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Java

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HtmlUnit: An Efficient Approach to Testing Web Applications

Daniel Gredler
DHL Global Mail
daniel.gredler@gmail.com

Ahmed Ashour
Zain KSA
asashour@yahoo.com

Agenda

- Integration Testing: Why?
- Browser Driving: Pros and Cons
- Browser Simulation: HtmlUnit
- Browser Simulation: Pros and Cons
- Wrappers Around HtmlUnit
- HtmlUnit Future Plans
- Q&A

Integration Testing: Why?

- Sanity checks
- Top-to-bottom integration
- Find errors early
  - HTTP errors
  - HTML errors
  - JavaScript™ errors
  - Backend errors
- **Not** proving the application is bug-free!

Browser Driving: Pros

- Feedback / visualization
- Fidelity to the user experience
- Leverages browser configuration
  - Browser plugins
  - Flash
  - Google Gears
  - …
- Easy to create tests (recorders)

Browser Driving: Cons

- Feedback / visualization
- Platform dependence
- Hard to test multiple browsers
- Limited extensibility
- Performance
- Scalability
- Recorders encourage limited, brittle tests

Simulation: HtmlUnit

- 100% Java-based headless browser
- Open Source (Apache 2 License)
  - 7 committers (3 active)
  - Very mature
- Useful for:
  - Integration Testing
  - Web Scraping
  - System Monitoring

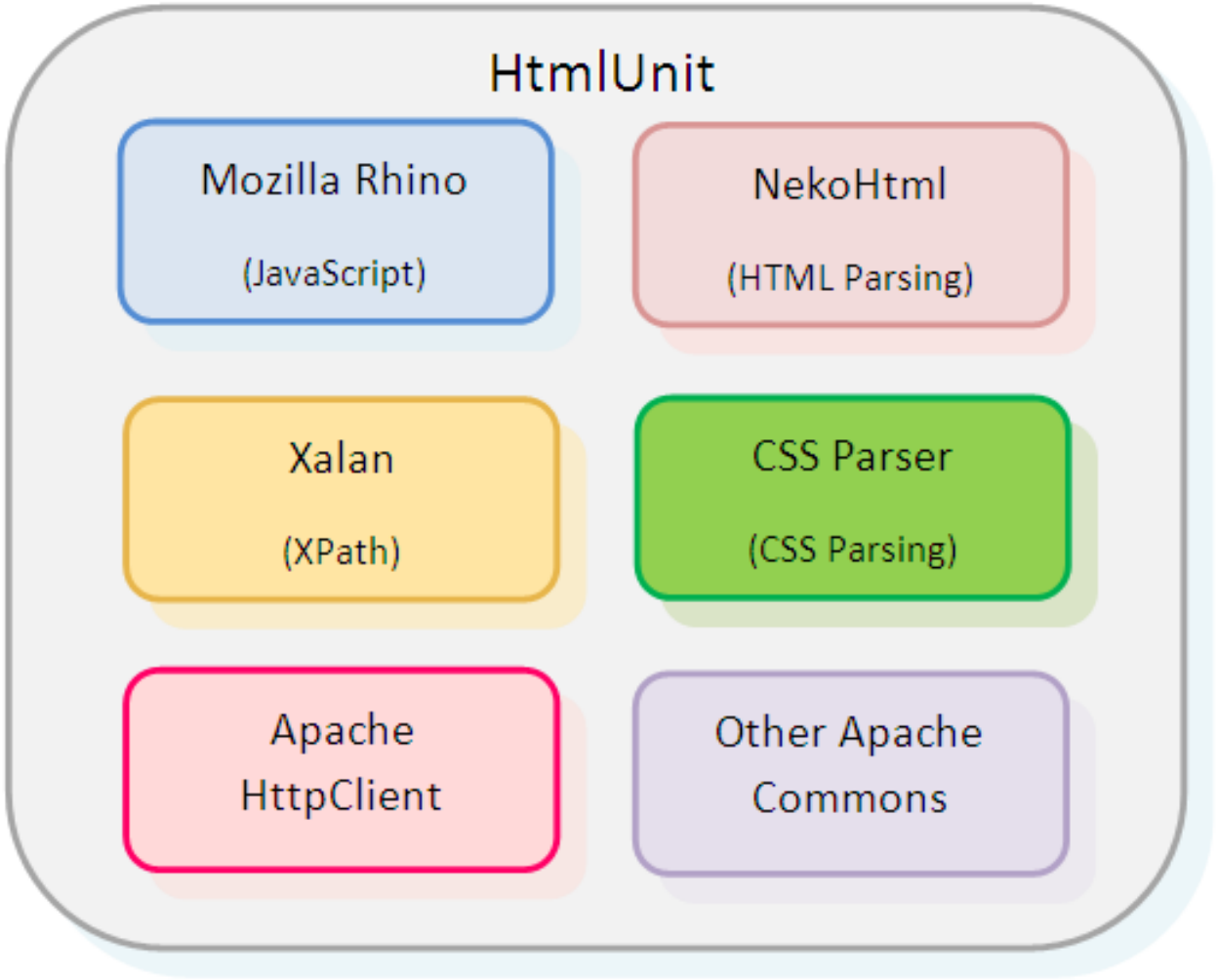
Sample Usage

```
@Test
public void google() throws Exception {

    WebClient client = new WebClient(BrowserVersion.FIREFOX_3);

    HtmlPage startPage = client.getPage("http://www.google.com/");
    assertEquals("Google", startPage.getTitleText());

    HtmlElement queryField = startPage.getElementByName("q");
    queryField.click();
    queryField.type("HtmlUnit");

    HtmlElement button = startPage.getFirstByXPath("//input[@name='btnI']");
    HtmlPage page2 = button.click();
    assertEquals("HtmlUnit - Welcome to HtmlUnit", page2.getTitleText());
}
```

