COMPOSITIONAL CONTROL

OF IP MEDIA

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DYNAMIC, POINT-TO-POINT MEDIA SERVICES OVER IP
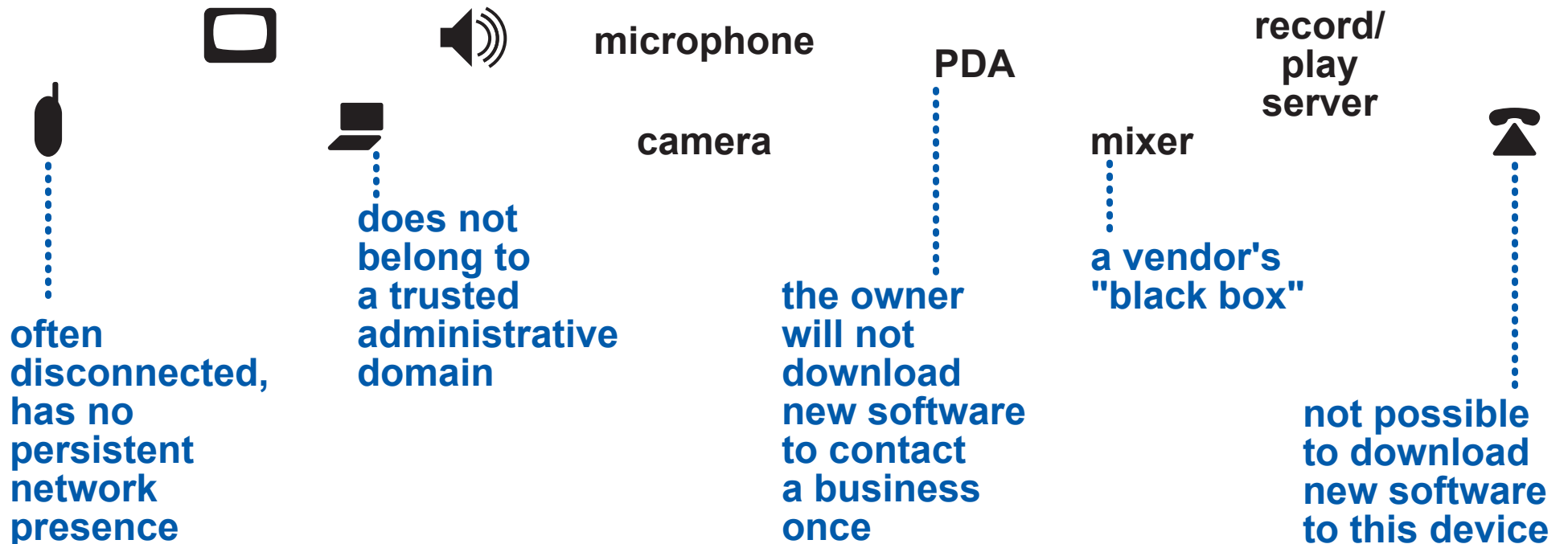
telephony

