Emotiv Systems

Revolutionary next generation human computer interaction

music
games
photos
videos
television
favorites
news
profile

Emotiv Systems Inc. is a neuroengineering company developing the next phase of **man-machine interface**

We are releasing a consumer product that offers a uniquely **personal experience** in the areas of:

- Games & Entertainment

- MMOGs

- Online Virtual Worlds

- Accessibility

- Semantic Application Interface

Emotiv's breakthrough neurotechnology platform enables a whole new realm of interaction

60-100 million people globally are participating in virtual worlds

Average age of users: 26 years old (Second Life: 33), only 25% are teens

Virtual worlds are on the verge of **going mainstream**

In 2008/09 Virtual Worlds
- Will become more like **social networks**
- Social networks will become **social experiences**
- Convergence consoles and PCs in online space

Facial expression & emotional feedback are critical hurdles to mainstream **adoption** of 3D virtual worlds

Our headset enables interact directly with elements on screen using the power of your brain

Facial expressions are detected naturally, in real-time – allowing **Avatars come to life** without conscious involvement

By understanding the emotional experience of the user, **content** can be **adjusted dynamically** to reflect excitement, engagement, calmness, tension, and frustration

Player's learn to **control objects by thought** – giving them the sensation of "**the Force**"

Designed to complement existing controllers, Emotiv provides a **intuitive, highly immersive** and **natural** extension of the **user experience**

In 2008, Emotiv will release the **Epoc** Neuroheadset

Complete, out-of-the-box entertainment experience

Control the universe with your mind through a game uniquely designed for the Emotiv headset

Extend the headset features to any game in your existing collection of PC games through **Emokey** software

Download and experience new detections for the headset through our web platform

Consumer product includes a game designed for the headset as well as tools to allow it to be used with existing game and applications

Emotiv Systems

Combines **low powered wireless** communication with a **high fidelity signal acquisition** system to produce a practical, light weight consumer product

Self adjusts to fit most head shapes and sizes

Features optimal sensor positioning that offers **accurate, spatial resolution** of the brain

Incorporates high performance **wireless** connectivity

A **gyroscope** to control avatar head or cursor movement

Stylish, wireless, high fidelity, consumer EEG signal acquisition headset

For the past **30 years** game development has been focused on **improved graphics** and sound

Graphics continue to evolve but with disproportional effort and **diminished return** on value
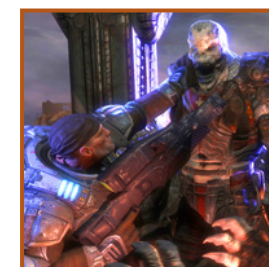
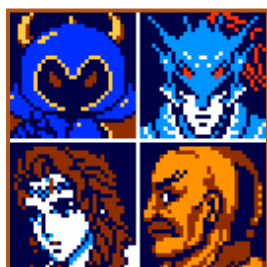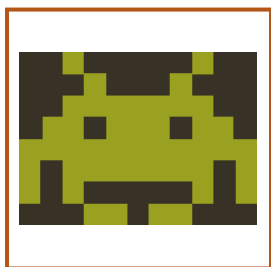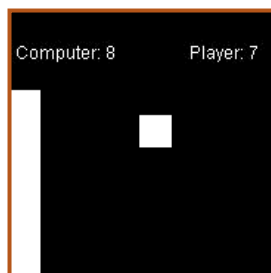Computer interface has hardly progressed

Until recently, innovations in other areas have suffered

Graphic realism has been the focus of innovation in game design

Comparison Timeline :

PAST

PRESENT

Innovation in gaming interface has not kept pace with graphics evolution

Dance Dance Revolution – 1999

'Buttons' are located on the floor, allow player to act out moves

EyeToy - 2003

Camera captures the player's movement by stripping video image from background and allows interaction via edge detection

Guitar Hero - 2005

Like DDR, player participates in a way more consistent with the fantasy

Nintendo Wii – Introduced Fall 2006

Interactivity trumps graphics performance

Natural interface demonstrates mass market appeal

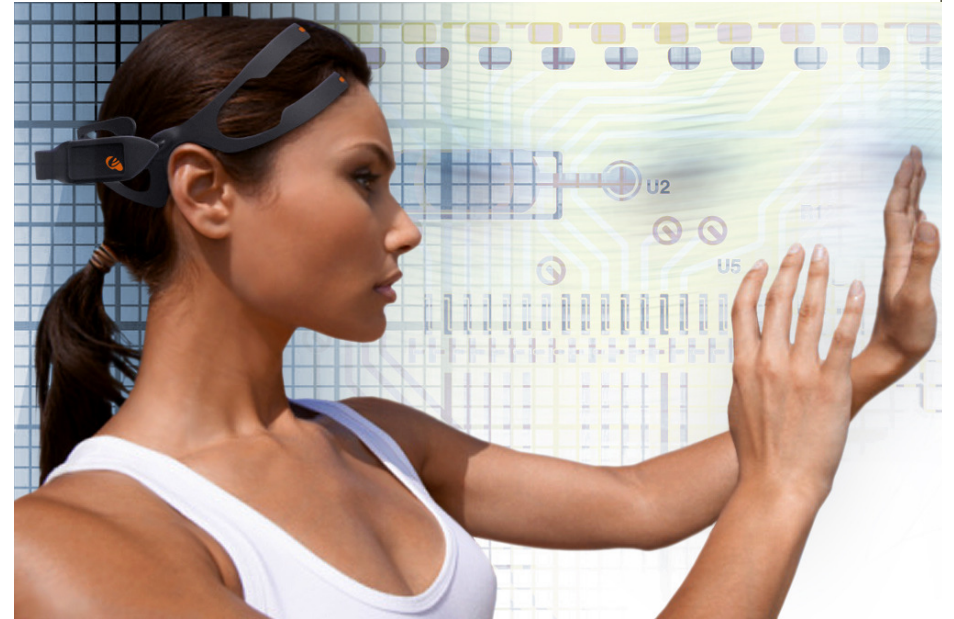Sales outperforms competition and device continues to be out of stock in stores 1 ½ years after introduction

Brain Computer Interface is the ultimate semantic device

Taps into the human 'control center'

Emotions and non-concious thoughts can be detected before you're even aware

Multichannel Human Computer Interface allows traditional input of conscious control while providing a feedback loop based on user perception

Information about the user's experience can be used to modify content and tailor experience

EEG (Electroencephalography)