HtmlUnit Simulates "Real" Browsers

- Focus on 4 browsers:
  - Firefox 2 & 3
  - Internet Explorer 6 & 7
- Mimics browser behavior:
  - HTTP requests
  - HTML parsing
  - CSS parsing
  - JavaScript execution

Architecture



Configuration

- Enable / Disable
  - JavaScript
  - CSS
  - Popup Blocker
- Throw / No Throw
  - On script error
  - On HTTP failure status codes
- Use Insecure SSL
- …

Extension Points

- Alert / Confirm / Prompt / Status Handlers
- JavaScript Pre-processors
- JavaScript Debugger Callbacks
- Custom Web Connections
- Incorrectness Listeners: HTML, CSS, etc.
- …

Extension Point Example

```
WebClient client = new WebClient();

client.setWebConnection(new FalsifyingWebConnection(client) {
    @Override
    public WebResponse getResponse(WebRequestSettings wrs) throws IOException {
        if ("some.other.server".equals(wrs.getUrl().getHost())) {
            int status = 500;
            String msg = "Internal server error.";
            byte[] body = "An error occurred.".getBytes();
            List<NameValuePair> headers = Collections.emptyList();
            WebResponseData wrd = new WebResponseData(body, status, msg, headers);
            return new WebResponseImpl(wrd, wrs.getUrl(), wrs.getHttpMethod(), 1);
        }
        else {
            return super.getResponse(wrs);
        }
    }
});
```