home networks

computer-supported cooperative WORK

computer-supported cooperative PLAY

**teleconferencing
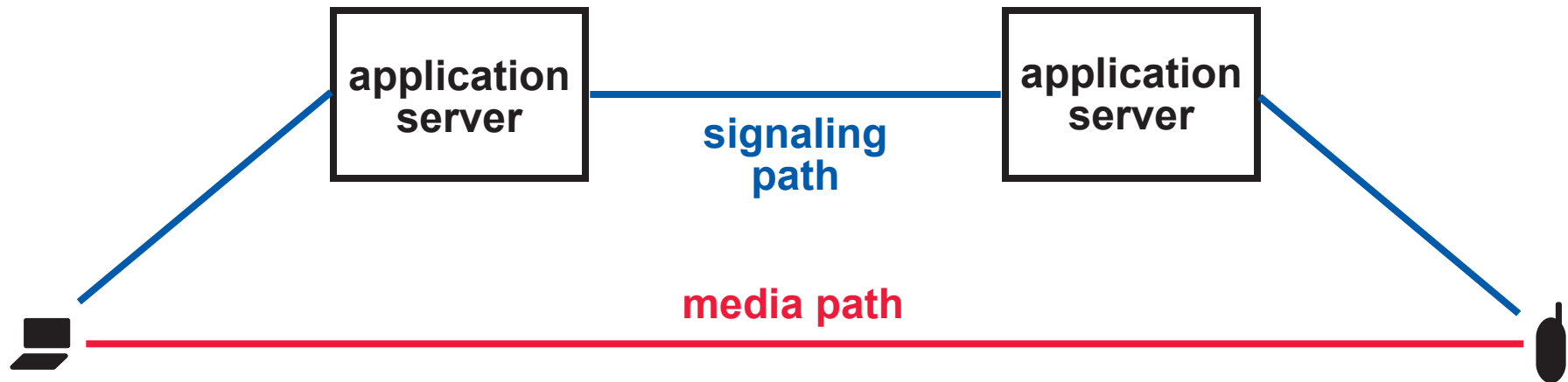telemonitoring
distance learning
virtual reality**

**collaborative television
multiplayer games
networked music performance**

**THESE SERVICES USE A DIVERSE
SET OF MEDIA ENDPOINTS**

**CAN ALL THE SERVICES BE
IMPLEMENTED IN THESE ENDPOINTS,
AS IS OFTEN ASSUMED?**

microphone

PDA

record/
play
server

camera

mixer

**does not
belong to
a trusted
administrative
domain**

**often
disconnected,
has no
persistent
network
presence**

**the owner
will not
download
new software
to contact
a business
once**

**a vendor's
"black box"**

**not possible
to download
new software
to this device**

IN PRACTICE, THESE SERVICES HAVE
SIGNALING/MEDIA SEPARATION

```
            ┌──────────────┐   signaling    ┌──────────────┐
            │ application  │────path────────│ application  │
            │   server     │                │   server     │
            └──────────────┘                └──────────────┘
           /                                                \
          /                    media path                    \
      [laptop]────────────────────────────────────────────[phone]
```

