

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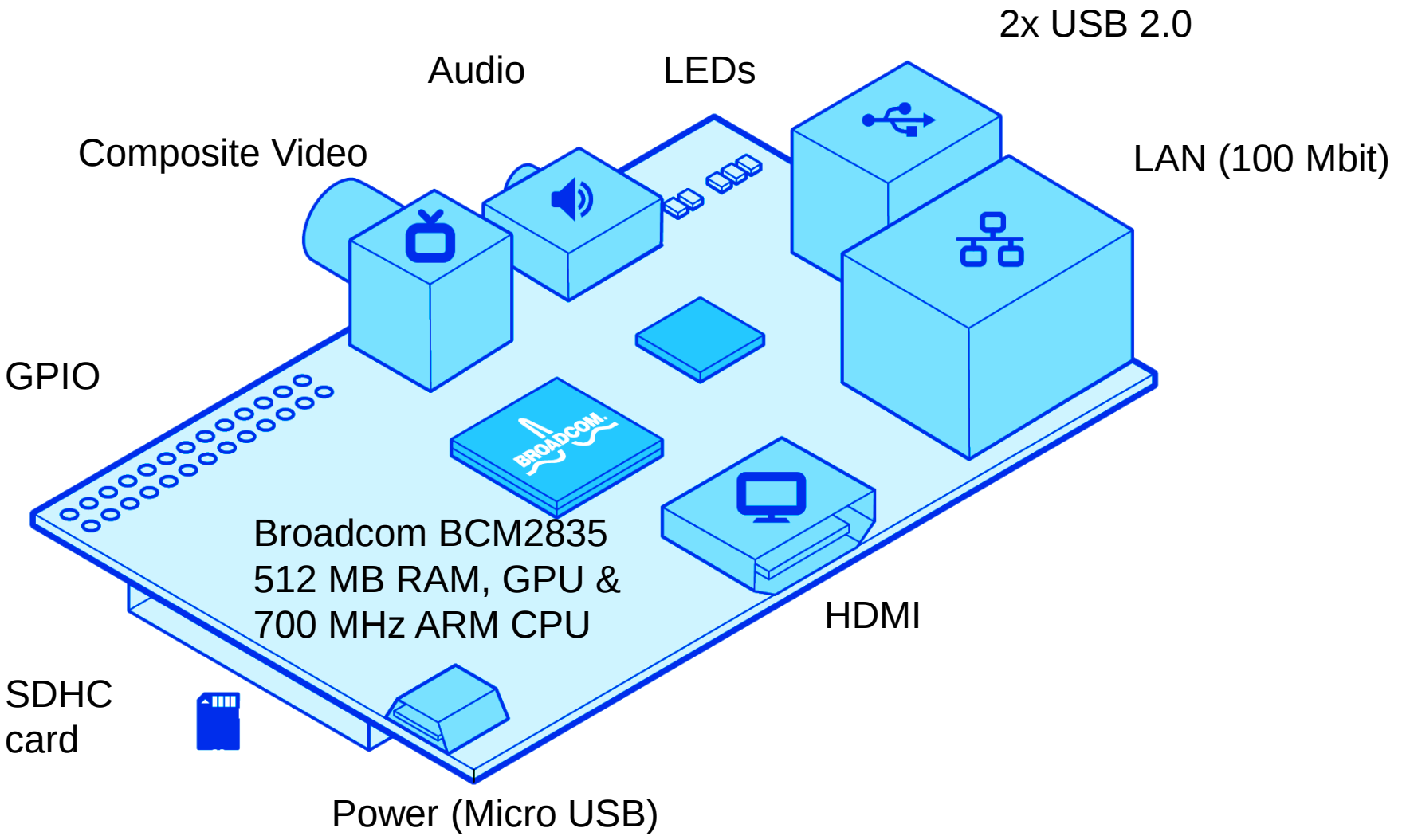