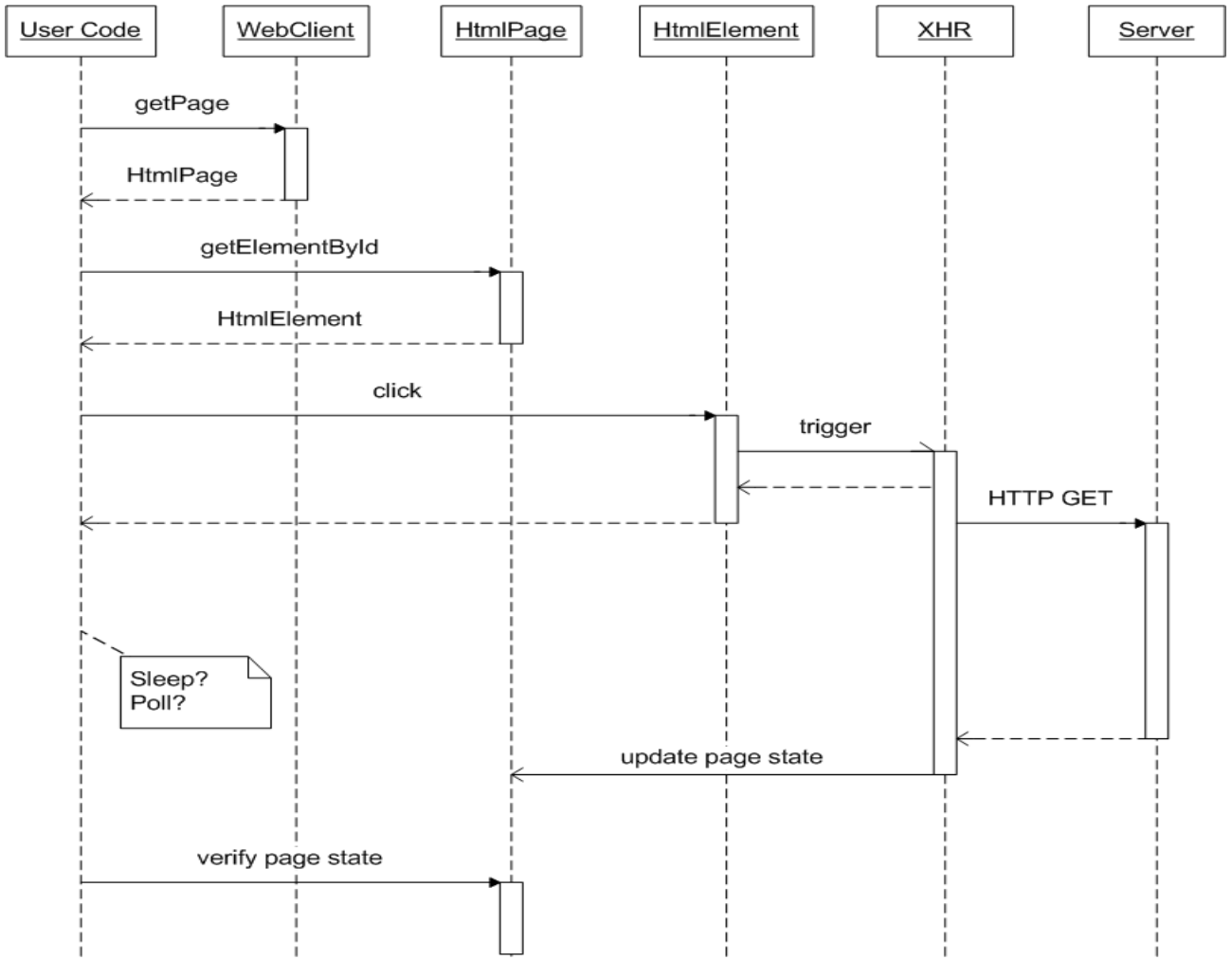
Extension Point Example

```
final MutableInt invocationCount = new MutableInt(0);

Debugger debugger = new DebuggerAdapter() {
    @Override
    public DebugFrame getFrame(Context cx, DebuggableScript fnOrScript) {
        return new DebugFrameAdapter() {
            @Override
            public void onEnter(Context cx, Scriptable act, Scriptable thiz, Object[] args) {
                invocationCount.increment();
            }
        };
    }
};

WebClient client = new WebClient();
client.getJavaScriptEngine().getContextFactory().setDebugger(debugger);

client.getPage("http://www.google.com/");
System.out.println(invocationCount);
```