SIGNALING PATH

often passes through several servers

**low bandwidth + requires reliability
= often uses TCP**

MEDIA PATH

should be the shortest end-to-end path

**high bandwidth + tolerates packet loss
= often uses RTP**

**OFTEN, THE APPLICATION SERVERS
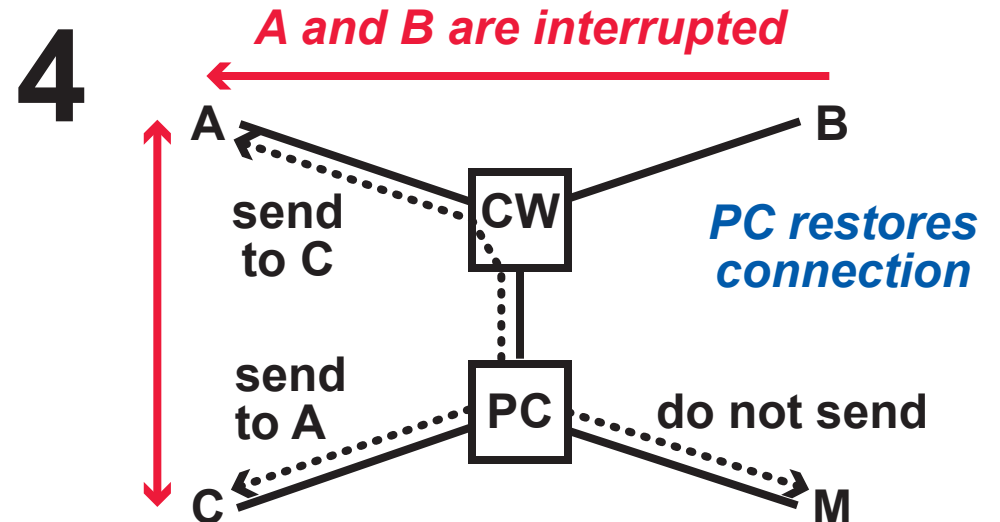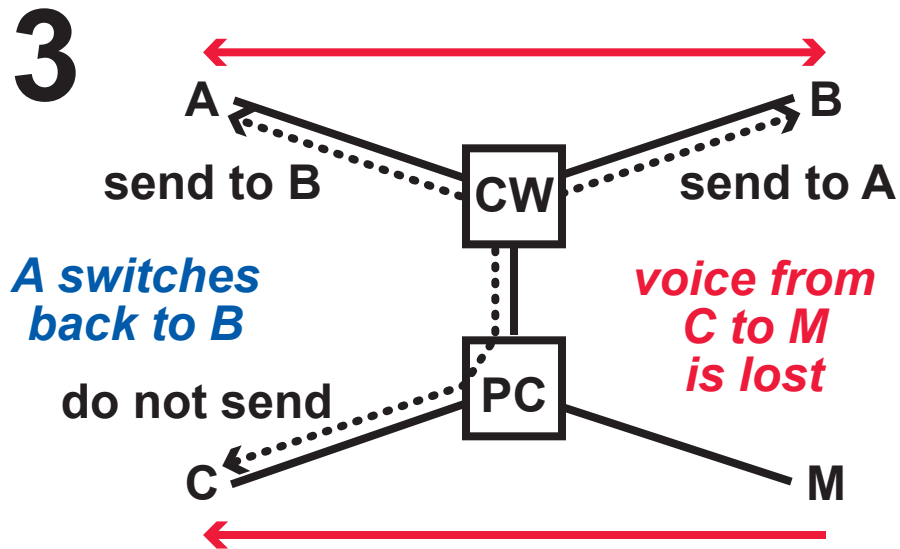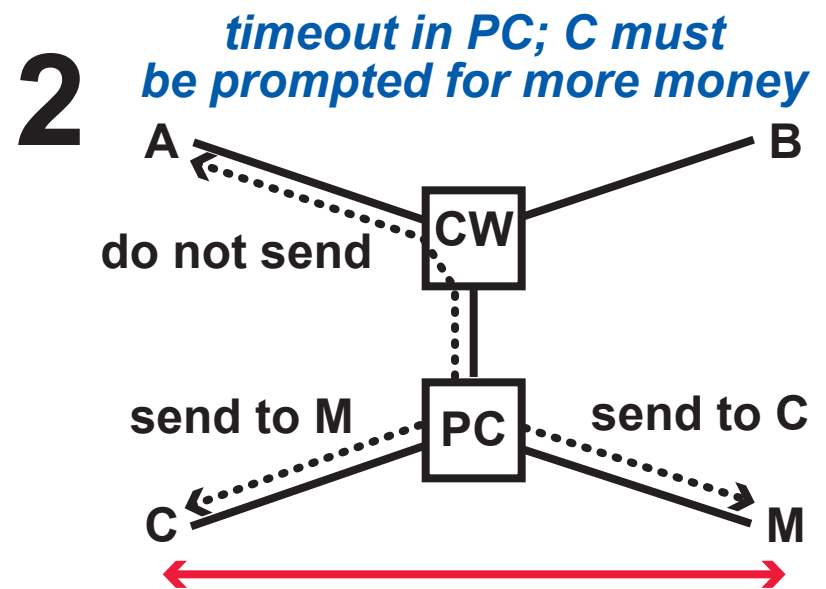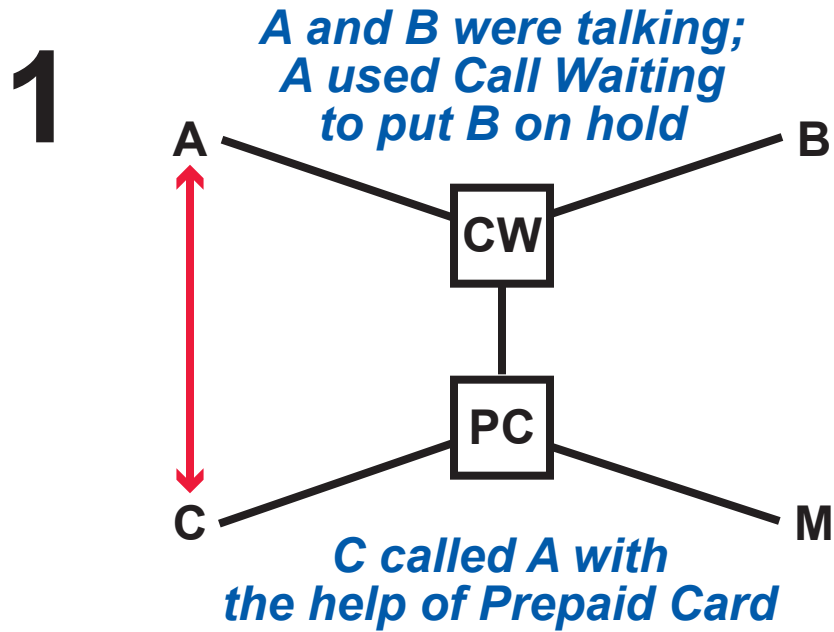DO NOT KNOW ABOUT EACH OTHER**