THE BUDGET

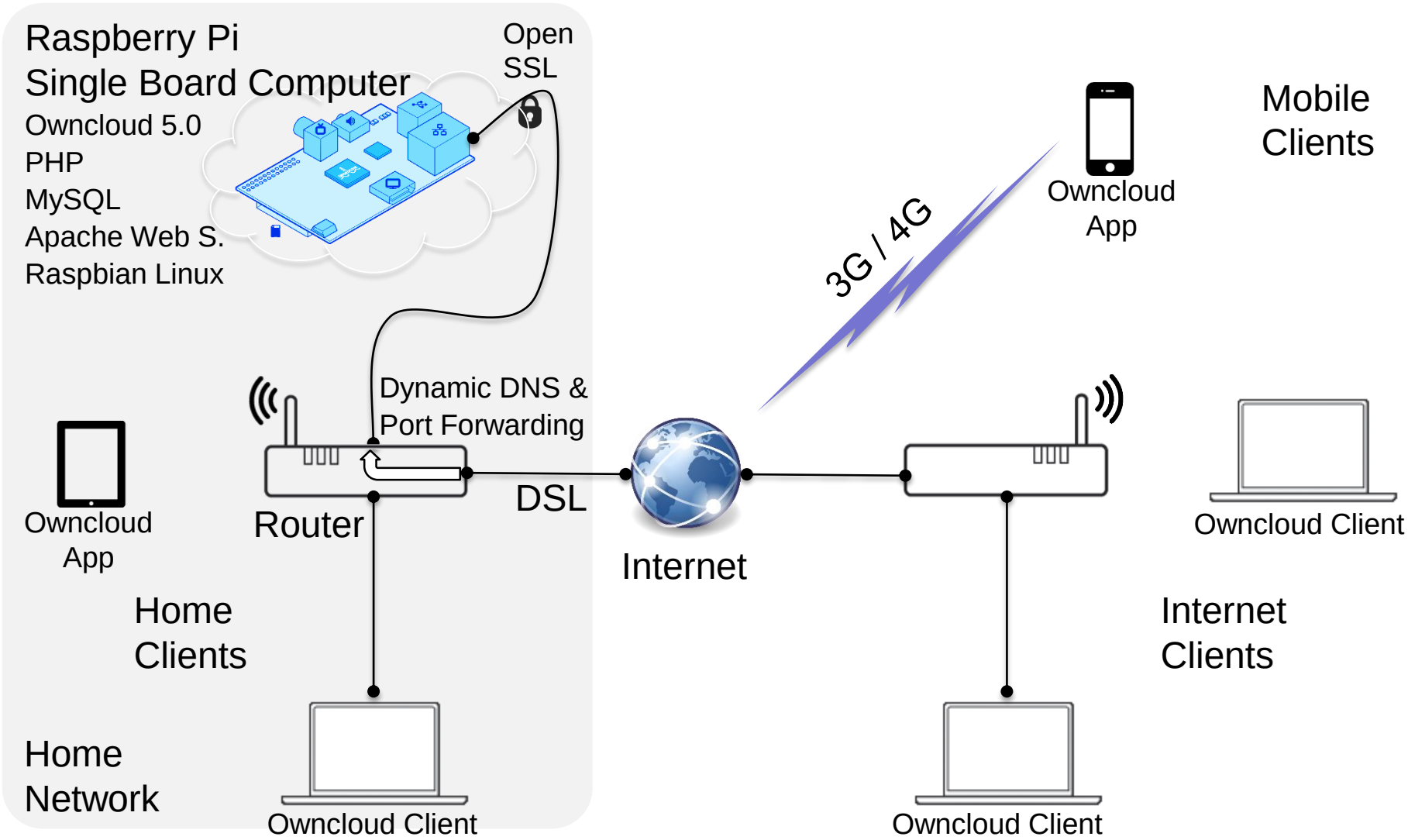
Raspberry Pi – Model B rev. 2	40 $
Transparent case	7 $
Power Supply Micro USB 5V 1000mA	10 $
Cat 5 TP patch cable	5 $
8 GB SDHC card (for software)	10 $
1 TB external hard disk USB 2.0 (for data)	60 $
Total	**132 $**

Useful additional equipment at configuration time:

- Keyboard, mouse, USB hub
- HDMI or composite video display

Later the computer can be administered remotely via SSH.

GENERAL ARCHITECTURE



OWNCLOUD FUNCTIONALITY (1)

- Internet drive functionality (file storage via WebDAV)
- File versioning, restoration of deleted files
- Web interface
- Calendar (also as CalDAV), task planner
- Address book (also as CardDAV)
- Music streaming (through Ampache)
- Photo gallery
- Bookmarking
- URL Shortening
- Viewer for PDF and ODF files

OWNCLOUD FUNCTIONALITY (2)

- Synchronisation of clients
  - ⇨ Windows, Mac OS, Linux clients
  - ⇨ Apps for Android and IOS
- User and group administration (e.g. via LDAP)
- Content sharing across groups or public URLs
- Online text editor
- Full text search
- Linkage to external storage (Dropbox, Google Docs, FTP...)
- Integrated virus scan
- Extensible via plugins

TYPICAL DATA RATES FOR HOME INTERNET CONNECTIONS

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(V)DSL	Mbit/sec			
Downstream	50 …100	16	6	2
Upstream	10	1	0,5	0,2

Cable network	Mbit/sec			
Downstream	100	50	10	
Upstream	5	2,5	1	

Download from personal cloud limited by upstream(!) data rate
Upload to personal cloud limited by downstream(!) date rate

Typical DSL to DSL transfer rate 0.5 … 1.0 Mbit/sec

Question: Is the combination of Raspberry Pi hardware plus Owncloud software fast enough to support this transfer rate?

RESULTS OF THE DEMONSTRATION PROJECT

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- All components could be installed and operated successfully.
- Internet drive & data sync functionality work satisfactory.
  - ⇨ Data download can keep up with typical DSL upstream rate of ~ 0.5…1.0 Mbit/sec.
  - ⇨ Data upload is even faster from a LAN with fast Internet upstream, e.g., from a university or corporate site.
  - ⇨ Data sync requires transmission of deltas only.
  - ⇨ Solution adequate for Internet drive application
- Web interface does not reach theoretical data transfer speed: The LAMP stack is too heavy.
  - ⇨ Remedy: Overclock CPU (950 MHz instead of 700)
  - ⇨ Remedy: Use APC (Alternative PHP Cache)
  - ⇨ Thus a moderate performance can be reached.

CONCLUSION AND OUTLOOK

- The Personal Cloud objectives are feasible
  - ⇨ Effective solution
  - ⇨ Performance ranges between moderate and good
  - ⇨ Low cost (~ 132 $), low power (2…5 Watts)
- Work to be done
  - ⇨ More accurate measurements needed to identify bottlenecks
  - ⇨ Future Raspberry Pi models may be faster
  - ⇨ Data security: detailed risk assessment of the solution needed
- Perspective:
  - ⇨ Personal cloud could be easily built into future DSL routers or other residential gateways