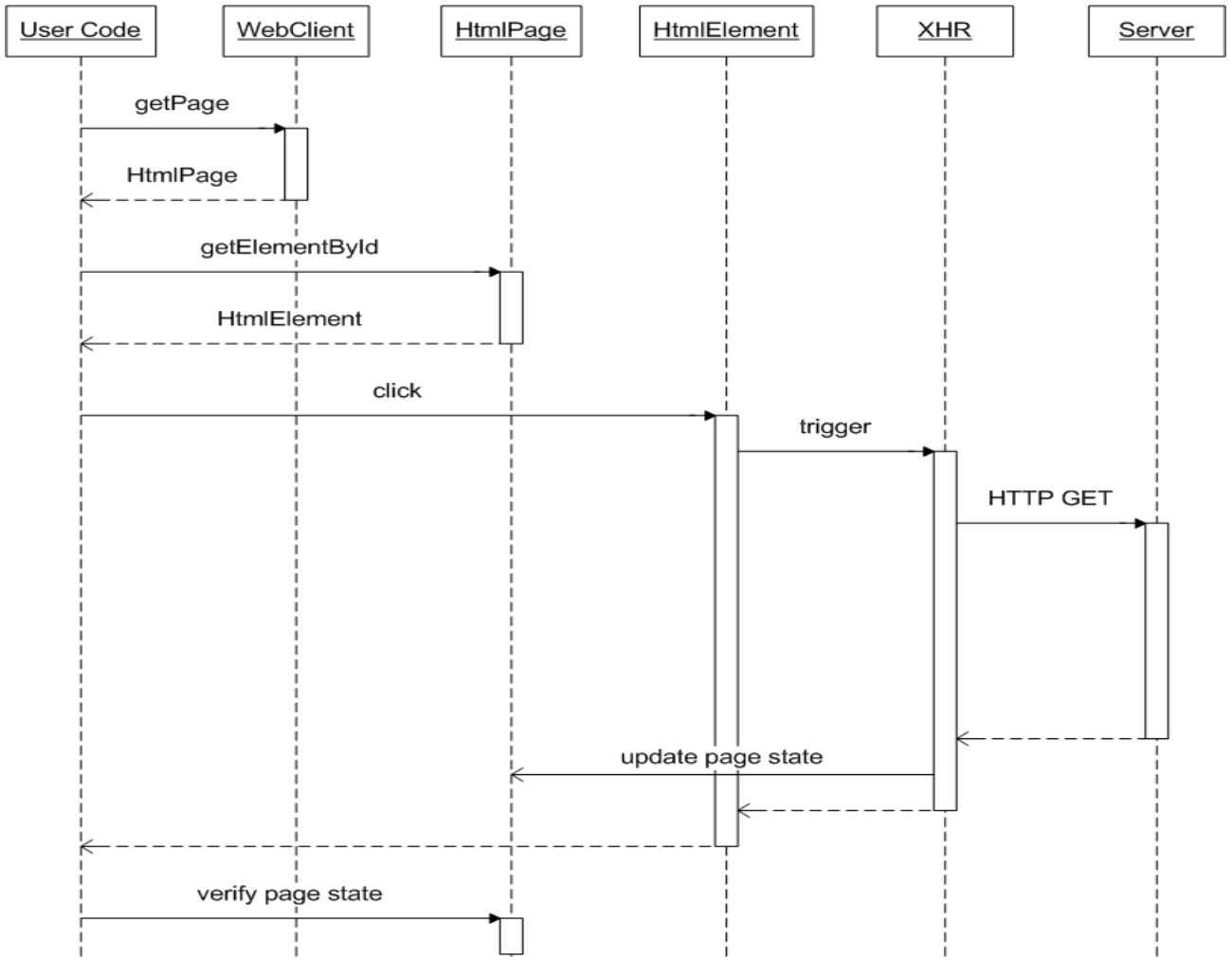
AJAX Timing

- Need to re-synchronize asynchronous logic
- Basic solutions:
  - Thread.sleep(long)
  - Polling
- HtmlUnit solutions:
  - NicelyResynchronizingAjaxController
  - waitForBackgroundJavaScript(long)
  - waitForBackgroundJavaScriptStartingBefore(long)