belong to different administrative
domains

serve different users

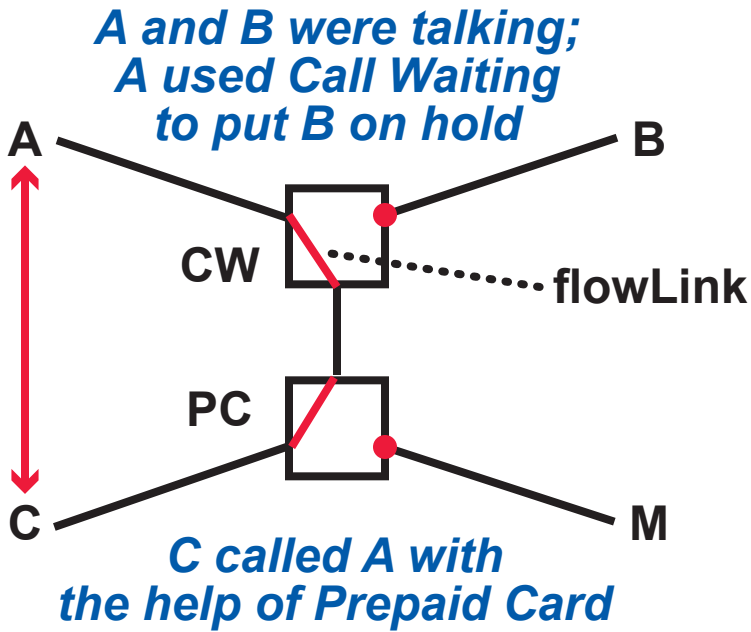are produced by different vendors

are added and/or updated individually
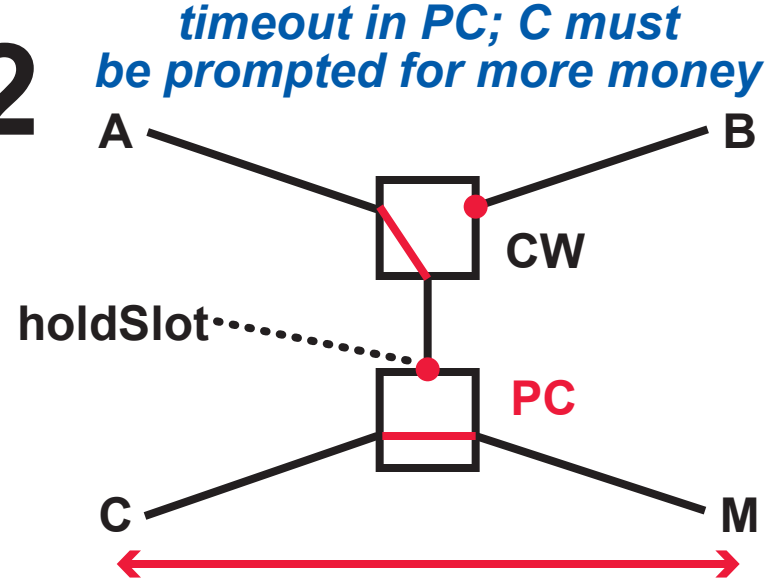
THE NEED FOR COMPOSITIONAL MEDIA CONTROL