Low latency

Portable

Inexpensive

Passive & Non-invasive

Neural Feedback: how it works

Brain
Mental Preferences
Complex Brainstates

Monitor
Game Software

Head sensor
Electrical activity from brain and skin on head measures strength of desired brainstate.
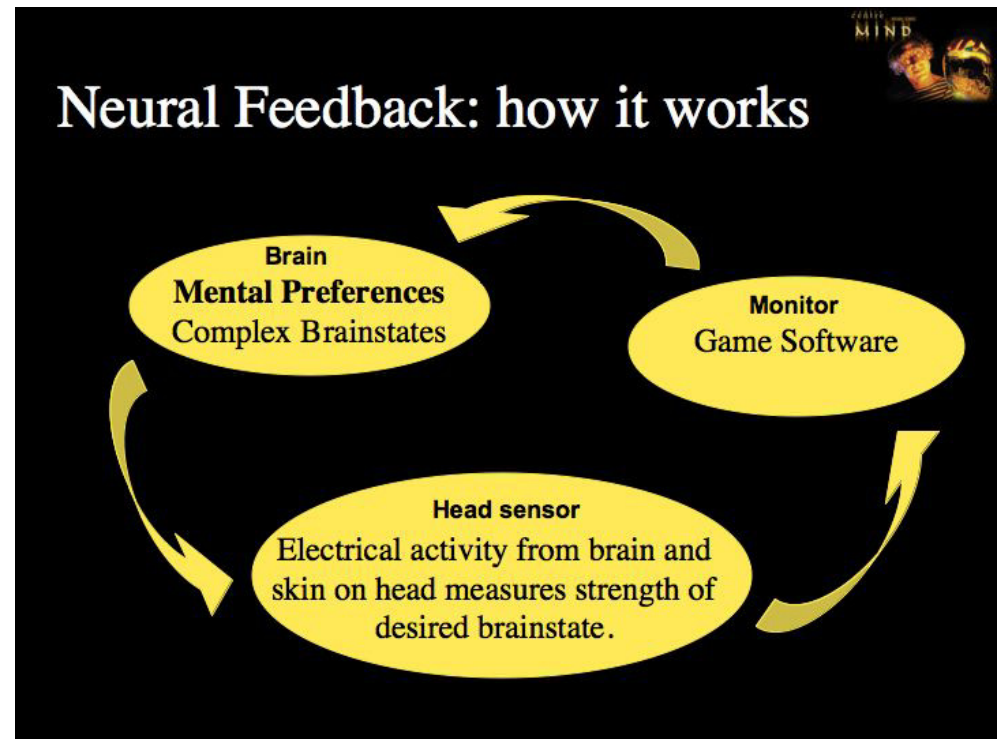
Emotiv has released three classes of detection using our neuroheadset

Expressiv – Identifies facial expressions

Affectiv – Detects emotional states

Cognitiv – Classifies conscious, active intent

Emotiv Detection Suites:

EXPRESSIV: *facial expressions*

   MMOG, Social Networks, AI characters --- become more humanly interactive

AFFECTIV: *feelings & emotions*

   Dynamic difficulty adjustment, feedback loop --- enables media to react to individual emotional engagement and adjust play accordingly

COGNITIV: *telekinesis*

   Lift, rotate, push… --- fulfills a powerful fantasy that crosses all cultures; beyond anything previously thought possible

Emotiv SDK

Enables game developers to deliver content for the Emotiv platform

Emulation tools allow for rapid prototyping of existing applications

Composer allows for off-line simulation of headset input

Downloadable SDKLite provides immediate access to Emulation and Composition tools

Levels of Software Integration :

Rapid integration into existing and emerging applications via traditional input device emulation

- Detection outputs (or combinations of outputs) are mapped to keystrokes which trigger events in the application

- User setup is performed outside the target application

- Initial integration in just minutes

Complete integration via API (edk.dll)

- The technology is fully integrated via a dynamically linked library and accessed thru a concise set of function calls (api)

- Setup can be integrated into the application

  - Example: instead of training in the control panel, Harry Potter would go to wizard school and learn his spells to train the cognitiv actions

  - Profiles can be managed by the application's own user profile

Emotiv Beta SDK

Hardware
- Headset
- Charger (power outlet or USB)
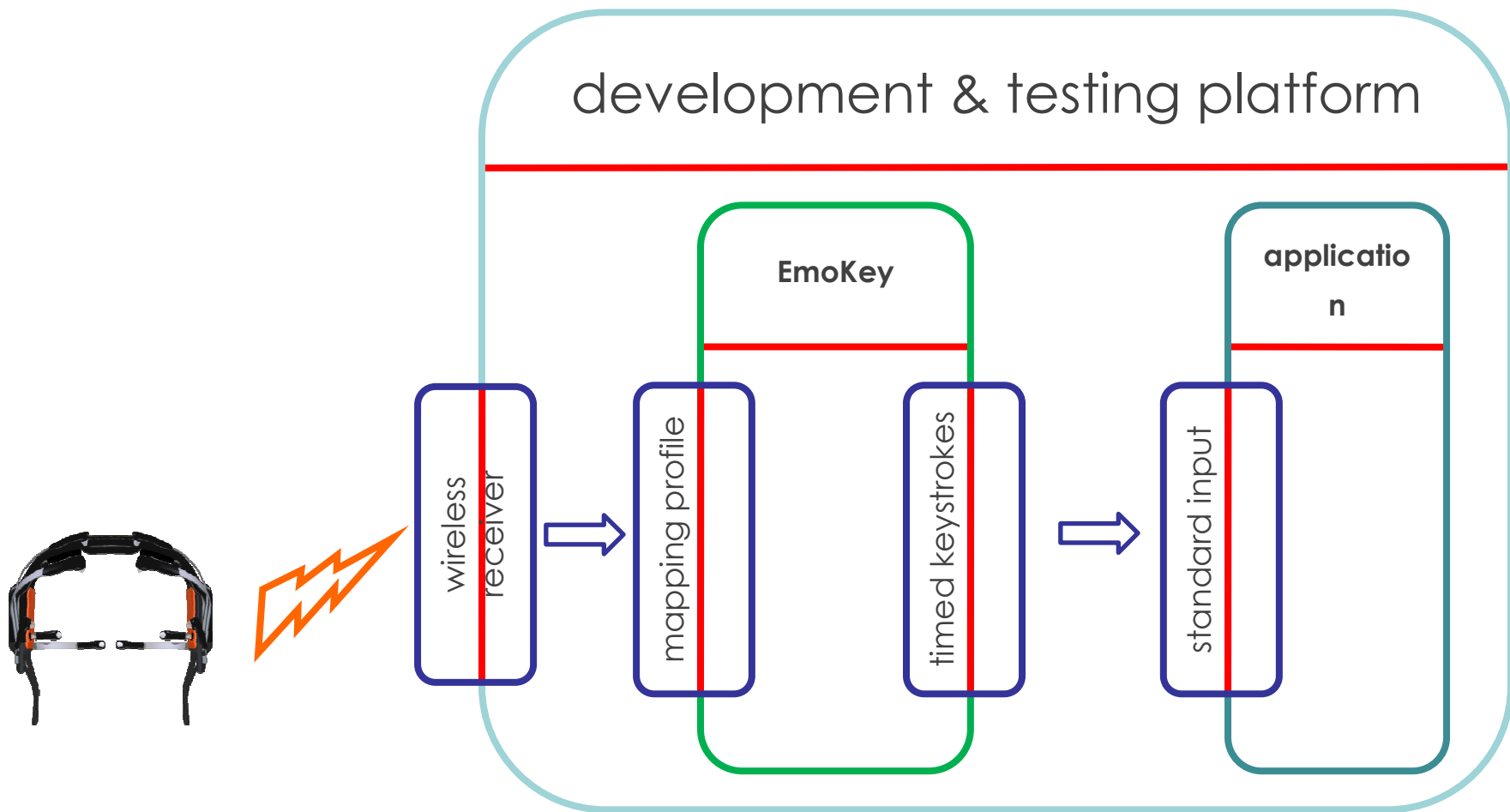- Headset battery life greater than 10 hours

Software CD
- User manual
- Emotiv Development DLL (edk.dll)
- API reference documentation
- Example projects (c++ source code)

- Control Panel
  - Supports 2 players
  - Includes hardware status and user profile management
  - Exposes detection suites in action