XMLHttpRequest



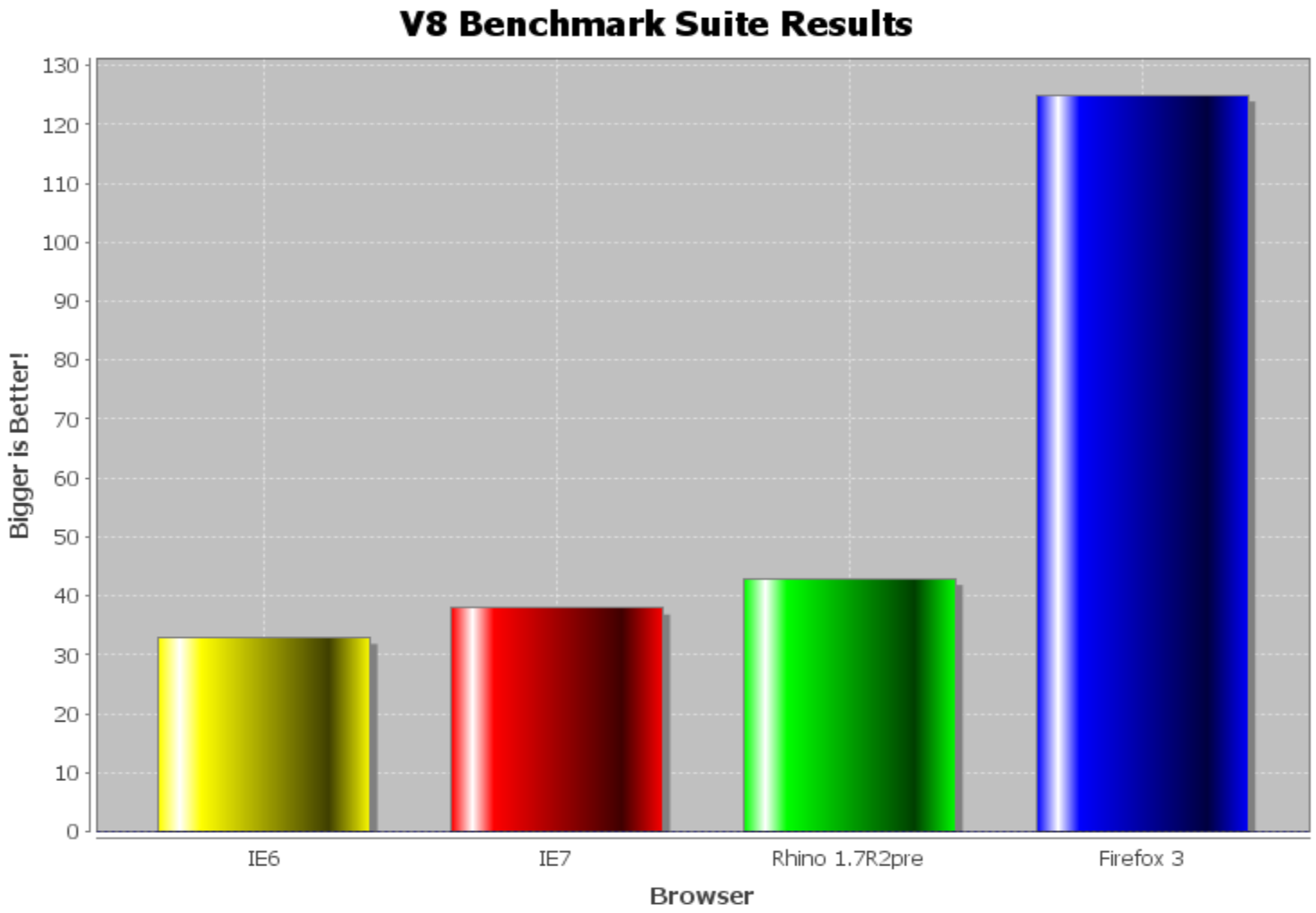
NicelyResynchronizingAjaxController



Performance

- Reduce network traffic
- No rendering
- No browser startup pause
- Data point: Celerity vs. Watir
  - Simple local file: test time reduced by 99%
  - Google image search: test time reduced by 69%
  - Digg front page scraping: test time reduced by 74%
  - Local file (DOM access): test time reduced by 97%

Performance: JavaScript Engines



Other Advantages

- Platform Independence
  - “I’m a PC” developer…
  - vs. “I’m a Mac” developer…
  - vs. build server…
  - vs. continuous integration server
- Scalability
  - Standard JVM setup…
  - vs. grid component…
  - vs. cloud infrastructure

Limitations

- Simulation is not 100% correct
  - For incorrect HTML code
  - For JavaScript execution
  - On the HTTP layer
- RIAs
  - No support for Flash or Silverlight
  - Applet support is very basic
- No recorder

Ensuring Accuracy

- We use…
  - Targeted unit tests (HTML+CSS+JS)
  - WebDriver-based unit tests
  - AJAX library integration tests
  - JavaScript execution flow comparisons
  - Over 8,000 tests in all

Targeted Unit Tests: Example

```
@Test
@Alerts(IE  = {"undefined", "undefined"},
        FF2 = {"[Node]", "[Element]"},
        FF3 = {"[object Node]", "[object Element]"})
public void windowProperties() throws Exception {

    String html =
          "<html>"
        + "<head><script>"
        + "  function test() {"
        + "    alert(window.Node);"
        + "    alert(window.Element);"
        + "  }"
        + "</script></head>"
        + "<body onload='test()'></body>"
        + "</html>";

    loadPageWithAlerts(html);
}
```