1 *A and B were talking; A used Call Waiting to put B on hold*

A — CW — B

CW — PC

C — PC — M

C called A with the help of Prepaid Card

2 *timeout in PC; C must be prompted for more money*

A — CW — B

do not send

send to M — PC — **send to C**

C — M

3 A — CW — B

send to B — CW — **send to A**

A switches back to B

do not send — PC

voice from C to M is lost

C — M

4 *A and B are interrupted*

A — CW — B

send to C — CW

PC restores connection

send to A — PC — **do not send**

C — M

these problems occur because the actions of the two servers are not coordinated

HOW MEDIA CONTROL SHOULD WORK (OVERVIEW)

1 *A and B were talking; A used Call Waiting to put B on hold*

A — CW — B
flowLink
PC
C — M

C called A with the help of Prepaid Card

2 *timeout in PC; C must be prompted for more money*

A — CW — B
holdSlot
PC
C — M

3 *A switches back to B*

A — CW — B
CW
PC
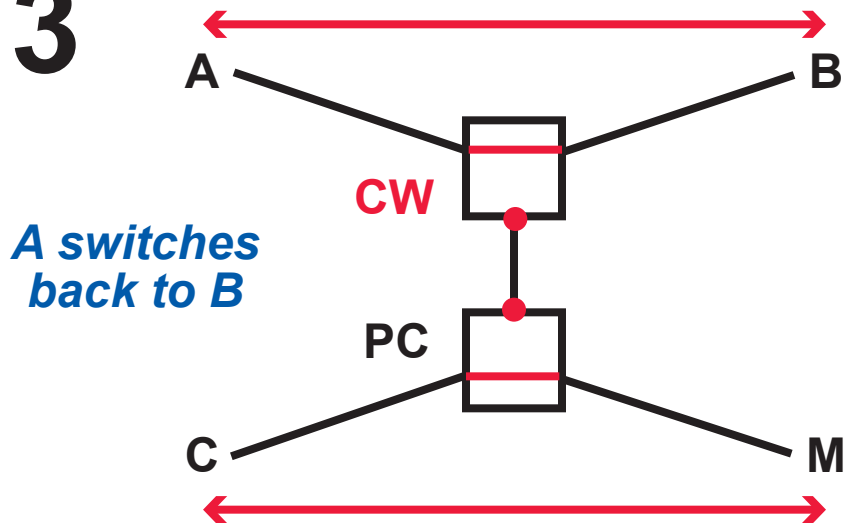C — M
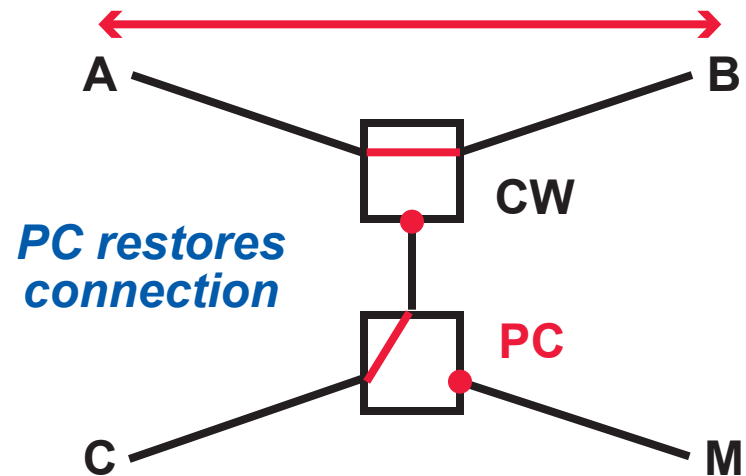
4 *PC restores connection*

A — CW — B
CW
PC
C — M

there is a voice channel between two endpoints if and only if there is an unbroken chain of signaling channels and flowLinks between them