- Development Tools
  - EmoKey – Headset interface via keyboard emulation
  - EmoComposer – Brain state emulation
  - EmoScript examples

development & testing platform

EmoKey

applicatio n

wireless receiver

mapping profile
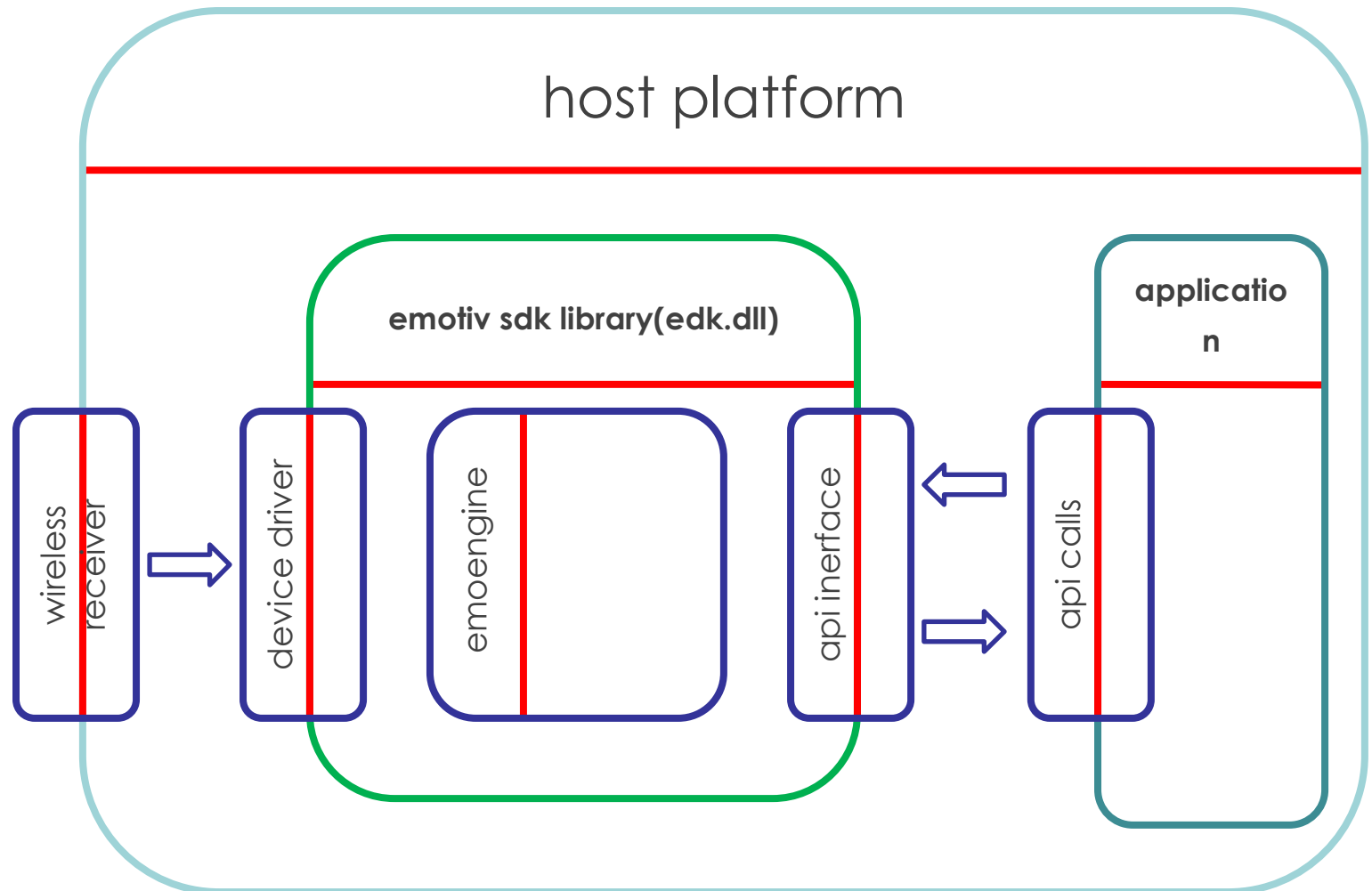
timed keystrokes

standard input

Emotiv Systems

Rapid Integration

EmoKey

- Converts detection events into signals that emulate traditional input devices

  - Simple events: Smile > 50% triggers ":)" keystrokes

  - Compound events: Smile > 50% + wink triggers ";)"

  - Simulated keystrokes can be triggered:

    - Once only (both hold and release time may be specified)

    - Repeatedly, while a mapping condition is met (both hold and release times between strokes may be specified)

- Emokey profiles can be saved for each application

- Common modifiers (shift, alt, ctrl) can also be used o create complex keystroke combinations.

- Implementation time in the order of minutes

host platform

emotiv sdk library(edk.dll)

application

wireless receiver

device driver

emoengine

api inerface

api calls

Complete Integration:

Hardware and user management

- Integrated into the menu system of the application

- Combined with other service routines
  - Controller configurations
  - Difficulty settings

Detections and Training

- Detections matched to the content and fantasy of the application

- Unified train and play environments facilitate more rapid and entertaining training

- Inclusion of new content and interactivity enabled by access to the detection suite output, for example:
  - Dynamic difficulty adjustment (Affectiv)
  - Real time personalized avatars (Expressiv)
  - New and more amazing super powers, mind powers or abilities (Cognitiv)

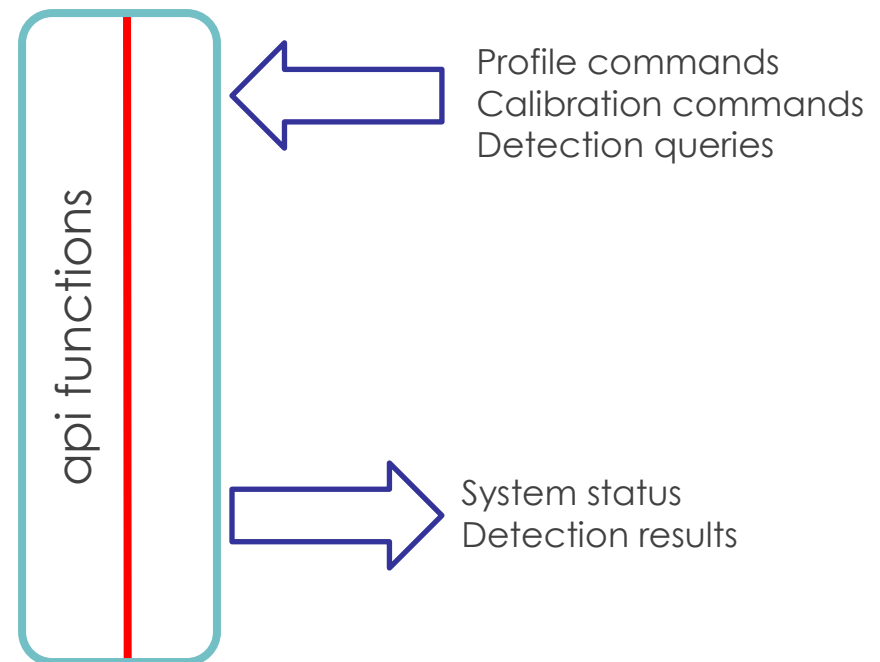### Development and testing tools
- EmoKey
- EmoComposer
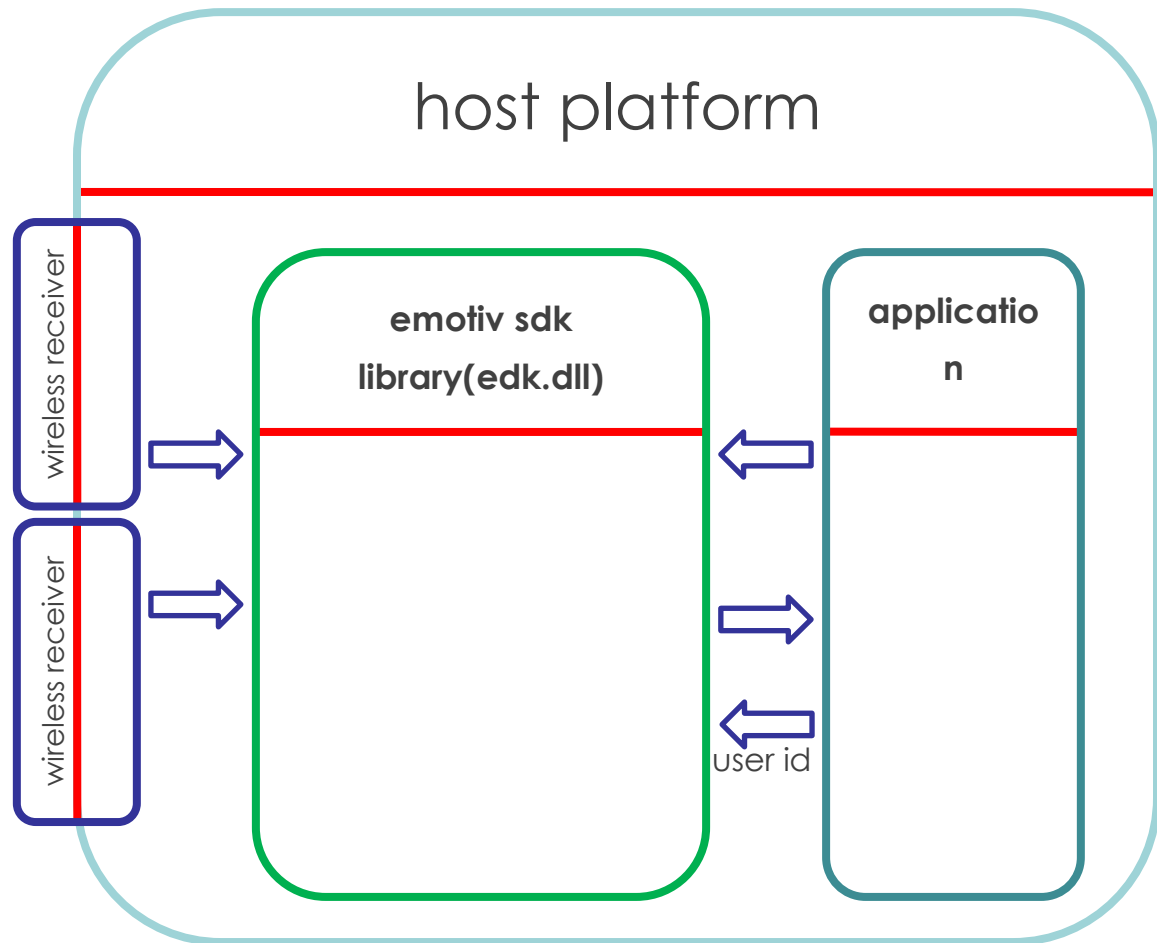
Emotiv SDK Function Classes