Library Integration Tests

- Dojo
- Sarissa
- Prototype
- CurvyCorners
- JQuery
- MochiKit
- YUI
- ExtJS
- GWT
- …

Wrappers

WebDriver

Canoo WebTest

JSFUnit

Wepawet

AppPerfect

JWebUnit

Grails Functional Testing Plugin

TestPlan

PushToTest TestMaker

Celerity

Schnell

Perl HtmlUnit

Example Wrapper: WebTest

```
import com.canoo.webtest.WebtestCase

class SimpleTest extends WebtestCase {
  void testWebtestOnGoogle() {
    webtest("check that WebTest is Google's top 'WebTest' result") {
      invoke "http://www.google.com/ncr",
         description: "Go to Google (in English)"
      verifyTitle "Google"
      setInputField name: "q", value: "WebTest"
      clickButton "I'm Feeling Lucky"
      verifyTitle "Canoo WebTest"
    }
  }
}
```

Example Wrapper: WebDriver

```
@Test
public void test() throws Exception {

    WebDriver driver = new HtmlUnitDriver();
    // WebDriver driver = new FirefoxDriver();
    // WebDriver driver = new InternetExplorerDriver();

    driver.get("http://www.google.com/");

    WebElement queryField = driver.findElement(By.name("q"));
    queryField.sendKeys("HtmlUnit");

    WebElement button = driver.findElement(By.name("btnI"));
    button.click();

    assertEquals("HtmlUnit - Welcome to HtmlUnit", driver.getTitle());
}
```

Future Plans

- Expand AJAX library integration testing
- Improved control of asynchronous JavaScript
- Support for more browsers
  - Internet Explorer 8
  - Chrome?
  - Safari?
- Continue releasing frequently!

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Thank You

Daniel Gredler
daniel.gredler@gmail.com

Ahmed Ashour
asashour@yahoo.com

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