EE_ Prefix
- Status, calibration & profile functions

ES_ Prefix
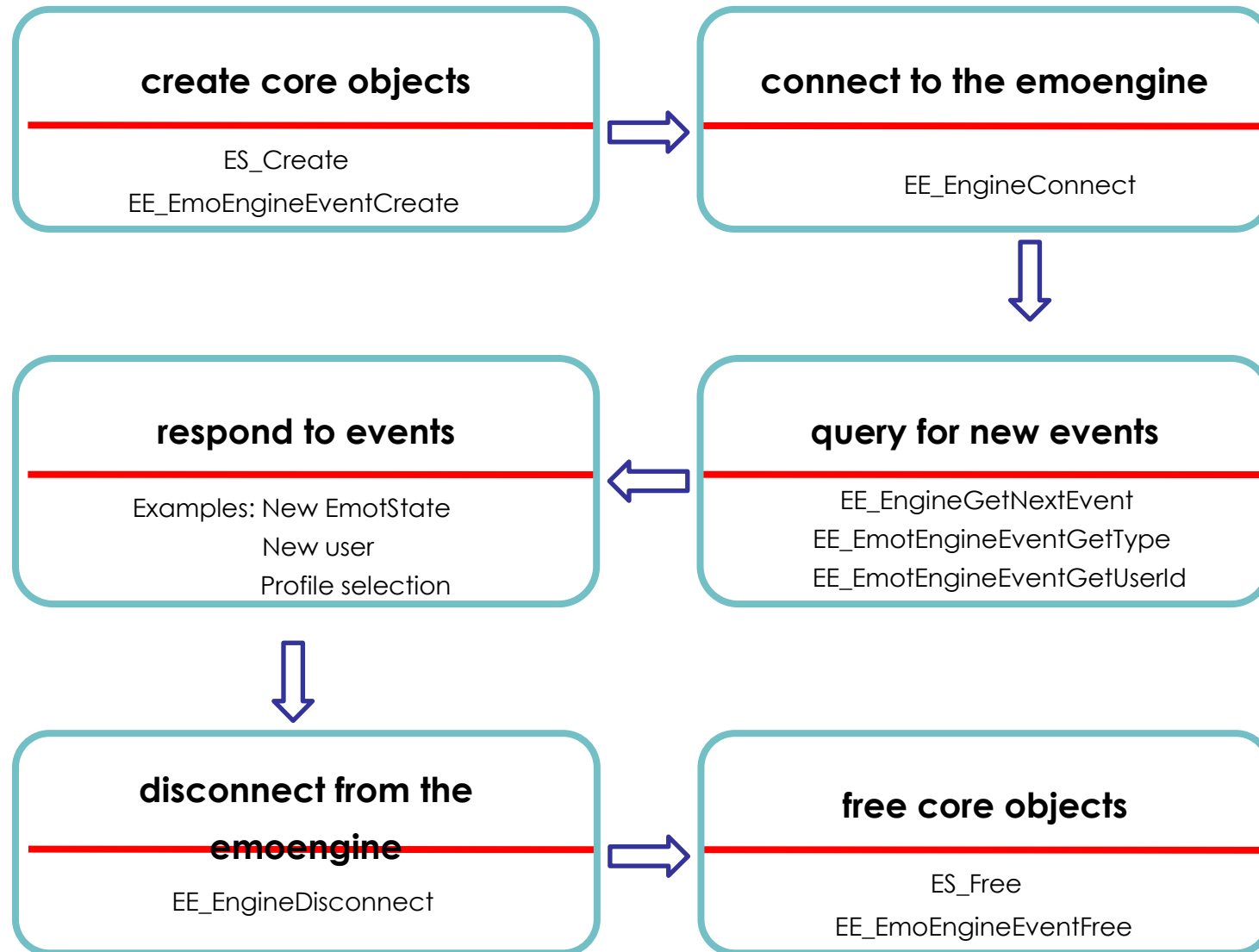- Detection suite access

Emotiv SDK Core Objects

EmoEngine Event Object
- Alerts to events such as new detection states being available

EmoEngine State Object
- Contains the status of hardware, software and detection suite outputs.

api functions

Profile commands
Calibration commands
Detection queries

System status
Detection results

Emotiv Systems

Each user has a unique profile to store:

- Expressiv sensitivities and ranges

  - Sensitivity specifies ease to trigger a detection

    - For example, smile may be triggered when the user is just starting to smile, or when they have a large grin

  - Range specifies how broad the detection is after onset

    - Low range: detections slightly above onset go to full scale

    - High Range: detections must be triggered far above the onset level to trigger full scale

- Cognitiv training data

  - Data from training to classify their individual brainwave 'signature', for each focussed and intent thought trained, as well as neutral
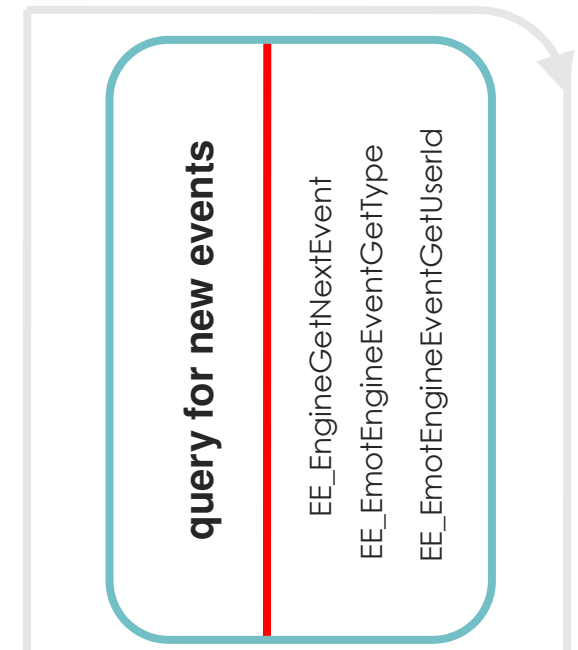
create core objects

___

ES_Create

EE_EmoEngineEventCreate

⇨

connect to the emoengine

___

EE_EngineConnect

⬇

respond to events

___

Examples: New EmotState

New user

Profile selection

⬅

query for new events

___

EE_EngineGetNextEvent

EE_EmotEngineEventGetType

EE_EmotEngineEventGetUserId

⬇

disconnect from the emoengine

___

EE_EngineDisconnect

⇨

free core objects

___

ES_Free

EE_EmoEngineEventFree

Events in the Emotiv SDK

EE_UserAdded / EE_UserRemoved
- New user registered with or removed from the emoengine, respectively.

EE_ ProfileEvent
- Profile access events, such as the return of the requested profile for a new user.

EE_CognitivEvent
- Dedicaed to events in the cognitiv suite, most importantly control of training

EE_EmoStateUpdated
- New detection event, such as a new facial expression.

query for new events

EE_EngineGetNextEvent
EE_EmotEngineEventGetType
EE_EmotEngineEventGetUserId

| Detection	EmoState Query	Result Type
Blink	ES_ExpressivIsBlink	Binary (integer 0 or 1)
Wink (Left or Right)	ES_ExpressivIsLeftWink / ES_ExpressivIsRightWink	Binary (integer 0 or 1)
Horizontal Eye Movement (Left or Right)	ES_ExpressivIsLookingLeft / ES_ExpressivIsLookingRight	Binary (integer 0 or 1)
Smile	ES_ExpressivGetSmileExtent	Continuous (float) (101 increments, from 0.00 to 1.00)
Clench	ES_ExpressivGetClenchExtent	Continuous (float) (101 increments, from 0.00 to 1.00)
Eyebrow movement	ES_ExpressivGetEyebrowExtent	Continuous (float) (101 increments, from 0.00 to 1.00)
Short Term Excitement / Calmness	ES_AffectivGetExcitementShortTermScore	Continuous (float) (101 increments, from most calm at 0.00 to most excited at 1.00)
Long Term Excitement / Calmness	ES_AffectivGetExcitementLongTermScore	Continuous (float) (101 increments, from most calm at 0.00 to most excited at 1.00)
Cognitiv Action (Up to 4)	ES_CognitivGetCurrentAction	Continuous (float) (101 increments, from low power at 0.00 to full strength at 1.00)

Hardware and Detection Emulation

EmoComposer

- Hardware emulator which can be used in place of the headset to simulate both the presence of the hardware as well as detection suite outputs

- Two modes of operation:
  - Interactive mode: events triggered and adjusted via on-screen controls. Events of all types including detection outputs, training sequences and profile management are supported

  - Script mode: timed sequence of events played back from pre-defined descriptions written in EmoScript, a simple markup language file

- Removes the need for each developer/designer to have a headset, thereby removing the potential bottleneck on headset access

- Enables rapid and automated testing for both development and quality assurance. Extensive scripting options are supported to facilitate rigorous testing of common and boundary conditions

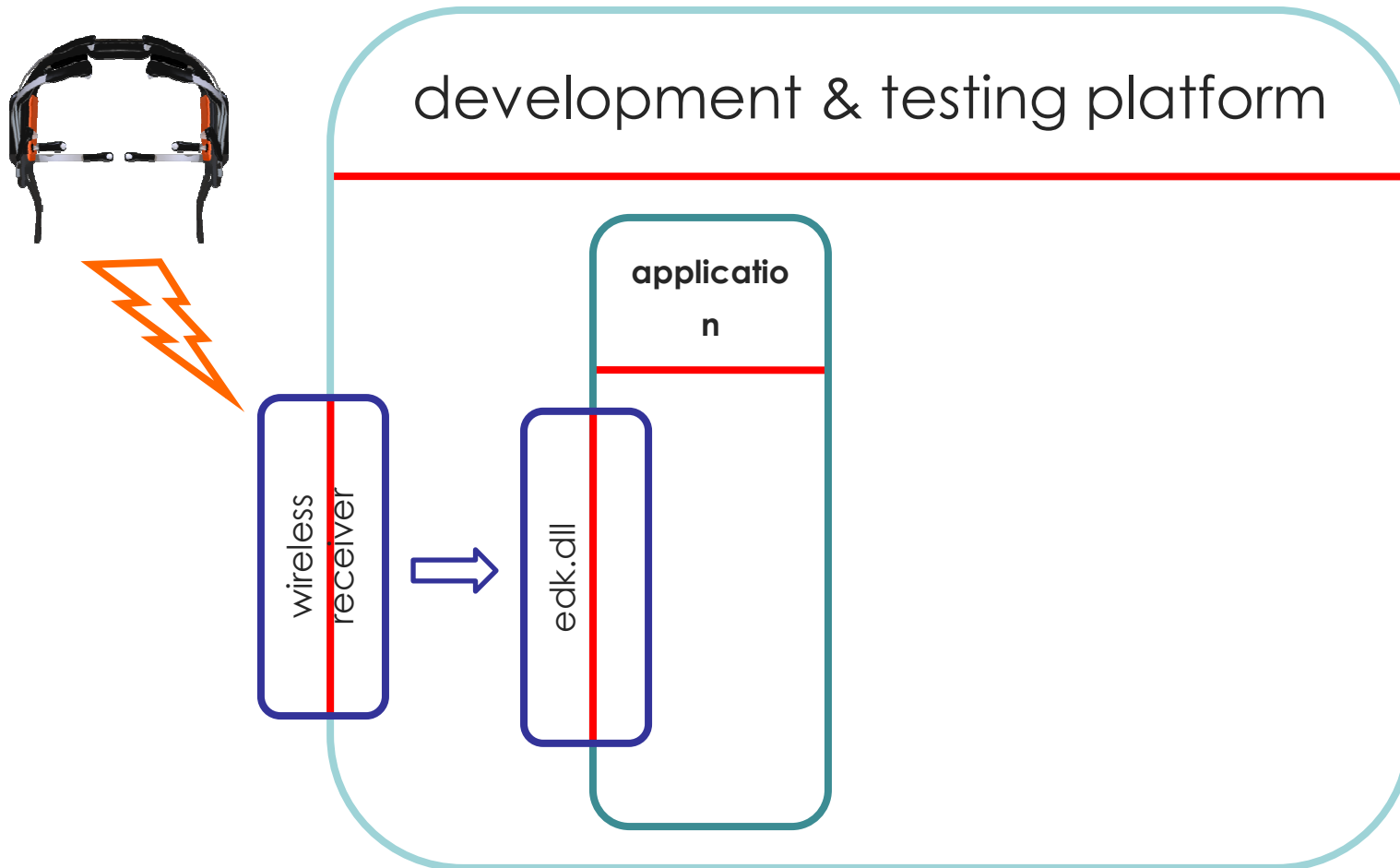- Interaction mirrors the real api architecture in calling convention and response.

Sample Development Process – Phase 1

development & testing platform

EmoComposer

application

EmoScript (eml)

EmoStates
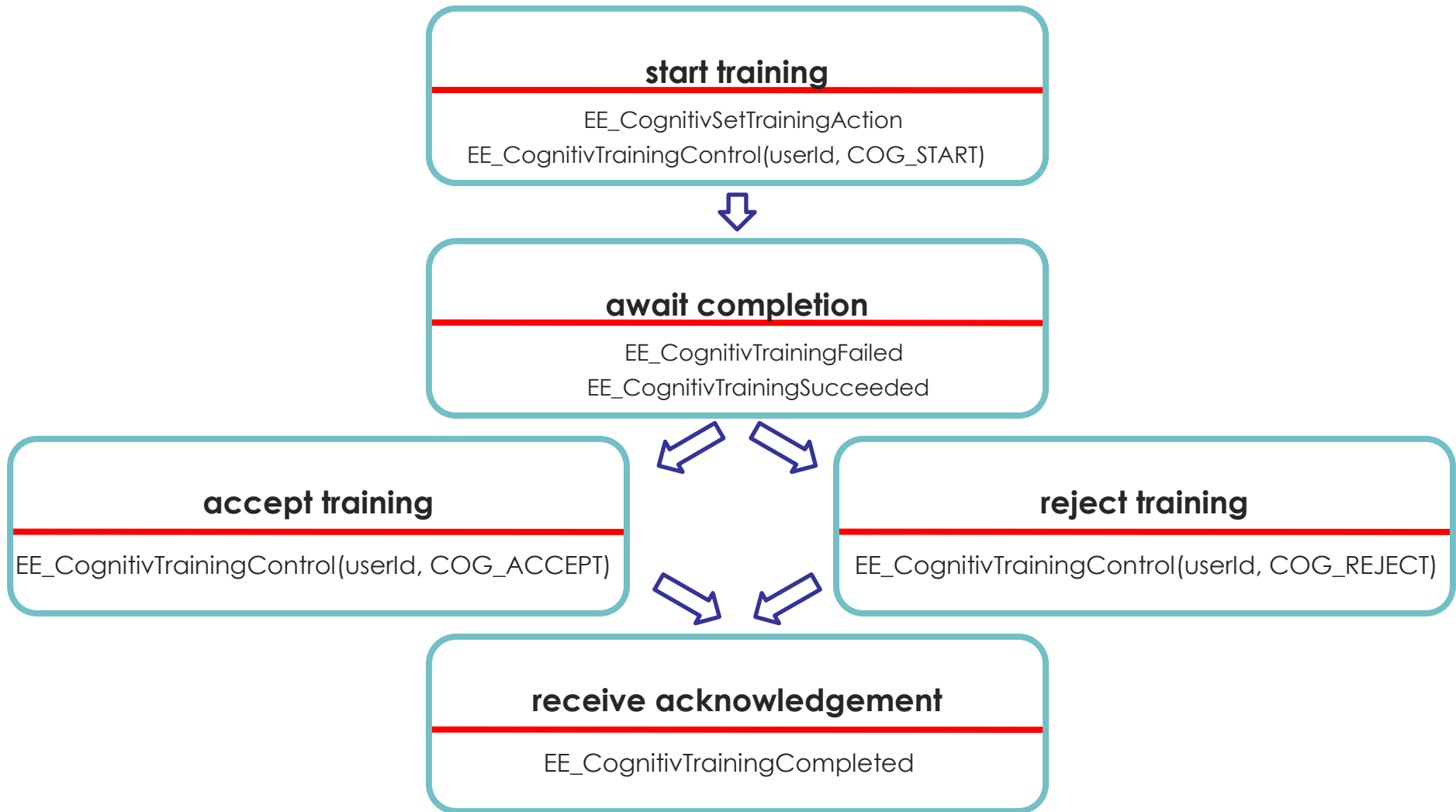
edk.dll
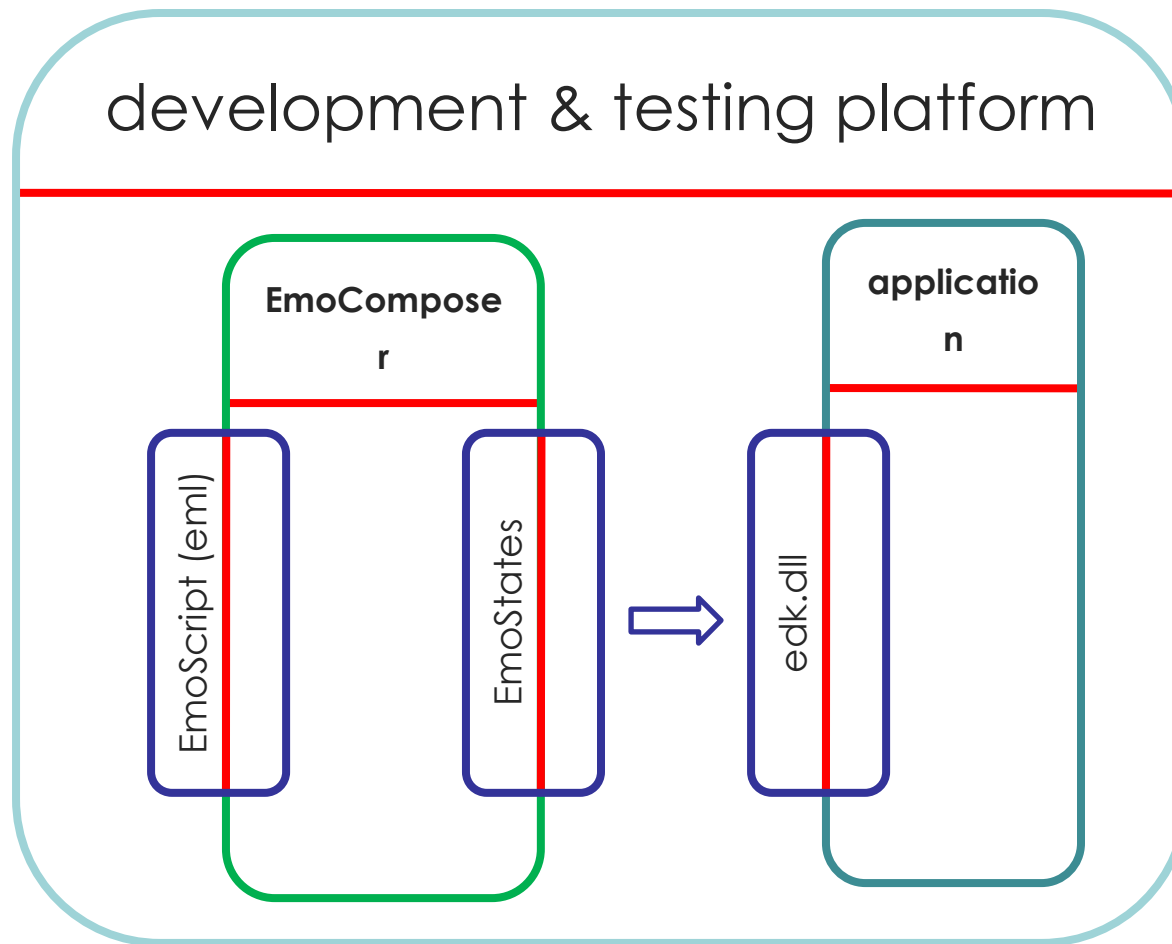
Sample Development Process – Phase 2

Training the Cognitiv Suite

The Cognitiv suite is trained by recording:

- Neutral: a background state, recorded when the user is not performing expressions or cognitiv actions

- Actions: recordings of the user focusing their intent on an action for about 8 seconds

Subsequent training helps the system learn to identify the user's brainwaves, and helps the user learn to focus on the actions

An application must alert the EmoEngine when to start recording the user's brainwaves, and which with cognitiv state to associate them. A dedicated event class returns training status

If the user is distracted, they may discard their last recording. If the signals are noisy, it is automatically discarded

Up to four actions are available at any one time, the number available is referred to as the current level of the user

Training the Cognitiv Suite

start training

EE_CognitivSetTrainingAction
EE_CognitivTrainingControl(userId, COG_START)

⬇

await completion

EE_CognitivTrainingFailed
EE_CognitivTrainingSucceeded

accept training

EE_CognitivTrainingControl(userId, COG_ACCEPT)

reject training

EE_CognitivTrainingControl(userId, COG_REJECT)

receive acknowledgement

EE_CognitivTrainingCompleted

For a copy of the SDKLite

Visit our website at www.emotiv.com

Select Developers on the menu bar

Select Download SDKLite from the side bar

Thank you!
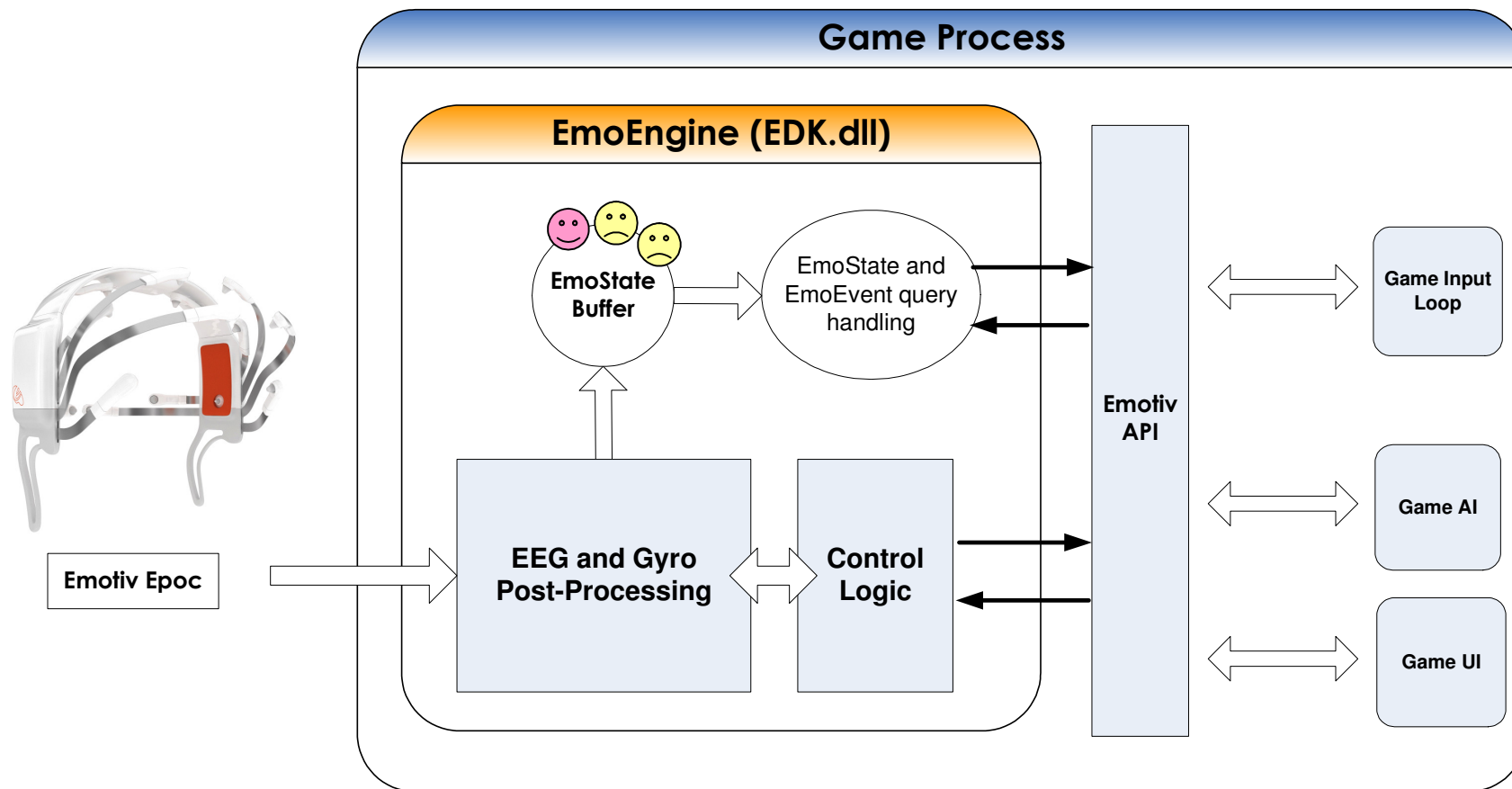
Initialization

> Open a connection to EmoEngine

```
                                        EE_EngineConnect()
```

```
                                        EE_EngineRemoteConnect()
```

Event Polling

```
            EE_EngineGetNextEvent(EmoEngineEventHandle hEvent)
```

Emotiv Systems

Detection Tuning

EE_ExpressivSetThreshold(…)

EE_CognitivSetCurrentLevel(…)

Detection Training

EE_CognitivSetTrainingAction(…)

EE_CognitivSetTrainingControl(…)

User Profile Management

EE_GetUserProfile(unsigned int userId, EmoEngineEventHandle hProfile)

EE_GetUserProfileBytes(EmoEngineEventHandle hEvt, …)

EE_SetUserProfile(unsigned int userId, …)

- User profile stores per-user detection settings and training data
- Allows game to manage user profile data in manner that is ideal for that application or platform
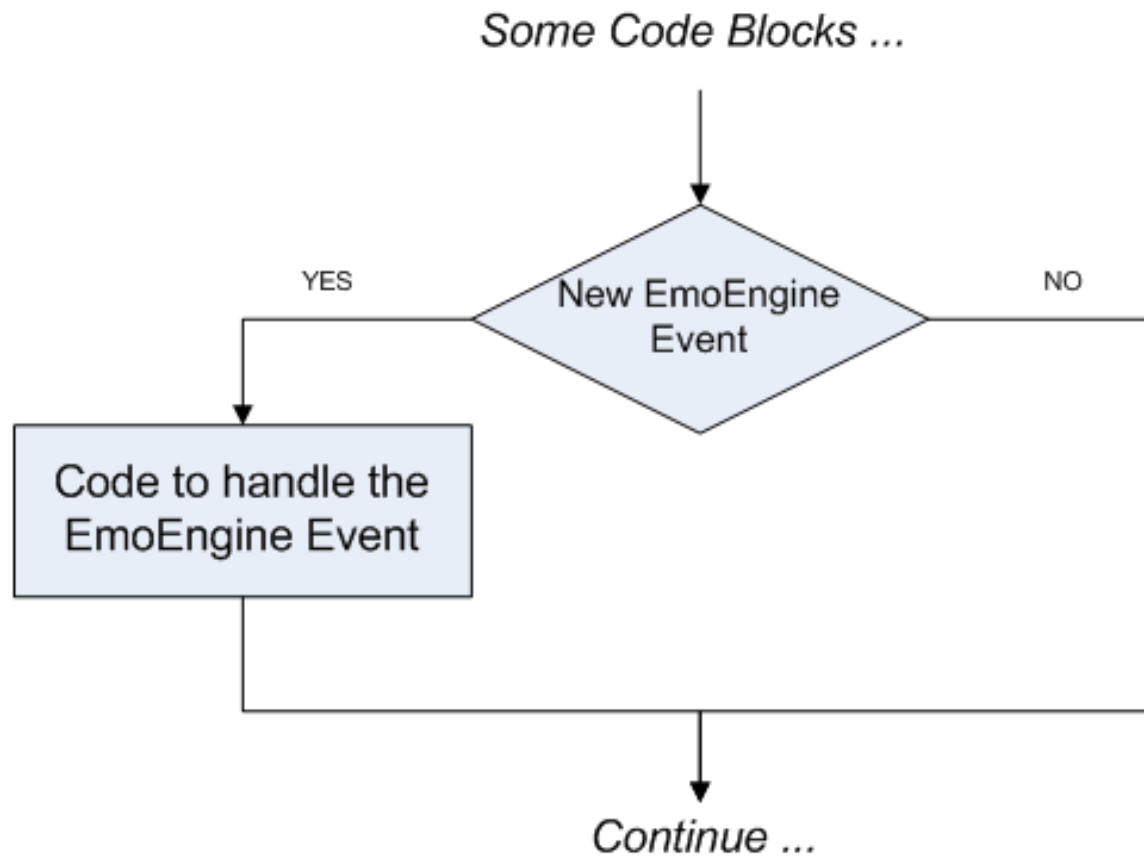
Emotiv Systems

- EE_UserAdded
  - Generated when Emotiv USB dongle is plugged into the computer. User ID is assigned at this time

- EE_UserRemoved

- EE_EmoStateUpdated
  - A detection has updated the user's EmoState
  - Call EE_EmoEngineEventGetEmoState to retrieve EmoState handle

- Getter functions to access detection results
- Detection results can be binary (0/1) or continuous (0..1)

Detection	Result Type
Blink	Binary (0 or 1)
Wink Left	Binary (0 or 1)
Wink Right	Binary (0 or 1)
Horizontal Eye Movement (Left)	Binary (0 or 1)
Horizontal Eye Movement (Right)	Binary (0 or 1)
Smile	Continuous (101 increments, from 0.00 to 1.00)
Clenched teeth / grimace	Continuous (101 increments, from 0.00 to 1.00)
Eyebrow movement	Continuous (101 increments, from 0.00 to 1.00)
Excitement / Calmness	Continuous scale (101 increments, from most calm at 0.00 to most excited at 1.00)
Engagement (Focus)	Continuous (101 increments, from 0.00 to 1.00)
Frustration (coming soon)	Continuous (101 increments, from 0.00 to 1.00)
Cognitiv Actions 1-4	Continuous (101 increments, from 0.00 to 1.00)

- EE_CognitivEvent
  - Informs application of the status of Cognitiv training

  - EE_CognitivTrainingStarted

  - EE_CognitivTrainingSucceeded

  - EE_CognitivTrainingFailed

- EE_ExpressivEvent

Demonstrate, tune, train and test detections
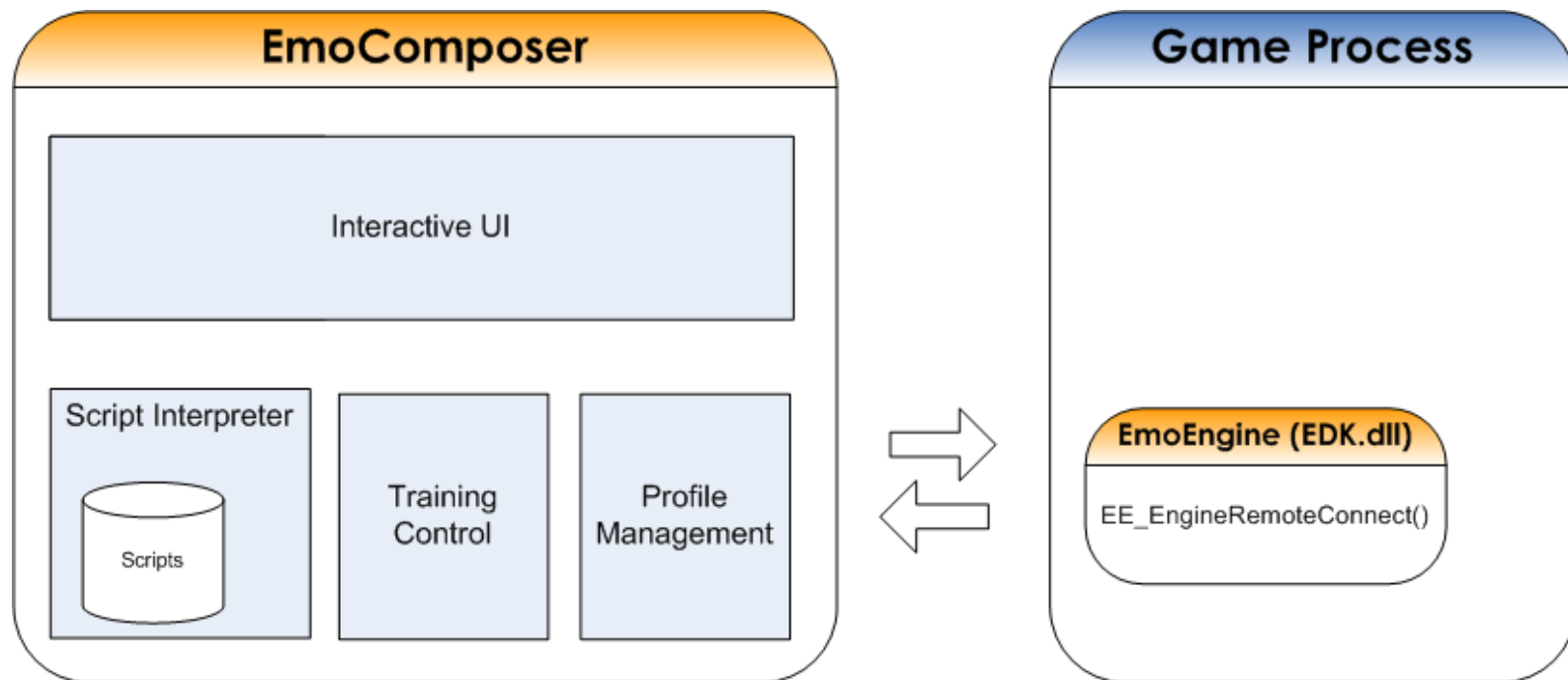
- EmoEngine proxy: Use EE_EngineRemoteConnect to connect EDK.dll to Emotiv Control Panel
- Allows developers to start game integration and testing without having to build complete UI and game logic to support training, profile mgmt, detection tuning
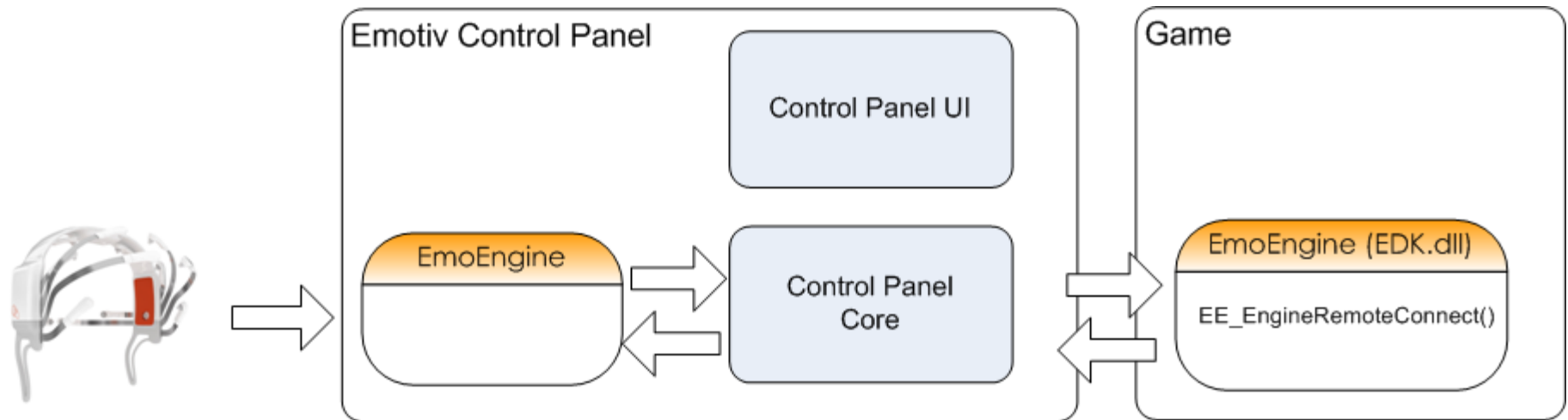
- EmoEngine and Headset emulator

- Generates EmoEngine events

- Reponds to training and profile mgmt requests

- An utility that maps detection results to keystroke sequences

- EmoEngine detections can be used with existing games/ application